# Developing the International Carbon Market. Linking Options for the EU ETS

Report to the Policy Planning Staff
in the Federal Foreign Office

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## Executive Summary

Following the start of the European Union Emissions Trading System (EU ETS) in 2005, **mandatory emissions trading systems (ETS) are mushrooming around the world**, both on the national and regional level (i. a. in the United States, New Zealand, Australia, Canada, and Japan). The creation of a **global carbon market is gaining** more and more **momentum**.

Emissions trading will be an important element of an international accord on climate change. Therefore, further steps are needed to prepare for the creation of an international post-2012 carbon market to establish an **ecologically and economically robust global system**. Several options for developing such an international carbon market are discussed in this report.

**Formal linking of regional ETS** may present a "bottom-up" alternative to constructing a global carbon market, supporting and complementing the comprehensive approach within UNFCCC negotiations. By discussing key design elements of proposals for emerging emission trading system**,** this report shows that **harmonization of certain key provisions and ETS design parameters should improve international carbon