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EMISSIONS TRADING: TRENDS AND PROSPECTS

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FOREWORD

This document was prepared by the OECD and IEA Secretariats in Autumn 2007 in response to the Annex I Expert Group on the United Nations Framework Convention on Climate Change (UNFCCC). The Annex I Expert Group oversees development of analytical papers for the purpose of providing useful and timely input to the climate change negotiations. These papers may also be useful to national policy-makers and other decision-makers. In a collaborative effort, authors work with the Annex I Expert Group to develop these papers. However, the papers do not necessarily represent the views of the OECD or the IEA, nor are they intended to prejudge the views of countries participating in the Annex I Expert Group. Rather, they are Secretariat information papers intended to inform Member countries, as well as the UNFCCC audience.

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Executive Summary

This paper provides the latest developments of announced, proposed and existing greenhouse gas emissions trading schemes (ETS) around the world since 2006. It also examines different potential design options for ETS (e.g. coverage, allocation mode, provision for offsets), and how these options are treated in the existing, announced or proposed schemes.

Emissions trading schemes are developing or being proposed in several regions and countries. While some have designed their schemes and defined rules (e.g. EU ETS, North Eastern US States, Japan, Norway), others have not yet finalised their options (e.g. Australia, Canada, New Zealand). Schemes already in operations also provide for adjustments in design as lessons are drawn from implementation – lessons which have also benefited schemes developed elsewhere. When deciding which design options best address the countries' emission levels, policy makers obviously account for national circumstances. Hence, the developing schemes differ in their size, scope, target, allocation mode, etc.

The European Union ETS, the largest scheme in operation, is evolving on two fronts. First, the second phase of National Allocation Plans (NAPs) running from 2008 to 2012, in line with the first trading period of the Kyoto Protocol, is now complete. As of October 2007, the European Commission had approved all EU countries' NAPs. The total cap for these countries represents a 6.5% reduction from verified 2005 emissions, while the coverage of the system has increased in terms of gases/sources. The second area in which the EU ETS is evolving is the scheme's design post-2012. The European Commission is planning to present its proposals for a revision of the ETS in January 2008. The Commission has also proposed to include the aviation sector in the ETS by 2011.

Several other ETS are being developed, including in countries that are not Parties to the Kyoto Protocol. In the United States, the first regional scheme, bringing together North Eastern States, is set to start in 2009. Others may follow. Further, at the federal level, starting October 2007, the U.S. Congress will consider a set of bills designed to limit the nation's GHG emissions. They all call for adoption of some form of a cap-and-trade system.

In June 2007, following the report of the Prime Ministerial Task Group on Emissions Trading, the Australian Government announced that it would introduce a comprehensive emissions trading scheme by 2012. The Australian emissions trading scheme will combine "downstream" liability for most emitters with "upstream" liability for fossil fuel producers and importers, to cover emissions from most small sources (e.g. transport). Independently from the Australian Government, state and territory governments had announced earlier their intention to establish an emissions trading scheme proposed by the National Emissions Trading Taskforce.

In Canada's Regulatory Framework for Air Emissions, the government has proposed to cap GHG emissions intensity in the electricity, oil and gas, forest products, smelting, refining, iron and steel, cement, lime, and chemicals production sectors. Emitters will be able to comply with their emission targets through five channels: internal reductions; a domestic offsets system; contributions to a technology fund; a pool of early action credits; and certain CERs to meet 10% of their compliance obligation.

In September 2007, the New Zealand government proposed a detailed framework for a domestic ETS. This cap-and-trade system is aimed at covering all six major GHG emissions and will be introduced in stages, applying to all sectors of the economy by 2013. Parliament will consider legislation to establish the NZ ETS in 2008.

Experience with the implementation of different ETS and the observation of various national/regional proposals brings the following results:

- One advantage of cap-and-trade is that it guarantees a fixed amount of emissions and market operators' predictability, whereas rate-based (or relative) targets do not. Nonetheless, rate-based

targets do not automatically mean rising emissions or lower stringency. What is critical for a scheme's environmental effectiveness is the ambition of the cap, as opposed to the specific approach taken.

- There is general agreement that auctioning is a more efficient method of permit distribution than free allocation, as it treats all participants equally and avoids potential distortions from determining which participants are entitled to free permits. A trend is emerging towards increasing use of auctioning, both in the more recent proposed schemes and in further phases of existing ETS.
- Nonetheless, as auctioning could potentially affect some sectors' profitability and/or competitiveness vis-à-vis unconstrained competitors, grandfathering allowances is often proposed at least in an initial transition phase. It requires sound data on historical emissions, which experience shows are not always readily available.
- A number of countries have opted for a mixed allocation mode, where free allocation would compensate for cost in trade-exposed industries. Free allocation may also be justified as a compensation for investments made without knowledge of forthcoming emission constraints.
- Rules governing plant closures and new entrants should be carefully designed to send the proper incentive to invest in low-GHG equipment.
- Cost control measures, such as facilitated access to various sources of carbon credits if the carbon price reaches some agreed level, or price caps, are considered in several announced schemes. They reduce the risk of high compliance costs. However, price caps remain controversial as they also introduce uncertainty on emission reduction levels.
- In principle, economic efficiency would demand that trading systems cover as many sources and gases as possible. In practice, good function of the market requires reliable monitoring, reporting and verification of emissions reductions for sources and gases included. Nonetheless, the choice of coverage depends on national circumstances, and on sectors' ability to effectively respond to price signals.
- Emissions trading is now being considered for implementation in sectors and areas where it was not seen as appropriate earlier. Announced schemes tend to mix upstream and downstream coverage. Other gases and sectors are considered for inclusion or addressed through provisions for offsets, notably aviation, agriculture and forestry, and waste.
- Market imperfections (or limitations), standing in the way of proper responses to price signals, and multiple policy objectives are often reasons for governments to adopt policy measures to complement emissions trading. However, some of such complementary policy measures may conflict with it or could be redundant.

Since GHG emissions trading schemes are relatively recent, it is important that their architecture remain dynamic, allowing experience from existing trading schemes to feed-back into their design. While providing certainty in the schemes' broad picture, policy makers in some countries have provided windows for flexibility, as lessons have yet to be drawn from experience to date. Policy makers also pay attention to possible implications of design options for linking systems.

Finally, the growing interest in emissions trading at the domestic level in many industrialised countries may have implications for the international mitigation architecture beyond 2012.

1. Introduction

Emissions trading remains high on the agenda for climate policy. In July 2007, at their Heiligendamm meeting in Germany, the G8 Heads of States and Governments mentioned that “market mechanisms, such as emissions-trading within and between countries (...) can provide pricing signals and have the potential to deliver economic incentives to the private sector. Fostering the use of clean technologies, setting up emissions-trading systems and, as many of us are doing, linking them are complementary and mutually reinforcing approaches.” They also mentioned the need to “share experience on the effectiveness of the different policy instruments [including emissions trading] in order to better provide the international business community with a predictable and long-term perspective, and strengthen and extend market mechanisms by, inter alia, developing and extending existing programmes”. The G8 declaration refers to the ambitious 2050 objectives set up by Canada, the EU and Japan. While non binding, this reference suggests that the G8 leaders are considering significant changes in emission patterns, likely to increase the interest for emissions trading schemes, as well as other policy options. Simultaneously, in a communiqué with the German Presidency of the G8, the Heads of State or Government of five large developing countries – Brazil, China, India, Mexico and South Africa – underlined “the crucial role of economic incentives, in particular by carbon markets, for the necessary investments in climate friendly technologies at large scale.”

Today, regional emissions trading systems are built, legislative proposals are put forward, options for creating broad regimes or broadening existing regimes are considered, from personal carbon trading and "domestic offsets" to upstream regimes. Cost control measures of various kinds are also being discussed, as well as allocations and other design issues. The early lessons from the first phase of the EU ETS have started to be taken on board in the revision of existing and design of new schemes, and to refresh the debate on emission trading features.

The current systems and those being planned differ in size, design features and scope. Some are designed to be used for compliance with emission commitments under the Kyoto Protocol, while others are planned or in use in non-Kyoto Parties. This paper describes recent developments of emissions trading for mitigating climate change since the AIXG October 2006 meeting. As such, it does not offer a comprehensive survey of all emissions trading proposals. Such information is provided in Philibert and Reinaud, 2004; IEA, 2005; Ellis and Tirpak, 2006.

This paper is in two main parts. Section 2 describes the recent evolutions of existing systems as well as the recently announced and proposed systems. For each of them, it provides an update, and outlines its main features. Section 3 provides analyses of design options, based on the recent literature, drawing lessons from existing systems and considering how concepts and ideas are finding their ways in the announced or proposed schemes. It considers in turn:

- Cap-and-trade versus rate-based trading systems;
- Allocation (mainly from the perspective of costs and competitiveness implications);
- Coverage, extensions and offsets;
- Banking, borrowing and cost control measures; and
- Interaction with different policies and objectives.

This paper does not, however, cover the length of commitment periods, which is addressed in Buchner, 2007. It does not cover either sectoral trading, as a possible element of sectoral approaches (Baron *et al.*, 2007).

Finally, a conclusion summarises some important lessons learned, and considers what role recent developments of trading schemes may play in the context of the forthcoming negotiations, in light of the recent developments described here.

2. Emissions Trading Schemes and Proposals: an Update

This section describes only updates since October 2006 in existing, announced or proposed emissions trading schemes throughout the world. Existing schemes are those for which the legislation has been passed, at least in some relevant jurisdictions, whether the first period of commitment has begun or not. Announced schemes are schemes that are still under elaboration by national or regional authorities, but have been endorsed at the highest level of governments. Proposed schemes are those that have been suggested by parliamentarians or by government officials but are still in a more exploratory stage.

While “announced schemes” seem more likely to come to life than “proposed schemes”, the outcome may still change, in particular as some proposed schemes cover the same emissions as some announced schemes, and the latter may be abandoned if the former finally come to life (e.g. in Australia).

2.1 Existing trading schemes

The existing schemes are schemes for which legislation has been passed. These are the EU ETS, the Japanese voluntary ETS, the New South Wales Greenhouse Gas Abatement Scheme (Australia), the Norwegian system, the Regional Greenhouse Gas Initiative (USA), and the Albertan Climate Change and Emissions Management Act (Canada).

- **European Emissions Trading Scheme (EU-ETS)**

Since 2006, there have been updates in the EU ETS on two fronts; the approval and decisions from the European Commission (EC) on the second round of national allocation plans (NAPs); and the review of the existing scheme and post-2012 developments.

- *NAP2 approvals and decisions*

National allocation plans of all 27 EU countries have been assessed as of October 2007 (see Table 1 below). Member States had up to June 30, 2007 to set up their second NAPs. With regard to the proposed number of allowances, the Commission accepted some of these NAP2 as such (those from Denmark, France, Slovenia, UK), and imposed relatively minor changes (less than 10%) for eleven other countries. But it also cut Hungary’s NAP by 12.4%, the Czech Republic’s by 14.8%, Slovakia’s by 25.2%, Poland’s by 26.7%, Malta’s by 29%, Luxembourg’s by 37%, Lithuania’s by 47%, Estonia’s by 47.8%, Cyprus’ by 23%, Romania’s by 20.7%, Bulgaria’s by 37.4%, and Latvia’s by 55.5%. Poland, alongside the Czech Republic, Lithuania, Estonia, Slovakia, Latvia and Hungary, are suing the Commission for these decisions.

The European Commission is being more stringent on the allocation level in the second trading period compared to the first trading period –to reach its Kyoto target and avoid undue distortions of the internal market. While the sum of all proposals by member countries would have led to an increase of 3.2% in emissions compared to 2005 verified emissions, the sum of the decisions by the Commission leads to a decrease of 6.5 %. Compared to the first trading period, there will be fewer allowances in the market¹. The second trading period will also see more auctioning: Germany (< 9 %) UK (7 %), Netherlands (>4 %), Ireland, Hungary, Lithuania, Austria and Belgium.

¹ Note that these figures take account of two factors that render the comparisons between 2005 emissions, the first and the second trading phases complex. First, phase 2 includes additional installations due to an extended scope applied by the Member States that amount to emissions of over 54 Mt. Second, UK installations emitting about 30 Mt are only covered as of 2007, due to their temporary opt-out in 2005/06.

Table 1: Summary of 27 National Allocation Plans assessed as of October 2007

<i>Member State</i>	<i>1st period cap</i>	<i>2005 verified emissions</i>	<i>Proposed cap 2008-2012</i>	<i>Cap allowed 2008-2012 (in relation to proposed)</i>	<i>Additional emissions in 2008-2012¹</i>	<i>JI/CDM limit 2008-2012 in %²</i>
Austria	33.0	33.4	32.8	30.7 (93.6%)	0.35	10
Belgium	62.1	55.58 ³	63.3	58.5 (92.4%)	5.0	8.4
Bulgaria	42.3	40.6 ⁴	67.6	42.3 (62.6%)	n.a.	12.55
Cyprus	5.7	5.1	7.12	5.48 (77%)	n.a.	10
Czech Rep.	97.6	82.5	101.9	86.8 (85.2%)	n.a.	10
Denmark	33.5	26.5	24.5	24.5 (100%)	0	17.01
Estonia	19	12.62	24.38	12.72 (52.2%)	0.31	0
Finland	45.5	33.1	39.6	37.6 (94.8%)	0.4	10
France	156.5	131.3	132.8	132.8 (100%)	5.1	13.5
Germany	499	474	482	453.1 (94%)	11.0	20 ⁵
Greece	74.4	71.3	75.5	69.1 (91.5%)	n.a.	9
Hungary	31.3	26.0	30.7	26.9 (87.6%)	1.43	10
Ireland	22.3	22.4	22.6	22.3 (98.6%)	n.a.	10
Italy	223.1	225.5	209	195.8 (93.7%)	n.k. ⁶	14.99
Latvia	4.6	2.9	7.7	3.43 (44.5%)	n.a.	10
Lithuania	12.3	6.6	16.6	8.8 (53%)	0.05	20
Luxembourg	3.4	2.6	3.95	2.5 (63%)	n.a.	10
Malta	2.9	1.98	2.96	2.1 (71%)	n.a.	Tbd
Netherlands	95.3	80.35	90.4	85.8 (94.9%)	4.0	10
Poland	239.1	203.1	284.6	208.5 (73.3%)	6.3	10
Portugal	38.9	36.4	35.9	34.8 (96.9%)	0.77	10
Romania	74.8	70.8 ⁷	95.7	75.9 (79.3%)	n.a.	10
Slovakia	30.5	25.2	41.3	30.9 (74.8%)	1.7	7
Slovenia	8.8	8.7	8.3	8.3 (100%)	n.a.	15.76
Spain	174.4	182.9	152.7	152.3 (99.7%)	6.7 ⁸	ca. 20
Sweden	22.9	19.3	25.2	22.8 (90.5%)	2.0	10
UK	245.3	242.4 ⁹	246.2	246.2 (100%)	9.5	8
SUM	2298.5	2122.16 ¹²	2325.34	2080.93 (89.5%)	54.61	-

¹ The figures indicated in this column comprise emissions in installations that come under the coverage of the scheme in 2008 to 2012 due to an extended scope applied by the Member State and do not include new installations entering the scheme in sectors already covered in the first trading period.

² The JI/CDM limit is expressed as a percentage of the member state's cap and indicates the maximum extent to which companies may surrender JI or CDM credits instead of EU ETS allowances to cover their emissions. These credits are generated by emission-saving projects carried out in third countries under the Kyoto Protocol's project-based flexible mechanisms, known as Joint Implementation (JI) and the Clean Development Mechanism (CDM).

³ Including installations which Belgium opted to exclude temporarily from the scheme in 2005

⁴ Due to Bulgaria's recent accession to the EU, this figure is not independently verified.

⁵ The German national allocation law contains a figure of 22 %, which relates to the allowances allocated free of charge, rather than the total cap.

⁶ Italy has to include further installations. The amount of additional emissions is not known at this stage.

^[7] Due to Romania's recent accession to the EU, this figure is not independently verified.

^[8] Additional installations and emissions of over 6 million tonnes are already included as of 2006.

^[9] Verified emissions for 2005 do not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt.

^[10] The figures indicated in this column comprise emissions in installations that come under the coverage of the scheme in 2008 to 2012 due to an extended scope applied by the Member State and do not include new installations entering the scheme in sectors already covered in the first trading period.

^[11] The JI/CDM limit is expressed as a percentage of the member state's cap and indicates the maximum extent to which companies may surrender JI or CDM credits instead of EU ETS allowances to cover their emissions. These credits are generated by emission-saving projects carried out in third countries under the Kyoto Protocol's project-based flexible mechanisms, known as Joint Implementation (JI) and the Clean Development Mechanism (CDM).

^[12] The sum of verified emissions for 2005 does not include installations which the UK opted to exclude temporarily from the scheme in 2005 but which will be covered in 2008 to 2012 and are estimated to amount to some 30 Mt. Furthermore, the emissions figures for Bulgaria and Romania are not independently verified.

Source: European Commission, 2007a.

- *Review of EU ETS and post-2012 developments*

Responding to Article 30 of the ETS Directive, in November 2006, the Commission submitted a report to the European Parliament and the Council considering the functioning of the EU Emissions Trading Scheme (European Commission, 2006). The report took stock of the scheme's achievements and set out the agenda for its revision for 2013 by defining four focus areas (scope, compliance and enforcement, increased harmonisation and predictability, linking).

In order to ensure broader involvement of stakeholders with a high quality input into the review process, the Commission intended to consult further by means of a separate Working Group on the review of the EU ETS within the framework of the European Climate Change Programme (ECCP).² The Working Group on the Review of the EU ETS was set up in 2006. The ECCP working group submitted a report on the EU-ETS review containing proposals for its revision. The Working Group's report could feed into a legislative proposal by the Commission expected in January 2008. The legislative proposal will be part of integrated climate and energy policy implementation package. The revised scheme is then due to come into force in 2013.

There are several regulatory changes considered for the third trading period starting in 2013 (Zapfel, 2007). The Commission has mentioned EU-level cap-setting and allocation process (including more use of auctioning and benchmarking).

Further, aviation may be integrated into the EU ETS as of 2011, according to the Commission proposal of December 2006 backed by the Environment Council in June 2007. In such a case, from the start of 2011, CO₂ emissions from all domestic and international flights between EU airports could be covered. At the start of 2012, the EU ETS scope could be expanded to cover emissions from all international flights - from or to anywhere in the world - that arrive at or depart from an EU airport.

² The EU Council of Environment Ministers acknowledged the importance of taking further steps at Community level by asking the Commission to put forward a list of priority actions and policy measures in the context of climate change. The Commission responded in June 2000 by launching the European Climate Change Programme (ECCP). The goal of the ECCP is to identify and develop all the necessary elements of an EU strategy to implement the Kyoto Protocol. The development of the first ECCP involved all the relevant groups of stakeholders working together, including representatives from the Commission's different departments (DGs), the Member States, industry and environmental groups. The second European Climate Change Programme (ECCP II) was launched in October 2005.

- **Japan Voluntary Emissions Trading Scheme (JVETS)**

Table 2: Main characteristics of the Japanese voluntary ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
Industry: food, breweries, pulp, chemicals 31 entities in 2005, 58 entities in 2006, 61 entities in 2007	CO ₂ emissions from energy conservation and switching from oil to less carbon-intensive fuels	April 2006-August 2007, April 2007-August 2008, April 2008-August 2009	History based allocation (average emissions in reference period minus companies' expected emission reductions)	Voluntary	No penalties but companies must return subsidies if targets are not met. No price cap.

Source: updated from Ellis and Tirpak, 2006; Shimada, 2005

Japan's Voluntary Emissions Trading Scheme was implemented in April 2005, covering CO₂ emissions from companies setting voluntary emission reduction targets (i.e. in 2005, 31 entities had emission reduction targets of 273 000 tCO₂ and 7 companies traded; in 2006, there were 58 entities). Allowances are allocated by the Japanese Ministry of the Environment to companies that have set voluntary emission reduction targets and subsidies are provided for emission reductions (the total budget reached YEN 3 billion for 2005, and YEN 2.76 billion for 2006, and YEN 3 billion for 2007). Subsidies can reach 1/3rd of the investment cost and have a ceiling of YEN 200 million per site. Participating companies can meet their target by purchasing emission reduction allowances from other companies or purchasing CERs. There are no penalties if targets are not met, but participants must return allocated subsidies. Since end-2006, no changes or updates have been made in the design of the scheme. During the trading period April 2006 - August 2007, 82,624tCO₂ of allowances were traded between the participants with an average price of YEN 1,212 (approx. USD11).

- **New South Wales Greenhouse Gas Abatement Scheme (NSW GGAS)**

Table 3: Main characteristics of the New South Wales Greenhouse Gas Abatement Scheme

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory /Voluntary	Penalty and price cap
- Electricity generators, - Electricity sellers, - Electricity retail license holders (benchmark participants), - Large consumers (>100GW/a) may voluntarily manage their own GHG benchmarks	All 6 GHG	Started in 2003 (yearly) The benchmark is set to 2012 but NSW government has committed to extend targets to 2020	GGAS establishes an annual State-wide GHG benchmark for the electricity sector – the “benchmark”. Benchmark participants are allocated the mandatory GHG benchmark based on their share of NSW electricity demand. To be compliant, benchmark participants must surrender abatement certificates created from project-based emission reduction activities.	Mandatory	AUD 11.50 (EUR 6.7 in 2006) 10% shortfall allowed without penalty, provided the shortfall is made up the following year

Source: New South Wales Government

www.greenhouse.nsw.gov.au/actions/agencies/deus/greenhouse_gas_abatement_scheme

The NSW GGAS is the second largest regional or state level operating scheme in the world. It has been mandatory since 2003 for electricity sellers, retailers and generators and is designed as a rate-based

scheme. Large electricity users (>100 GWh per year) may also voluntarily manage their own GHG benchmarks (see Box above for further explanations on how the benchmark is set). GHG State-wide benchmarks for the electricity sector are established annually, and participants are allocated benchmarks based on their share of NSW electricity demand. To be in compliance, participants must surrender abatement certificates created from project-based emission reduction activities. Since GGAS commenced, a total of 97 organisations have been accredited as abatement certificate providers for 206 abatement projects (New Zealand Institute of Economic Research NZIER, 2007). No new developments in the scheme's design have been made since 2006.

- Norway

Table 4: Main characteristics of the Norwegian ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
<p>Energy production, Mineral oil refining, Coke production, Production and process of iron and steel, including roasting and sintering of iron ore, Production of cement, lime, glass, and ceramic products.</p> <p>Activities exempted (2005-2007): offshore petroleum activities and pulp and paper industry – these activities will be included starting 2008. The production of fertilizers will most probably be included from 2008. Further Opt-in installations are considered, e.g. aluminium, ferrous metals, chemicals and others.</p>	<p>CO₂</p> <p>Probably N₂O and possibly PFC from 2008</p>	<p>2005-2007;</p> <p>2008-2012</p>	<p>Free of charge from 2005-2007, based on historical emissions 1998-2001. Installations that started operation after 2001 are allocated on the basis of projections, incl. technological and economic potential to reduce emissions.</p> <p>No limits to auctioning in 2008-2012. Land-based industry will be allocated based on historical emissions 1998-2001. No allocation to new entrants, except highly efficient CHP-production and gas-fired power plants with CCS-facility. The offshore oil industry will be included in the ETS but get no free quotas. The CO₂ tax will be adjusted.</p>	<p>Mandatory for plants not under CO₂ tax</p>	<p>EUR 40/tCO₂ per missing allowance (corresponds to the Norwegian CO₂ tax) between 2005-2007</p> <p>EUR 100/tCO₂ per missing allowance including the restoration of the missing allowance in the next trading period</p> <p>No price cap</p>

Source: Nordic Council of Ministers, 2007; Reuters, 2007

Norway's domestic emissions trading scheme was implemented in 2005, simultaneously with the European Union's. Its design is similar to the EU scheme, with the exception that companies that have a CO₂ tax have been exempted from the scheme in the first period. Compared to the EU ETS, the Norwegian system also includes fewer reserve allocations of emissions to be handed out to possible new business entrants.

Norway will implement the EU directive from 2008, thanks to the agreement between the EU and the other members of the European Economic Association (Iceland, Liechtenstein and Norway) announced at the end of October 2007. Once the agreement approved by the countries, the Commission will work closely with the European Free Trade Area (EFTA) Surveillance Authority in its assessment of EEA National Allocation Plans, using the same methods as for EU plans. Norway intends to cap industrial carbon emissions at 15 million tonnes annually from 2008 to 2012.

Norway has been granted an exemption from article 10 of the Directive, which states that in the second trading period at last 90% of the allowances should be given for free. Auctioning may indeed play the

bigger role (>50%) in the Norwegian allocation process, as off-shore industries will account for more than half of the covered emissions.

- **Regional Greenhouse Gas Initiative (RGGI)**

Table 5: **Main characteristics of the Regional Greenhouse Gas Initiative**

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory /Voluntary	Penalty and price cap
Electricity generators Coal, oil and gas fired power generation with capacity over 25 MW	CO ₂	Starts in 2009 to 2018 (3 year periods)	Depends on each participating State. 25% of the allowances would be set aside for consumer benefit (energy efficiency, new clean technologies etc.) and strategic energy purpose.	Mandatory	Not decided yet

Source: RGGI website, www.rggi.org

In December 2005, seven Northeast States in the United States announced an agreement to implement the Regional Greenhouse Gas Initiative (RGGI), as outlined in a Memorandum of Understanding (MOU) signed by the Governors of the participating States.³ In August 2006, the seven founding States released a model set of regulations to be proposed in each state to implement the programme.

Since the end of 2006, progress has been made on two levels. First, the scheme has expanded in its geographical scope. The States of Massachusetts (January 2007), Rhode Island (January 2007), and Maryland (April 2007) joined the Northeast regional climate change and energy efficiency program. Second, several states have further developed the state regulation that will implement the program. For example, Massachusetts has committed to auction 100% of its allowances, and use the funds generated by those sales to fund energy efficiency, demand reduction, renewable energy programs, and combined heat and power (CHP) projects, which use what is normally wasted heat from power generation for efficient heating or industrial applications. The State of New York has also announced its intention to auction 100% of its allowances.

- **Alberta's Climate Change and Emissions Management Act**

Albertan facilities that emit more than 100 000 tonnes of greenhouse gases a year must reduce their emissions intensity by 12 a year under the recently amended Climate Change and Emissions Management Act. The reductions, which include facilities in the energy, chemical and electricity sectors, came into effect July 1, 2007. They apply to about 100 large industrial emitters, which account for about 70 per cent of Alberta's industrial greenhouse gas emissions.

Industries have three options to meet the reduction. Facilities can make operating improvements, buy Alberta-based credits or contribute to the Climate Change and Emissions Management Fund. Industries can comply by using any combination of the three options.

Under the Alberta-based credit system, any project initiated and any reduction realized after Jan. 1, 2002, are eligible. Also, any reductions that occurred after that date may qualify. Any credits used to meet the reduction targets must be verified by an independent third party. Credits will be created using protocols approved by the Alberta government (Environment Alberta, 2007)

³ The States that agreed to sign the MOU are Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont. In addition, the District of Columbia, Massachusetts, Pennsylvania, Rhode Island, the Eastern Canadian Provinces, and New Brunswick are observers in the process.

2.2 Announced trading schemes

Announced schemes are schemes that are still under elaboration by national or regional authorities, but have been endorsed at the highest level of governments. In this chapter, the new schemes announced in 2007 will be described. They include the Australian and Canadian federal systems, the New Zealand's proposed system, and the Swiss ETS.

- **Australia**

In Australia, two parallel processes have led developments on the design of a possible nation-wide emissions trading scheme. First, at the states and territories' level, in January 2004, Australian State and Territory Governments established a Taskforce (the National Emissions Trading Taskforce, NETT) to develop a multi-jurisdictional emissions trading scheme. In August 2006, the Taskforce issued its final "Discussion Paper: Possible Design for a National Greenhouse Gas Emissions Trading Scheme". The Council of States and Territory Governments approved a "cap and trade" scheme to limit emissions developed by the NETT.

In parallel and entirely separate from this initiative, at the federal level, the Prime Minister created a Task Group on emissions trading in December 2006. The Task Group released its report end of May 2007. At the federal level, the Task Group recommended that any future Australian scheme should be based on a cap-and-trade model with the following key features (see summary in the table below). Trading would commence in 2011. The government would set long-term goal for CO₂ emission reductions and a trajectory that commences moderately, progressively stabilises then results in deeper emission reductions over time, with maximum practical coverage of all sources and sinks, and of all greenhouse gases. Permit liability would be placed on direct emissions from large facilities and on upstream fuel suppliers for other energy-related emissions with a series of short-term annual caps. Trading would thus be based on time-date single-year emissions allowances. The agriculture, forestry and waste sectors would be excluded at the beginning, but a wide programme of offsets should develop over time and prepare for the progressive inclusion of these sectors in the trading regime.

Short term emission targets would be set for ten years, and would be supplemented by ten-year gateways, which would provide upper and lower bounds for emissions caps initially for the years 2021 to 2030. Hence, if the scheme started in 2011, explicit targets would be set for 2011 to 2020 and gateway targets for 2021 to 2030. Both annual caps and gateways would be updated every five years. Existing installations would receive a once-off free allocation of allowances with various dates of effect (i.e. different vintages), including some permits for years beyond 2020, corresponding to their loss in asset value. Trade-exposed, emissions-intensive existing or new industries, would receive free allowances every five years, until major competitors face similar carbon constraints. The scheme also contains a price cap, whereby the payment of the emissions fee (or penalty) 'buys out' a firm's obligation to surrender allowances in respect of emissions in a given year. After an initial phase with a relatively low level, the level of the fee would move away from expected permit prices to reinforce the abatement incentive.

Table 6: Main characteristics of the proposed federal Australian ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
<p>Direct emissions from large facilities that emit more than 25 000 tonnes of CO₂ equivalent per year and on upstream fuel suppliers for other energy-related emissions.</p> <p>Agriculture and land use sectors will be initially excluded from the scheme.</p>	All GHG	<p>Starts in 2011</p> <p>Short term emission targets would be set for ten years, and would be supplemented by ten-year gateways, which would provide upper and lower bounds for emissions caps initially for the years 2021 to 2030.</p>	Free permits to trade-exposed emissions intensive industries (TEEIs) to cover direct emissions and to offset the cost increase flowing from indirect emissions, and to existing businesses identified as likely to suffer a disproportionate loss of value due to the introduction of a carbon price. Fossil fuel-fired generators would be allocated a once-off allocation of permits with various dates of effect (i.e. different vintages), including some permits for years beyond 2020. The remaining permits would be auctioned.	Mandatory	Price cap and penalty level not determined yet

Source: Report of the Task Group on Emissions Trading, 2007

As of July 2007, the Prime Minister announced that the government will introduce an emissions trading scheme, no later than 2012, as the primary mechanism for achieving the long term emissions reduction goal (Australia's Climate Change Policy, 2007). Further, the government endorsed the key design features of the emissions trading system set out in the report of the Prime Ministerial Task Group on Emissions Trading. Work on a detailed system has started, in consultation with industry and other stakeholders. To underpin the Australian Emissions Trading System the Australian Government has developed a National Greenhouse and Energy Reporting system which is expected to be in place by July 2008.

- **Canada**

Table 7: Main characteristics of the proposed Canadian ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
Electricity produced by combustion, oil and gas, forest products, smelting, refining, iron and steel, cement, lime, chemicals production	All GHG	Starts in 2010	Not defined	Mandatory	<p>Compliance possible through a technology fund at CAN 15/tCO₂ (CAN 20/tCO₂ in 2013, then according to GDP growth), limited to 70% of total regulatory obligation in 2010 in 2010, falling to 10% in 2017</p> <p>Penalty level is not yet defined</p>

Source: Hull, 2007

In April 2007, the Canadian government presented its Regulatory Framework for Air Emissions. Existing Facilities will be required to reduce their GHG emissions intensity by 6% each year from 2007 to 2010. This yields an initial emissions intensity reduction of 18% from 2006 levels in 2010, the year the proposed greenhouse gas regulations would be implemented. Every year thereafter, a 2% continuous improvement in emissions intensity will be required. By 2015, therefore, a reduction in the GHG emissions intensity of 26% from 2006 would be mandated.

The proposed 2007 Regulatory Framework for Air Emissions will be a rate-based system applied to combustion and non-fixed process emissions, with a 2006 baseline⁴. New facilities, defined as those whose first year of operation is 2004 or later, will be granted a three-year grace period before they have to meet an emission intensity reduction target. After the third year, the initial greenhouse gas emission intensity target will be based on cleaner fuel standards and new facilities will also be required to improve their emission intensity each year by 2%.

Compliance within the regulations will be permitted via a range of mechanisms, including contributions to a technology fund (to promote development, deployment and diffusion of emission reduction technologies across industry); use of emissions trading, including inter-firm trading, offsets, and qualified CERs; and a one-time recognition for firms that took verified action between 1992 and 2006 to reduce their greenhouse gas reductions. Companies that fail to comply with current environmental rules can face fines of up to CAD 1 million a day.

Overall, capped emitters will trade emissions through three channels (Willis, 2007): internal abatements beyond the baseline which will trigger credits; a domestic offsets system to which capped emitters will have unlimited access; and qualified CERs to meet up to 10% of their compliance obligation. No other Kyoto Protocol units are recognised for corporate compliance.

The government has also said that it will consider international linkages with other emissions trading systems, as the international carbon market becomes more robust, and as emissions monitoring, verification, and reporting systems evolve further. Beyond access to the Kyoto Protocol's project-based mechanism, the Canadian government has announced it will explore other linking opportunities. Canada will consider linking with US regulatory-based emissions trading schemes whether these are at state, regional or federal level. Canada will also consider cooperation on emissions trading with Mexico.

Apart from federal decisions, Canadian provinces are also taking or considering action. The Albertan rate-based ETS has been mentioned in 2.1. British Columbia's Premier has announced that his province will implement legislation on binding caps for GHG emissions, including a one-third reduction by 2020.

⁴ The Canadian proposal speaks of a "baseline-and-credit". We prefer using the term "rate-based trading", as in 3.1

- New Zealand

Table 8: Main characteristics of the proposed New Zealand ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
Forestry (includes deforestation of pre-1990 forest land and afforestation post-1989) Liquid fossil fuels (mainly transport) Stationary energy (includes coal, natural gas and geothermal) Industrial process (non-energy) emissions Agriculture (includes pastoral and arable farming and horticulture), Waste, and all other emissions	All GHG	Forestry 1 January 2008 (first compliance period is two years). Compliance will be on an annual basis thereafter for all sectors. Liquid fossil fuels 1 January 2009 Stationary energy 1 January 2010 Industrial process (non-energy) emissions 1 January 2010 Agriculture, waste and all other emissions 1 January 2013	For some sectors, the point of allocation in each sector may be different from the point of obligation See below for details on the allocation mode	Mandatory	Failure to surrender units incurs a financial penalty of NZD30/t CO ₂ e plus a 1:1 make-good requirement. If a participant <i>knowingly</i> fails to comply, then the penalty increases to NZD 60/t CO ₂ e plus a 1:2 make-good requirement. Other offences can result in fines or imprisonment.

Source: New Zealand Ministry for the Environment, 2007

Legislation to enact the New Zealand Emissions Trading Scheme (NZ ETS) will be introduced for passage during the life of the current Parliament (i.e., in 2008). The government has made in-principle decisions regarding the following core design features of the ETS (New Zealand Ministry for the Environment 2007). Nonetheless, the final design of this scheme will be decided by Parliament

The government's intent is that the various sectors of the New Zealand economy will be brought into the ETS in a staged transition with the aim of having all the major sectors covered by the Kyoto Protocol included in the ETS by the start of 2013 (New Zealand Ministry for the Environment, 2007). The NZ ETS will operate within the cap on emissions established under the Kyoto Protocol (for the first commitment period) and within whatever cap is established under international agreements post-2012. No further cap will be placed on the emissions that occur domestically in New Zealand. However, the government will limit the number of units allocated for free under the scheme.

Under proposed NZ ETS, the government will create New Zealand Units (NZU) that will be backed by Kyoto units. NZUs will be convertible to Kyoto units and sold internationally. Kyoto units can be bought offshore (subject to some restrictions) and used to meet obligations. The core obligation is to surrender one NZU per tonne of emissions.

A point of obligation to surrender units will be selected for each sector, and is one of the key issues for engagement (see 3.2.1 for details). The government's preference is to go upstream (at the level of production/import) in the energy, industrial process, forestry, agriculture (e.g. fertiliser producer) and waste sectors, but to look at the mid-stream level in the livestock sector (e.g. meat and dairy processing).

Forestry will be in first – 1 Jan 2008. Owners of pre-1990 forests will not earn credits, but become liable for the carbon dioxide emitted if the forest is harvested and not replanted. The Government will assist

owners of pre-1990 forest who are affected by these provisions by issuing them with free NZUs. Landowners who planted new forest after 1989 can opt in to the scheme. They will thus gain credits and incur liabilities, and have to report on carbon stock changes.

The NZ ETS will cover all liquid fossil fuels (primarily used for transport) as of 1 Jan 2009, except international aviation and marine. Obligations will lie with large fuel suppliers, and no free allocation will be provided.

The stationary energy (heat and power) sector is more complex and will enter the NZ ETS only as of 1 Jan 2010 as will the industrial process sector. It is important that the stationary energy and industrial process sectors enter simultaneously given their interdependence and the need to develop a comprehensive assistance package. The NZ ETS will cover industrial processes such as steel, aluminium, cement, and lime. The point of obligation will differ depending on the gas and industry in question. For several industries this is best placed on the emitter (e.g. smelter), for others it will be the point of import. The government favours assisting industry with increased costs via free allocation, but has left open the possibility of using a progressive obligation, under which participants initially are only required to surrender units for some percentage of their full obligation..

The agriculture sector will enter the NZ ETS 1 January 2013. The government expects agriculture to start monitoring in 2011 and continue to take voluntary action to reduce emissions before 2013. Government will engage on points of obligation. Its initial preference is to make processing companies, not individual farmers, responsible for methane emissions and nitrous oxide from livestock, and fertiliser producers responsible for nitrous oxide emissions from fertiliser application.

In first commitment period to the Kyoto Protocol, the NZ ETS will be fully linked to international Kyoto markets. NZ ETS participants can buy Kyoto units, and can exchange NZUs for Kyoto units to sell internationally. They can also use Kyoto units to meet their domestic obligations. Further, the design could allow direct bilateral linkages to other domestic trading schemes in the future.

- **South Korea**

In August 2007, the South Korea government announced that it may launch a voluntary carbon trading market by the end of 2008, which will enable the country's largest emitters to trade allowances. It would run until 2011. The South Korean ministry in charge of the scheme would be the Ministry for Commerce, Industry and Energy (Mocie). Companies would be able to earn voluntary emissions reduction certificates by registering their efforts in cutting releases of carbon into the atmosphere.

- **Switzerland**

Table 9: Main characteristics of the Swiss ETS

Sources/ Participants	Gases	Trading periods	Allocation methodology	Mandatory/ Voluntary	Penalty and price cap
<p>Heating process fuels</p> <p>Sectors such as ceramics, glass, paper, chemistry, metal-working and engineering, plastics, aluminium, foodstuffs and lime, as well as foundries, printers and haymakers have committed to emission reduction targets in order to be exempted from the CO₂ tax.</p> <p>Companies with CO₂ emissions 0.25MtCO₂ per year can participate in the scheme directly.</p>	CO ₂	2008-2012	Free of charge	Voluntary but legally binding once companies commit to targets	<p>No price cap</p> <p>In case of non-compliance, companies have to pay the CO₂ tax:</p> <ul style="list-style-type: none"> - EUR8/tCO₂ in 2008 if emissions exceed by 94% the 1990 level; - EUR 16/tCO₂ in 2009 if emissions exceed by 90% 1990 level; - EUR 24/tCO₂ in 2010 if emissions exceed by 86.5% the 1990 level.

Source: Federal Department of the Environment, Transport, Energy and Communications DETEC and Federal Office for the Environment FOEN, 2006

No significant changes have taken place in the design of the Swiss CO₂ emissions trading scheme since Ellis and Tirpak (2006). Nevertheless, legislation on its timeframe and implementation has been approved. In early 2007, the Swiss Parliament and the federal government agreed that a CO₂ levy on heating fuels will be implemented on January 1, 2008, at CHF 12 (EUR 7.5) per tonne of CO₂, possibly doubled and tripled in 2009 and 2010. However, the 600 or so businesses that have already agreed on a CO₂ emission cap with the federal authorities are required to have their voluntary agreement converted into a legally binding commitment by September 1 if they wish to be exempted from the levy in 2008. These companies could then trade their allowances. The scheme is estimated to cover 4-5 MtCO₂, or about 10-15% of Switzerland's total emissions.

The CO₂ Law will expire at the end of 2012, as will the Swiss ETS. The government has already announced it will make proposals for post-2012 in due time.

2.3 Proposed trading schemes

Proposed schemes are those that have been suggested by legislative branches or members of the executive branch of governments but seem to be at a more exploratory stage. They include in particular the various US congressional bills put forward since the end of 2006, the Western States' Initiative or the draft report for the design of a greenhouse gas cap and trade system in California.

- **Legislative proposals in the US**

In 2007, the U.S. Congress is considering a set of bills designed to limit the nation's GHG emissions. Several of these proposals call for adoption of some form of a cap-and-trade system (see Annex 1 for further details).

The cap-and-trade proposals differ in many respects, starting with ambition and coverage. They also vary on the cost control measures suggested and access to offsets. For example, the McCain-Lieberman bill would stabilise emissions by 2010 at their 2000 level, then bring them back to their 1990 level. The

Bingaman-Specter bill would stabilise emissions by 2020 at their 2006 level and bring them back to their 1990 level by 2030. The Boxer-Sanders bill aims at a reduction of 80% below current levels by 2050. The Lieberman-Warner bill aims for a reduction of 70% below 2005 emission levels by 2050.

The McCain–Lieberman bill covers emissions by large point sources downstream, and those resulting from the production or import of petroleum products for transport. Similarly, producers or importers of industrial greenhouse gases (e.g., HFCs, SF₆, etc.) are required to obtain an allowance for each tonne CO₂-eq produced or imported. During the first six years of the program (2010-2016), annual greenhouse gas emissions would be limited to the amount released in 2000. In subsequent years, the limit would be reduced to the 1990 emissions levels. The bill allows for some limited borrowing with a 10% per year “interest” rate. It also allows access to offsets, rewards early movers, and allocates a significant portion of allowances for free at the outset of the programme, gradually transitioning to a full allowance auction.

The Bingaman-Specter “Low Carbon Economy Act” of July 2007 draws on the National Commission on Energy Policy (NCEP), a bi-partisan group, including some former high-level US officials. It would regulate emissions for oil and natural gas “upstream”, and those from coal “downstream”. The carbon market would begin in 2012 and industries subject to the cap would not have to pay more than USD 12 per emission allowance in that year. The price ceiling would rise by 5% annually over inflation and when it is exceeded, the government would sell additional allocations until the price goes down.

The Lieberman-Warner bill, “America’s Climate Security Act”, proposes to cover U.S. electric power, transportation, and manufacturing sources that together account for 75% of U.S. greenhouse-gas emissions. The cap over those sources would start at the 2005 emission level in 2012 and then would lower year-by-year, reaching 1990 emissions level (15% below the 2005 emissions level) in 2020 and 65% below the 1990 emissions level (70% below 2005 emissions level) in 2050. The bill calls for the creation of a carbon-market efficiency board that monitors the economy and the allowance trading scheme, and that will be authorised to trigger relief remedies in order to forestall any sustained adverse impact on the US economy.

- **California**

On September 27, 2006, Governor Schwarzenegger signed AB 32, the Global Warming Solutions Act. The Act caps California’s greenhouse gas emissions at 1990 levels by 2020. This legislation represents the first legally-binding state-wide program in the U.S. to cap all GHG emissions from major industries and other entities. Implementation is to include penalties for non-compliance. It requires the State Air Resources Board to establish a program for state-wide greenhouse gas emissions reporting and to monitor and enforce compliance with this program. The Act also authorises the State board to adopt market-based compliance mechanisms including cap-and-trade, however whether and how emission trading is part of the implementation of the cap is still to be determined. The bill allows a one-year extension of the target under extraordinary circumstances.

On June 1, 2007, a Market Advisory Committee (MAC) established by the Governor released a draft report and recommendations for the design of a greenhouse gas cap and trade system in the state. This report represents a set of recommendations made to the California Air Resources Board, which will ultimately decide whether and how to implement a market-based system as part of the state’s efforts to reduce greenhouse gases under AB 32, the Global Warming Solutions Act.

- **Western States Climate Action Initiative**

On February 26, 2007, the governors of Arizona, California, New Mexico, Oregon, and Washington signed an agreement establishing the Western Regional Climate Action Initiative (WRCAI). Under the agreement, the five states will jointly set a regional emissions target within six months, and by August 2008 should establish a market-based system – such as a cap-and-trade program covering multiple economic sectors – to aid in meeting the target. In the following months, an additional US state, Utah, and two Canadian Provinces, British Columbia and Manitoba, announced they would join the WRCAI.

3. Design Features of Emissions Trading Schemes

In this section, we address the following points: cap-and trade vs. rate-based trading, sector coverage and extension to other sectors and gases; allocation; cost control measures; and interactions with other policies and measures. The issue of commitment period length is addressed in Buchner (2007).

An extensive body of literature on different aspects of GHG emissions trading has developed since the inclusion of the emissions trading provision in the Kyoto Protocol (Ellis and Tirpak, 2006). This section also describes how the literature on emissions trading schemes' design options has evolved over these past years.

3.1 Cap setting: cap-and trade or rate-based

The main approaches to target-setting in emissions trading are cap-and-trade and rate-based. In a cap-and-trade system, the government defines the "cap," or the total amount of pollution that regulated sources can emit over a specified period of time. Typically, the cap is set in physical units (usually tonnes), is often lower than past emissions and shrinks over time (Aulisi et al., 2005).

Under rate-based systems (also called relative cap), emission credits are generated when emissions are reduced from an agreed level (e.g. emissions per unit of output); emissions per unit of output above the agreed level generate an obligation to buy credits. These systems do not put a hard cap on emissions.⁵ Rate-based trading has been proposed as a means to address cost concerns at the level of countries – and is usually designated by "intensity targets", although these only represent one possible form of "dynamic" or "indexed" targets (Philibert, 2006). Indexed targets at country levels are now standard in most reviews of options for future international framework. Analysts continue to investigate their possible merits and demerits at this level (e.g. Quirion, 2005; Jotzo and Pezzey, 2005; Sue Wing et al., 2006; Newell and Pizer, 2006).

In existing, announced or proposed schemes, only the New South Wales and the Canadian Plans use rate-based objectives. This may result from the complexity of setting baselines or concerns with the liquidity of the secondary market. Moreover, rate-based targets give less certainty to governments about the future emission level of sources covered by their regime and may require adjustments to policies covering other sectors in order to achieve compliance with fixed national targets, if any (Baron and Bygrave, 2002).

It is possible, however, to combine a rate-based approach for some sectors with a fixed cap at country level. In this case, any increase in emissions by one sector will need to be compensated by more aggressive and costly reductions in another activity of the country or through the purchase of other country's emission reductions (i.e. international offsets).

Rate-based systems do not automatically mean rising emissions or lower stringency. What is critical for a scheme's environmental effectiveness is the ambition of the cap, as opposed to the specific approach taken. However, rate-based targets create less substitution effect between products as they do not trigger full opportunity cost past-through in product prices, and should theoretically end up with higher overall costs than a cap-and-trade system to achieve the same abatement.

3.2 Allocation

Permit allocation methods have implications on the distribution of costs – the potential transfer of wealth within the economy under a carbon trading programme is tremendous (Burtraw, 2001). The allocation mode will have complex impacts on the costs and profits of carbon constrained companies. It may also imply important wealth transfers between companies and tax-payers.

⁵ In section 3.2.2.1, this is also called benchmarking under an output-based allocation.

3.2.1 Point of obligation

In an upstream design, the point of application of the overall limit on GHG emissions (i.e. the point of obligation) is, for example, at the level of the producers and importers of fossil energy, or at the level of landowners in the forestry sector. In a downstream design the point of application is, for example, the end-users of fossil fuel energy, i.e. the actual emitters of CO₂ and sources of other GHGs (Baron and Bygrave, 2002). The point of obligation in the production or consumption chain may differ from the point of allocation – as illustrated in the New Zealand framework proposal (see Table 10 for illustration) where some allowances would be given for free to trade exposed industries, whether they consume large amounts of electricity or fossil fuels.

Table 10: Proposed Point of Obligation Coverage

DATE	SECTOR	POINT OF OBLIGATION	ANTICIPATED NUMBER OF PARTICIPANTS	POINT OF ALLOCATION
1 January 2008	Forestry	Landowners or forestry rights holders	Pre-1990 forests: <1000 Post-1989 forests: 2000-9000	Free allocation to landowners of pre-1990 forest
1 January 2009	Liquid fossil fuels (but only those used in NZ)	Fuel suppliers (petrol, diesel, aviation gasoline, jet fuel, light and heavy fuel oils and naphtha) (unless jet fuel users opt in)	5 but jet fuel users may opt in	Zero free allocation to participants with unit obligations.
1 January 2010	Stationary energy (but not exported fuels, coal mine methane or CCS-captured emissions)	Coal: upstream (e.g., importers, miners); or combination of upstream plus mid-stream (e.g., wholesalers and/or major users) Gas (incl LPG and venting/flaring of fugitive natural gas emissions): upstream (e.g., importers, producers, processors); or combination of upstream plus mid-stream (e.g., distributors and/or major users) Geothermal: electricity generators or direct users of industrial heat Used oil: industrial producers that combust used oil	45 (but large users may opt in)	Zero free allocation to fuel producers/importers and electricity generators. Some assistance to eligible industrial producers (excluding electricity generators) for direct and indirect emissions from stationary energy after entry into the NZ ETS and declining to zero by 2025.
	Industrial processes	End emitters	35+	Some free allocation to eligible participants after entry of the sector into the ETS and declining to zero in 2025.
1 January 2013	Agriculture (synthetic fertiliser use, , enteric fermentation and manure management – note: 49% of NZ emissions)	Nitrogen fertiliser suppliers	10	Three possible options as the point of receipt of free allocation are: (a) farmers (b) processors (c) sector bodies.
		Meat/dairy processors	25	
	Waste	Landfill operators	60	Zero free allocation
	All other remaining sectors	To be determined		

Source: New Zealand Ministry for the Environment, 2007

3.2.2 Allocation to existing installations: free versus auctioning

3.2.2.1 Potential effects of free and auctioned allowances

Emission allowances to plants, companies or sectors can be allocated free of charge, auctioned or be a combination of the two. There are two options for free allocation:

- Grandfathered allowances are distributed in proportion to sources' past emissions, measured for one or several years. Grandfathering can either be a one-off allocation to existing installations, or be regularly updated, with new emissions data.
- Allowances can also be distributed for free based on the average, or expected, performance for the sector as a whole (e.g. tonne of emissions per unit of output). This is generally called benchmarking. Benchmarking can either provide fixed allowances based on expected output or be used in a rate-based trading system, with allowances adjusted ex-post based on actual production volumes.

Under auctioning the government sells allowances to eligible entities, which may be liable sources or other points of obligation, and market intermediaries. Auctioning allowances presents one practical advantage over grandfathering or benchmarking alternatives: as such, it doesn't require gathering ex ante information on installations' emissions. It will be up to them to turn to the market to acquire allowances to cover their emissions, in light of their own expectations on future emissions and on their abatement cost. One should note, however, that a government that intends to use revenues to offset possible negative effects on specific sectors would probably need to gather emissions and other data to guide the recycling scheme.

There is general agreement in the economic literature that auctioning is more efficient than free allocation. A number of studies have examined the potential impact of auctioning allowances (e.g. Keats et al., 2004; Grubb, 2006; Rehbinder and Schmalholz, 2001; Baerwalkdt, 2004; WWF, 2003; Hepburn et al., 2006). Auctions are first and foremost a distributional mechanism – they redistribute at least some of the revenue created by ETS from firms to government. The government can then recycle revenues in the form of lower income taxes to businesses impacted by emissions trading, use the funds to invest in the development of clean or low-emitting technologies, or use them to offset distortionary taxes. For example, in the federal proposal for an ETS in Australia, it is suggested that the revenues from the periodic auctioning of unused permits, will be used, in the first instance, to support the emergence of low-emissions technologies and measures to improve energy efficiency.

In designing emissions trading schemes and allocation modes, governments may influence the level of potential loss or gain of cost competitiveness for certain industries. The loss in competitiveness arises when competing firms are not covered by similar constraints, or are covered by different systems, with one perceived as less constraining than the other. In theory, free allocation amounts to compensating companies for the introduction of a cost on carbon (Grubb and Neuhoff, 2006). Allowances given for free represent a rent transfer, in the form of a financial asset that can be sold on the carbon market. Free allowances thus have a so-called opportunity cost, which can be found in these sectors' product prices. This was illustrated by the strong debate on the power sector's "windfall profits" in Europe at the beginning of the first trading period.

Auctioning allows the government to keep the rent from the environmental constraint, and to avoid the politically difficult issue of CO₂-intensive plants generating profits from an environmental constraint – a far cry from "polluters pay principle". Currently in Europe, electricity generators are passing on part (and in some cases all) the opportunity cost of carbon allowances through to electricity prices, carbon allowances that they received for free. This natural pricing response from the industry is necessary to ensure that electricity prices reflect the cost of carbon, and that demand eventually adjusts to the carbon

signal. As a result, profits increase for both fossil-fuel and carbon-free technologies ('windfall' profits). There is therefore no reason to assume that auctioning allowances would have a stronger effect on electricity prices than currently experienced with a free allocation. The picture is of course very different under regulated electricity markets – as they exist in some US States, for instance – where the regulator would decide how much of the actual cost of achieving CO₂ objectives would be charged through increased electricity tariffs moving from a free allocation to an auctioned allocation should have no impact on electricity prices. Windfall profits have been extremely controversial in many EU Member States and have resulted in credibility concerns being raised about the system of trading schemes.

Some governments chose to provide a share of the carbon "rent" to liable or impacted sources as a means of compensation for introducing a constraint, and a cost, on emissions. Australia and New Zealand's proposed systems mention this option. The Australian position is that free allocation is 1) a compensation of vested interests for the cost of introducing the new regulation and 2) a way of alleviating competitiveness problems for trade-exposed industries. In the NZ ETS, the government's rationale for providing transitional assistance to eligible firms through free allocation includes the avoidance of long-term regrets associated with the closure or reduced output from firms, concentrated job losses, and reputation issues regarding investment risk (New Zealand Ministry for the Environment, 2007).

However, even when allowances are purchased, it is possible that a company's profit remains unchanged – if it can pass-through its cost increases onto its final prices without loss in market shares. Viewed in that light, they would have the same impact on prices as grandfathered allowances. Consequently, the economics' literature is quick to dismiss a popular argument against auction, namely that they will result in price increases (and therefore costs) to downstream industries and consumers that would be higher than in the case of free allocation (Frontier Economics, 2006).

Nonetheless auctioning does impose upfront costs on sources because they must buy an allowance for every emitted tonne; this is not the case when allowances are allocated for free. Loss in competitiveness from an industry players' perspective may entail either loss of market share or loss of profits, or both. Loss of market share may occur if the cost increase is passed through to product prices and there is competition from companies which do not face similar cost increases. This may lead to leakage, for example in the RGGI, as electricity can be imported from non-carbon constrained coal-intensive States outside the Initiative. Loss in profits may also occur if companies are unable to pass the cost increase onto final consumers. While the choice between free allocation and auctioning is not supposed to modify the conditions of competition at the margin, it is likely to have important implications on corporate balance sheets, access to capital for investments, and market behaviour.

3.2.2.2 *The current practice for allocation*

Today several allocation modes co-exist in countries and regions where trading systems are in place or are planned. Switzerland, for example, opted for 100% free allocation – as did most EU States, ignoring the possibility of the trading Directive to auction up to 5% of allowances for the 2005-2007 period. At the other extreme, within the RGGI Massachusetts has committed to auction 100% of its allowances, and use the funds generated to finance demand-side management and renewable energy programs, and combined heat and power (CHP) projects. The State of New York has also recently proposed to auction 100% of its state-wide allowance allocation under the programme.

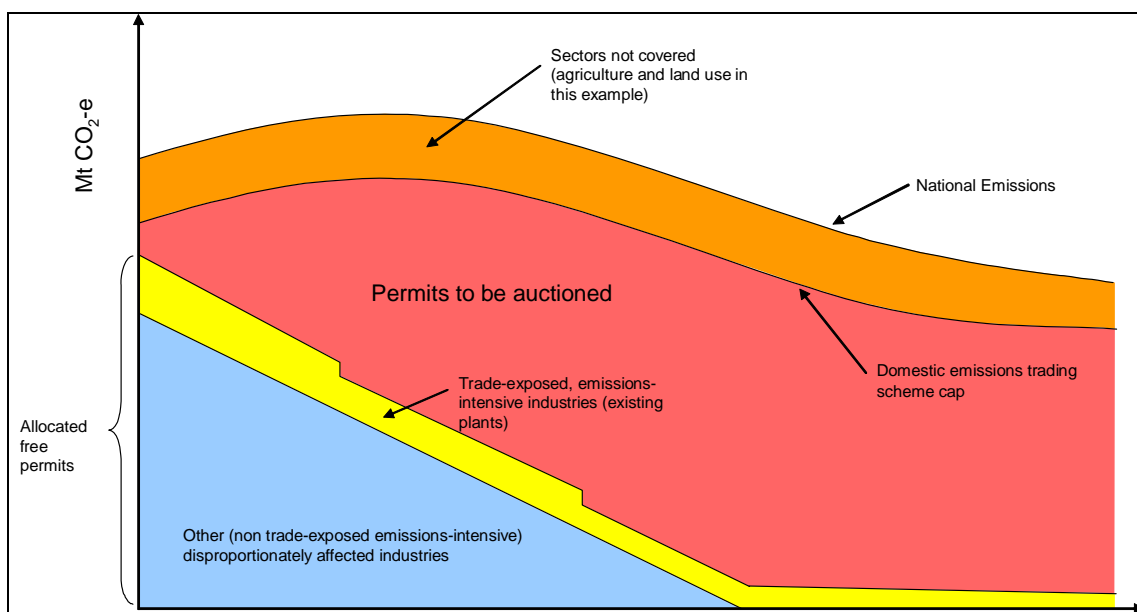
However, most systems combine free allocation and auctioning. Four EU Member States (Denmark, Ireland, Hungary and Lithuania) used the possibility to auction some allowances within the 5 % limit in the first trading period. The remainder of the allocation was mainly based on grandfathering according to historical emissions, given the difficulties of finding acceptance for benchmarks due to the heterogeneity of sources. For the period 2008-2012, the level of auctioning is increased to a maximum of 10%, with several member states making use of this option (e.g. Germany (< 9 %) UK (7 %), Netherlands (>4 %), Ireland, Hungary, Lithuania, Austria and Belgium). For the third trading period and beyond a significant increase in the share of auctioning is under serious consideration. In the July 2007 Bingaman-Specter bill, 24% of allowances would be auctioned at the beginning of the programme. The share of increased

allowances would increase progressively to 53% by 2030, and thereafter increase by 2% per year. Last, in New Zealand, as mentioned in 2.2, free allocation would be phased out in favour of auctioning, with a linear rate of decline from 2013 to 2025.

In Australia, the Task Group recommends the allocation every five years of free permits to trade-exposed emission-intensive industries (TEEIs), to cover direct emissions and to offset the cost increase flowing from upstream emissions (e.g. rising power prices). Over time, allocation calculations will be adjusted to encourage the use of international best-practice low-emissions technologies. New investments in trade-exposed industries would also receive a stream of free permits only if they meet a standard benchmark for best low emissions practice (Borthwick, 2007). This creates an incentive for investment in low emissions technology/fuel sources/practices and avoids a lock-in of carbon intensive investment which may be less competitive over the long term as the world moves to constrain carbon.

For existing businesses identified as likely to suffer a disproportionate loss of value due to the introduction of a carbon price (such as fossil fuel-fired generators), there would be a once-off allocation of permits with various dates of effect (i.e. different vintages), including some permits for years beyond 2020 (Report of the Task Group on Emissions Trading, 2007). The remaining permits would be auctioned (i.e. periodic auctioning of the remaining permits for the period 2011 to 2020, and periodic auctioning of a small volume of future-dated permits beyond 2020 in order to promote the establishment of liquid forward markets). Figure 1 provides the full allocation method recommended by the Task Group.

Figure 1: Allocation of permits under the proposed Australian federal scheme



Source: Report of the Task Group on Emissions Trading, 2007.

3.2.3 New entrants and closure provisions

The economic implications of allocation regimes to new entrants have been the subject of extensive literature (Ahman et al, 2005; Ellerman, 2006; Grubb and Neuhoff, 2006). The government may set aside allowances for new entrants, or new entrants may have to buy allowances from the market.

A set-aside allocated for free to new entrants would be more favourable to investments, as new entrants would otherwise incur direct additional cost to enter the market (i.e. a market barrier) (Reinaud, 2005b). However, if free allocation to new entrants is differentiated according to the CO₂-intensity of the new investment, this provides an incentive to more CO₂-intensive means of production, thereby eroding the

incentives of the scheme. Further, free allocation to new entrants effectively increases the price of CO₂ in a capped system if fossil fuel technologies become cheaper for investors (Lindboe et al., 2007). While grandfathering of allocations to existing investments might be explained by the need to soften the transition, no similar argument would justify a new entrant reserve.

In the New Zealand proposal, no free allocation will be provided to new entrants, or to existing facilities that expand production. In this way, production increases from existing producers and from new entrants will have to compete on an equal footing with regard to emissions pricing. This is expected to create incentives for low-carbon technologies investment in the economy.

If the constitution of a new entrant reserves is deemed necessary to facilitate market entrance, Grubb and Neuhoff (2006) suggest that it should be based on output or capacity, and avoid differentiating according to the CO₂-intensity of the new investment.

Rules for plant closures vary: in systems with free distribution of allowances, companies are sometimes asked to redeem unused allowances, or allowed to keep them. Literature on new entrants' provisions (e.g. see Ahman et al (2005), Neuhoff et al (2006)) emphasises the importance of a consistent approach between the rules for new entrants (i.e. entry) and those for exit (Frontiers Economics, 2006). On the one hand, the obligation to give allowances back may reduce the incentive to close presumably inefficient plants. On the other hand, giving an on-going stream of free emission units to plants for a period of time after they have closed down may constitute a subsidy that benefits companies that may have decided to operate outside the system, possibly with lower environmental standards

All EU countries have provided new entrants with free allowances, often based on their CO₂-intensity – thus setting up the example not to follow, as suggests the large number of coal-fired plants under construction in Europe. Indeed, in many European countries, allocation to new entrants was based on rewarding the best performing plant of its category (e.g. coal-fired or gas-fired) but it did not encourage switching to less CO₂-intensive fuels. Further, most have requested closing plants to surrender their allowances – thus reducing incentives to close inefficient plants in order to maintain emissions allowances. Lessons from experience are being drawn, and regarding the post-2012 developments, the different stakeholder groups mentioned in 2.1 and Ellerman et al. 2007 indicate that the harmonisation of rules on new entrants, plant closure and transfer is an area of priority. “The EU should formulate EU-wide rules for new entrants, including those for the establishment of a new entrant reserve wherein size, access and allocation criteria (possibly based on benchmarks if data are available) are applied throughout the EU as a means to induce appropriate technology choices, to create transparency and to reduce transaction costs and internal market distortions” (Gagnier et al, 2007).

The Australian Prime Ministerial Task Group recommended that new entrants deemed to be trade-exposed energy-intensive would also receive free permits, until major competitors face similar carbon constraints. Other schemes (e.g. RGGI, New Zealand) are considering full auctioning for new entrants. They will not, therefore, require new entrant reserves.

3.3 Coverage, offsets, sectoral trading

Emissions trading is increasingly regarded as a policy instrument which can be applied to areas which were not considered before. While earlier trading programmes focused on “downstream” reductions from the power sector and energy-intensive industries, more recent programmes announced or proposed tend to combine downstream allocation for these large stationary point sources with upstream allocation to fossil fuel producers and importers. Other gases and other sectors are considered for inclusion or addressed through provisions for offsets, notably aviation, agriculture and forestry, and waste. Other options are discussed in the literature, including personal carbon trading.

3.3.1 Coverage

Not all systems cover the same sources and gases, the result of varying national circumstances, including the earlier choice of other policy instruments to address emissions in specific sectors. Early trading schemes have targeted CO₂ emissions from power generators and heavy industry. These industries' relatively large contribution to total emissions, their relative ease with which their emissions can be monitored, and the variety of mitigation options explain this choice. Moreover, as the IEA (2005) notes, "these actors are more likely to choose energy of lowest cost than households and smaller businesses of limited energy expenditures (...) often caught in a 'landlord-tenant' dynamic whereby the final energy user does not control its energy-using equipment and cannot respond to changing energy prices".

Nevertheless, governments may want to exert control over as many GHG sources as possible, and various ways have been suggested for using emissions trading to control a much wider number of sources and thus ensure a much broader coverage of all GHG emissions. An important argument for broadening the scope of emissions trading is that this gives carbon a price on a larger scale, which can then be taken into account in economic decisions. Further, generally speaking, the more sectors and gases that are covered in an emissions trading scheme, the greater the potential for liquidity and market efficiency (Baron and Bygrave, 2002). One option appears to offer a broad coverage of energy-related CO₂ emissions – the upstream system. In the energy sector, an upstream system assigns obligations to firms supplying an economy its carbon-based fuels. Fossil fuel producers and importers will then influence the consumption of their products, presumably through pricing. Hence allowances needed by the obligated firms should be bought from those who hold them (i.e. this is the case of New Zealand where the upstream point of obligation for the stationary energy sector is different from the downstream point of free allocation for eligible trade-exposed firms facing emissions-related increased energy costs) or auctioned at the outset, not given for free, as larger windfall profits would otherwise appear. Another aspect is that the carbon signal tends to be blurred in the overall price of fuels.

Most existing schemes focus on downstream point of obligations (e.g. EU-ETS.) However, various announced or proposed systems, starting with Australia and New Zealand, would combine an upstream regime for small sources, and a downstream regime for large sources. Most of the US bills also mix downstream with upstream features. For example, the Lieberman Warner bill would cover power plants and industrial facilities emitting more than 10 000 tCO₂-eq a year, facilities producing or importing petroleum- or coal-based transportation fuel, the use of which will emit the same annual amount, and facilities producing or importing non-fuel chemicals that will emit again the same amount. The ETS proposed in the bill would thus not cover buildings, but it does integrate all greenhouse gases (CH₄, N₂O, SF₆, PFCs, HFCs) at the outset – a feature often neglected by other systems or considered for some undefined future expansion.

Other options have been suggested in the literature, aimed at targeting other elements in the chain that lead to emissions, such as carmakers, which would be liable for the emissions of the cars they sell, based on some estimate of mileage (IEA, 2005). Perhaps more strikingly, a study commissioned by UK's Department of Food and Rural Affairs shows that individual carbon trading (i.e. giving to everyone a limited allowance to emit carbon dioxide and allowing those who want to emit more to buy from those who emit less), may be much easier to implement than one might expect (Roberts and Thumin, 2006).

One may fear that a personal system would require large administrative and monitoring costs; however, looking at the existing banking and financial systems to manage carbon accounts and transactions, and to existing government personal databases for allocating allowances to individuals, would suggest simple practical solutions, according to the report. The various systems examined would be less regressive than carbon taxes and even slightly progressive, according to Roberts and Thumin (2006). Moreover, such systems would give direct information about carbon emissions to stakeholders while upstream regimes would merge this information with energy prices.

Sectors of interest for broadening emissions trading schemes include transport, agriculture, land use change and forestry, and waste. The New Zealand proposed scheme has announced that it would initiate its system with these sectors as described in section 2.2. The Australian federal emissions trading

proposal also mentions that agricultural emissions will be brought into the scheme as practical issues are resolved.

Meanwhile, these sectors are often included as sources of “offsets” or credits from “domestic projects” which are linked to an emissions trading scheme. The clean development mechanism (CDM) currently includes approved methodologies to credit anaerobic digestion of animal waste and forest CO₂ sequestration (not to mention waste, in the form of CH₄, HFC23, N₂O), and many countries or various companies already sell voluntary “offsets” of CO₂ emissions based on tree-planting. As will be seen in the next section, offsets could offer a transition towards broader coverage, but they may also create barriers to an enlarged scope for reasons set out below.

There might, however, be areas in these non energy-related sectors where an incentive could be provided more easily through a cap-and-trade system, than with project-based credits. In particular, according to NERA (2007), “shifts in agriculture, forestry and land management activity (e.g. from ruminants to non-ruminants) and reductions in farming intensity and output would be difficult to incentivise via a project-based scheme, but would be relatively easy to incentivise through a cap-and-trade scheme.”

3.3.2 Offsets

Offsets are credits from project-based mechanisms which could be generated from abroad (e.g. through the clean development mechanism (CDM) in the Kyoto Protocol) or from “domestic projects” outside of the scheme. Some systems use a broader definition of offsets that includes credits from JI and allowances from other trading schemes. Offsets do not lead to greater emission reductions beyond the cap, as project-based credits will likely be used for compliance purposes under an emissions trading scheme, but may help reduce overall costs. This is why some believe that offsets should be transitory only and pave the way for future broader systems.

3.3.2.1 International offsets

Most existing or planned ETS allow for entities to meet their emissions targets by using credits from CDM, JI or other project-based “offsets. Table 11 indicates which of the described emissions trading scheme in section 1 accept international Kyoto offsets.

Table 11: **Types of international Kyoto offsets accepted by different emissions trading schemes**

Name	Can be used in...	Eligible gases	Eligible project types	Eligible project countries
CDM	EU ETS Phase I and II, Norway, Japan, Chicago Climate Exchange, Swiss system, proposed Australian federal system, proposed New Zealand scheme, Canada	6 GHG	All “additional” emission-reduction and re/afforestation projects. Countries are to “refrain from” using credits from nuclear facilities. “Sinks” credits are temporary, and are not currently accepted by the EU ETS and the New Zealand proposed scheme.	Non-Annex I countries (NAI)
JI	EU Phase II, Swiss scheme, proposed Australian federal scheme, proposed New Zealand system, Norway	6 GHG	All projects that “[aim] at reducing anthropogenic emissions by sources or enhancing anthropogenic removals by sinks... in any sector of the economy” that produce “additional” emission reductions.	Annex I countries

Source: updated from Ellis and Tirpak, 2006

3.3.2.2 Domestic offsets

Currently, New South Wales (Australia) holds the greatest amount of actual domestic projects. In New Zealand, the government is considering the potential role for an offsets scheme as a complement to the NZ ETS. Such an offsets scheme potentially would provide tradable emission units for activities not covered within the NZ ETS, or not fully recognized under the standard GHG accounting methods under the NZ ETS. Canada, the RGGI and some European countries are also showing interest and considering legislation; France has even enacted specific legislation (see below). Domestic offsets are also in the most recently announced or proposed systems including Australia and the various US bills. The EU ETS does not include domestic offsets.

In the case of downstream existing regimes, such as the EU ETS and the RGGI, domestic offsets could play an important role in addressing primarily CO₂ emissions from large-emitting, multi-source sectors such as transportation and buildings, and small industry. Implementation might rest on various systems. The RGGI Model Rule has developed in detail five general categories of domestic offsets: “(i) Landfill methane capture and destruction; (ii) Reduction in emissions of sulphur hexafluoride (SF₆); (iii) Sequestration of carbon due to afforestation; (iv) Reduction or avoidance of CO₂ emissions from natural gas, oil, or propane end-use combustion due to end-use energy efficiency [improvements]; and (v) Avoided methane emissions from agricultural manure.” These may take place within any participating States as well as other US States – though the latter with a 50% discount on tonnage.

The extent to which offsets can be used for compliance purposes in the RGGI is up to 3.3% of a source’s emissions, unless allowance costs exceed some thresholds. If the average annual price of emission allowances rises above USD 7, sources will be permitted to use offsets for up to 5%. If the average price rises above USD 10, then sources will be permitted to use offsets for up to 10% and offsets from trading and offset programmes outside the USA will be allowed, including those issued within the context of Kyoto project-based mechanisms, but not international trading under Kyoto.

For industrialised countries participating in the Kyoto Protocol, establishing a regime for domestic projects fills a possible gap, as JI allows their domestic entities under a trading regime to undertake any type of project in any other Kyoto country through either JI or the CDM but perhaps not domestically – views diverge on this point. The regime, instituted in March 2007 by the French government following proposals formulated by the State-owned financial institution *La Caisse des Dépôts*, provides Emission

Reduction Units (ERUs) to the developers of emission reduction projects in France under the condition that one of the developers is in a foreign country. ERUs can be used for compliance by the firms covered by the EU ETS and are thus more “liquid” than AAUs, which cannot be used for compliance in the EU ETS (Arnaud et al., 2005). To facilitate project developers’ task, the government is on its way to label eight standard methodologies for different project types. Domestic offsets under JI procedures would provide foreign countries the same guaranties than any other JI project with respect to the additionality of such offsets, while countries unilaterally setting up domestic project systems would raise concerns on the quality of credits that would need to be accepted under international regimes such as the Kyoto Protocol and the EU ETS.

In the broader announced regimes (see Chapter 2.2), which, through a combination of upstream and downstream allocation, cover most energy-related CO₂ emissions, domestic offsets are mostly used to address emissions of CO₂ and other GHG from other sources and sectors that are not covered, notably the agriculture, land use change, forestry and waste sectors, through market incentives.

Domestic offsets are usually preferred to plain integration into emissions trading schemes for sectors for which the additional burden of defining additionality and baselines for project emissions is felt lighter than the burden of monitoring the emissions of all sources within the covered sectors. There is, however, another important difference, that the French example clearly exhibits. Emissions trading systems, especially if free allocation is limited, make polluters pay. Offsets systems offer positive incentives to market players. While this may help gain public acceptance, this also means that others bear the costs – either taxpayers if the government gives allowances or buys ERUs and CERS, or other emitters if offsets are directly linked to emissions trading at firms’ level. Moreover, domestic offsets may reduce the incentive for sectors to “opt-in” for full integration in emissions trading schemes.

This again suggests using offsets should be transitory only. It is hard to justify that the burden of climate change policy should durably rest on the shoulders of heavy industry alone. Arguably, this includes the power sector and thus all electricity end-users, and the carbon price will be passed on to the consumers of energy products. Nevertheless, GHG reductions from the housing, transport, waste or agriculture sectors should ultimately be priced with their products or services, not with industry products, if one is to build an effective regime. Of course, other policies than emissions trading could entail costs borne by these sectors themselves.

Learning from domestic offsets could have positive insights for international negotiation, however, and help set standards for project-based mechanisms. Part of the interest of Australia and Canada in offsets from the agriculture, forestry and land-use changes can be traced to the willingness “to influence the evolution of international rules in a direction that would provide a positive incentive for engagement by developing countries” (Prime Ministerial Task Group on Emissions Trading, 2007).

3.4 Cost containment and control measures

Emissions trading is about reducing GHG emissions at the lowest possible cost. However, uncertainties remain on the marginal cost of achieving any given emission target in the future, as this depends on unabated trends, economic output, development of new technologies, relative energy prices, which are all uncertain, and, of course, the ambition in emission targets. Governments that wish to limit the risk of unexpectedly high costs while maintaining the incentive for abatement, have several options. Banking and borrowing allowances may help smooth out cost variations. The choice of the length of the trading period is also relevant in this context. Project-based mechanisms may provide cheaper reduction options – “credits” or “offsets” – in sectors or countries whose emissions are not covered by a given ETS.

Of all cost-containment provisions, a more specific set is designed to control (not only contain) marginal abatement costs. Most cost-control measures would facilitate access to additional sources of carbon offsets from project-based mechanisms if – and only if – carbon prices reach some pre-agreed level. Others would under the same conditions further facilitate borrowing. Finally, price caps would make available additional allowances at a given cost, hence relieving the cap on emissions.

Cost-containment measures may be aimed to avoid undue allowance price volatility in the early years of a trading scheme. However, e.g. if subject to government discretion, cost containment measures may induce speculative behaviour and prove counter-productive. The first phase of the EU ETS has shown that a carbon market starting with a short first trading period and no banking may be subject to high volatility, while the fundamental price drivers are not fully understood by the market.

The EU ETS does not include for the second trading period and beyond any discretionary cost-control measure, as defined above. It does however allow for the import and use of JI and CDM offsets for a total of almost 14 % above and beyond the EU-wide cap. Furthermore, in the first trading period the EU ETS design includes a cost-containment provision that allows under *force majeure* circumstances the allocation of additional allowances (expanding the cap) to individual operators.

The RGGI is similarly cautious in considering cost-control measures. The drafted regulation would allow greater use of offsets – from 3.3 to 5% if the average allowance price exceeds USD 7 per tonne over twelve consecutive months – and offsets from US States not participating in the RGGI would not be discounted anymore. The use of offsets could go up to 10% if the average allowance price exceeds USD 10 per tonne in the same conditions. In the latter case, offset projects outside the US, including through the Clean Development Mechanism, and allowances from other countries' trading schemes, could be used, and the achievement of the target would be postponed one year.

How would this work in practice remains to be seen. Projects often have a long lead time and developers need some guarantee on their markets. However, there is no certainty for project developers that offsets will be needed (i.e. that the market price will be above the trigger price). If and when this scenario materialises, there may not be offsets available in sufficient quantity (although some, like CERs, will be mainly developed for other markets). The financial uncertainty seems shifted from polluters within the trading regime to project developers. In particular for developers outside RGGI's participating States, to undertake a project with a marginal cost over USD 3.5 would reflect the conviction that the USD 7/tCO₂ price level will be reached, briskly doubling the value of the offsets.

Some proposed schemes include other cost-control measures. The McCain-Lieberman bill allows liable entities facing a temporary shortage to borrow for up to five years, a total of 25% of their obligation, with a 10% interest rate. Under the Sanders-Boxer proposal, the yearly decline of the target may be stopped for up to three years if the carbon price exceeds the so-called "technology-indexed stop price" – a price that is not pre-set but would follow the marginal costs of a basket of technologies that include most renewables.

The announced Australian trading scheme, the Canadian 2007 Regulatory Framework for Air Emissions proposal, and the Bingaman-Specter bill adopt the more straightforward price cap as a comprehensive cost control measure, "while maintaining an economic incentive for firms to develop cheaper abatement and permit-purchase strategies" (Prime Ministerial Task Group on Emissions Trading, 2007). The level of the Australian price cap, or "emission fee" (often referred to as a "safety valve"), is yet unknown but is clearly meant to be set over the average expected costs of the forthcoming targets, at least after the few initial years.

In Canada, when the short term emission-intensity reduction targets come into force in 2010, covered emitters will have access to several compliance mechanisms to meet their targets, including access to a technology fund at CAN 15/tCO₂ (rising to \$20 per tonne in 2013, and thereafter escalating yearly at the rate of nominal GDP growth). Contributions to the fund would be limited to 70% of the total regulatory obligation in 2010, falling in consecutive years to 10% in 2017.

The July 2007 Bingaman-Specter bill proposes a price cap at USD 12/tCO₂ by 2010, escalating by 5% per year over the inflation. Its exact name is the "Technology Accelerator Payment", as its possible proceeds will go to funds for research and development. The initial proposal set a starting level at USD 7/tCO₂, as first suggested by the National Commission on Energy Policy (NCEP, 2004), with the same escalating rate. In April 2007 the NCEP had raised the level of its proposed safety valve to USD 10/tCO₂ while suggesting more ambitious targets than before.

However, in a detailed report on the future of coal, researchers from the Massachusetts Institute of Technology (MIT, 2006) compared the effects of two global “CO₂ penalties” against a background of an unabated trend leading to global CO₂ emissions of 60 Gt per year by 2050. The first penalty was set at USD 25 by 2015, escalating at 4% per year over inflation, the other at USD 7/tCO₂ escalating 5% per year. The MIT report concluded that, “under the High CO₂ Price path, by contrast, global emissions are stabilized by around 2015 at level of about 28 GtCO₂. If only the Low CO₂ Price path is imposed, emissions would not stabilize until around 2045 and then at a level of approximately 42 GtCO₂ per year.” These results also depend on support for research, development and demonstration projects, in particular in the area of carbon dioxide capture and storage technology. They are in line with other modelling exercises undertaken at the IEA (2006) or surveyed by the IPCC (2007), and suggest that, if acceptable a minimum price of USD 25 would have a markedly more important impact on emissions than USD 7/tCO₂. The increased price cap level in the Bingaman-Specter proposal is an obvious attempt to respond to critics while keeping the price low enough to make the proposal acceptable to a sufficient number of Senators and Congresspersons. The Lieberman-Warner bill would allow a carbon market efficiency board to further facilitate borrowing “if the emission allowance market poses a significant harm to the economy of the United States”.

Price caps may reduce uncertainty on compliance costs but create an uncertainty on emission levels. Some see the trade-off as beneficial for the environment if price caps are set in the upper range of price expectations, as they may help set relatively more ambitious targets. Others fear that price caps will be set too low, deter climate-friendly investment, defer technology development, and finally hamper the efficacy of emissions trading schemes.

3.5 Interactions with other policies and objectives

If markets were perfect, one single instrument could address all emissions from all sources. Market imperfections (or limitations) are often quoted as a justification for complementary measures. . These may lead government to use different policy instruments. Ultimately governments may adopt multiple policy objectives that complement and/or conflict with each other.

Market imperfections such as the principal-agent problem hamper energy efficiency improvements and capital-intensive energy sources such as nuclear and renewable (IEA, 2007). The OECD (2007) notes that, “in several cases, combining two instruments has been found to enhance the effectiveness and efficiency of both instruments. For example, a labelling scheme can increase the impacts of a tax, and vice versa.” (...) But while “overlap between some types of instruments can be beneficial and/or mutually reinforcing, overlap between other types of instruments (e.g. taxes and product standards) can both hamper the proper working of the instruments involved, and cause redundancies and unnecessary administrative costs”. In practice, the scope for such positive interactions between instruments seems particularly important if the instruments in question provide affected decision-makers (households, farmers, industrial firms, etc.) with a high degree of choice as regards how they would comply. If one instrument “instructs” the target groups how they should behave – e.g. applying a specific “Best Available Technology” – there is limited scope for other instruments to enhance the environmental effectiveness of that instrument. (OECD 2007).

The OECD (2007) notes an important difference between a tax and a cap-and trade system: “The environmental outcome is directly embedded in a cap-and-trade system. An information instrument used in combination with such a system would, hence, primarily impact on the price of the permits – not on total emissions – and, thus, on the economic efficiency of the approach.” Over the long run, however, reducing the cost under a cap-and-trade system will facilitate the setting and the achievement of more ambitious objectives.

One important market imperfection or rather limitation is markets’ usual “short-termism”, as they may not “see” that some nascent technologies have large learning-by-doing cost-reduction potentials. In such cases, CO₂ market instruments may be complemented with specific measures to develop these emerging technologies through their early deployment (i.e. before they are fully competitive, CO₂ cost included).

Search for dynamic, rather than static, cost-effectiveness is one way to characterise such complementary measures. For example, public support through feed-in tariffs and renewable energy portfolios has proven effective in reducing wind power costs. However, governments are proverbially bad at picking up “winners” – and therefore better refrain from doing so.

Governments that multiply policy instruments, and more broadly policy objectives may want to verify that they do not duplicate objectives and/or conflict with each other. Indeed, in a report to the European Commission, Harrison et al. (2005) have analysed the “complicated ways” in which the current EU ETS, the green certificates (from renewable energy portfolio standards) and white certificates (from energy efficiency improvements) programmes interact. Interactions are transmitted through wholesale and retail electricity markets, through markets for the various commodities created by the programmes (i.e., CO₂ allowances, green certificates, and white certificates), and through other markets (e.g., fuel, labour). Nonetheless, it is also recognised that there could be good reasons for complementing an emissions goal with other policy objectives. Further, in some cases, there may be a need for a portfolio of complementary measures to achieve a government’s full range of environmental and other goals.

For example, the Australian Prime Ministerial Task Group on emissions trading recommends that all Australian schemes that set mandatory targets for deployment of particular technologies should be wound up over time, and new ones forestalled. The New South Wales Government has already announced that it would transition its Greenhouse Gas Abatement Scheme into an Australian emissions trading scheme if one were introduced, given the direct overlap in objectives, design and participants. Following the Prime Ministerial Task Group’s report the Australian Government has announced a new Clean Energy Target that will build on the existing Australian Government Mandatory Renewable Energy Target and replace existing state and territory targets with a single national scheme.

4. Conclusions

Today, a new wave of greenhouse gas emissions trading schemes is appearing, which aim at covering a broader range of emission sources and mix downstream and upstream allocation. Lessons from existing schemes are progressively drawn by policy makers and stakeholders and other considerations are emerging from announced and proposed schemes. There are several elements:

- In order to enhance the cost-effectiveness of the system, the scope of the ETS should cover as many sectors and gases as possible – to the extent that they can effectively respond to a price signal and it is possible to reliably monitor, report and guarantee their emissions reductions.
- Auctioning permits is a more economically efficient allocation method than free allocation of permits, although free allocation is often used to reduce impacts of the ETS on affected sectors. Different allocation methods can be used for different sectors within a single scheme, reflecting the diverse vulnerability of economic activities to carbon constraints.
- Design options relative to plant closures and new entrants should be carefully balanced to send the proper incentives while not shielding incumbents against competition from new entrants.
- Reliable historical data is needed in order to be able to set grandfathered allowances at an appropriate level.
- Monitoring, reporting and verification of emissions are critical in ensuring the integrity and credibility of the scheme, and are also important for inclusion of broader sectors and gases.
- Domestic offsets may be used to pave the way towards broader trading regimes, by gaining knowledge on emission reductions in other sectors, but they are not without problems. In Kyoto countries, domestic offsets could probably take the JI road, avoiding the need to set up specific institutions.

- Most importantly, the design of ETS should be flexible, allowing experience from existing trading schemes to feed-back into their design - while providing certainty in the schemes' broad picture.
- Policy makers should pay attention to the relationship of ETS with other policies – those which are definitively complementary and should be part of the toolkit, and those which create redundancies at best, inconsistencies at worse.

The international implications of the development of various national and regional ETS are important for linking of ETS. Possible solutions have been suggested for most technical difficulties in linking different ETS together, although some imply restrictions – such as one-way trading (see, e.g., Bygrave and Baron, 2002; Blyth and Bosi, 2004; Ellis and Tirpak, 2006; Philibert, 2005). However, governments may have concerns that linking their system with another that they perceive as less environmentally ambitious (e.g. ambition or nature of targets, cost-control measures, offset provisions, compliance provisions, etc.) will undermine the functioning and hamper the environmental effectiveness of their emissions trading system. A coalition of European countries, U.S. states, Canadian provinces, New Zealand and Norway announced on October 29, 2007, the formation of the International Carbon Action Partnership, a forum to share experience among governments and public authorities on the design of ETS.

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Annex 1: Main US Congressional bills introduced in 2007

	McCain - Lieberman	Bingaman – Specter	Kerry – Snowe	Sanders - Boxer	Feinstein – Carper	Lieberman - Warner
Bill number/name	Climate Stewardship and Innovation Act S.280	Low Carbon Economy Act H.R.620	Global Warming Reduction Act S.485	Global Warming Pollution Reduction Act S.309	Electric Utility Cap-and-Trade Act S.317	America's Climate Security Act of 2007 S.2191
Targets	Return emissions to 2004 levels by 2012, to 1990 levels by 2020, and to 60% below 1990 levels by 2050	Calls for a reduction o GHG to 2006 levels by 2020 and to 1990 levels by 2030	Return to 1990 GHG levels by 2020 2021-2030: emissions reduced by 2.5% per year, then by 3.5% per year	Freeze emissions in 2010; achieve 1990 levels by 2020, and 80% below 1990 by 2050.	2011-2014: capped at 2006 levels 2015 capped at 2001 levels 2016-2019: cap declines 1% from previous year 2020 and thereafter: emissions cap declines 1.5% per year	Cut US GHG emissions to 1990 levels by 2020, 65% below 1990 by 2050 (or 70% below 2005)
Coverage	Covered entities that emit, produce, or import products that emit over 10 000 metric tons of GHGs per year in the electric power, industrial, and commercial sectors of the U.S. economy	Hybrid: regulated entities include: petroleum refineries, natural gas processing plants and LNG facilities, importers of liquid fossil fuels and non-CO ₂ GHGs, and large coal-consuming facilities	Determined by EPA Sources or sectors with greatest GHG emissions as determined by the EPA	System to be determined by EPA	Power sector only with a generating capacity greater than 25MW	Electric power generators, transportation fuels (upstream), non-energy chemical facilities emitting > 10 000 MtCO ₂ -eq annually
Allocation	EPA and Secretary of Commerce to set allocation and determine auction/gratis split	53% free, 24% auctioned, the rest will be reserved to certain sectors and projects	President assigns authority to develop allocation plan, decide on gratis/auction split	Undetermined allocation. Any allowances not allocated should be given to non-covered entities	Auction: 2011: 15% auction, remainder is gratis; 2012-2031: additional 3% per year auctioned; 2031-2036: an additional 5% per year	Auctions 24% of allowances initially, increasing to 73% by 2035 with phase-out of free allocations 20% of auction proceeds reserved for low-income consumers.

					is auctioned; 2036 and thereafter: 100 auctioned	
	Lieberman – McCain	Bingaman – Specter	Kerry – Snowe	Sanders - Boxer	Feinstein – Carper	Lieberman - Warner
Offsets	30% limit on how many allowances can be purchased from the international markets and domestic farm, forest and other offsets. Farmers and foresters can earn credits to sell through sequestration EPA to grant allowances generated from project activities in developing countries	Secretary of Energy promulgates regulations	Secretary of Agriculture promulgates regulations establishing programmes to grant allowances for biological sequestration	Secretary of Agriculture promulgates regulations establishing programmes to grant allowances for biological sequestration Renewable energy credit program No international offset provisions	No limit on the amount of credits that can be earned from the agricultural and forest sectors EPA promulgates regulations establishing programmes to certify GHG offsets and to permit international GHG credits, from CDM or JI projects	15% of GHG limit
	Lieberman – McCain	Bingaman – Specter	Kerry – Snowe	Sanders - Boxer	Feinstein – Carper	Lieberman - Warner
Banking, borrowing and cost control measures	Borrowing up to 5 years for up to 25% of the obligation, with an interest rate of 10%	Safety valve of USD 12 per tonne of CO ₂ in 2012, rising by 5% per year over inflation. The proceeds, if any, will go to an “Energy Technology Deployment Fund”	Not specified	The yearly decline of the target may be stopped for up to three years if the carbon price exceeds the so-called “technology-indexed stop price”.		Unlimited banking of allowances Borrowing up to 15% of total allowances up to 5 years at a default interest rate A carbon-market efficiency board may temporarily facilitate borrowing.
	Lieberman – McCain	Bingaman – Specter	Kerry – Snowe	Sanders - Boxer	Feinstein – Carper	Lieberman - Warner
Other features	Non-compliance penalties Proceeds from auctions used for transition	Tariffs on goods from high-emitting countries Non-compliance penalties	Non-compliance penalties National renewable energy quotas of 20%	Non-compliance penalties National renewable energy quotas and	Non-compliance penalties Established an independent scientific	Proceeds from auctions used for technology (55%), energy assistance to low-income (20%),

	assistance, habitat restoration, and technology R&D The bill calls for a Five-Year Review Process in light of efforts by US' major trade partners		by 2020 Climate Reinvestment Fund: proceeds from auctions, civil penalties,	energy efficiency goals with credit trading programmes	panel to make recommendations to the EPA every four years on the reduction rate required May allow borrowing and 1 for 1 repayment plus interest	adaptation and wildlife (20%), worker training (5%)
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Sources: Resources for the Future, 2007; Larson, 2007; Paltsev et al., 2007

Notes:

(1) The term 'technology indexed stop price' means a price per tonne of global warming pollution emissions determined annually by the Administrator that is not less than the technology-specific average cost of preventing the emission of one tonne of global warming pollutants through commercial deployment of any available zero-carbon or low-carbon technologies.

<http://www.usclimatenetwork.org/federal/110th-legislation/Global%20Warming%20Pollution%20Reduction%20Act%20%28Sanders-Boxer%29.pdf>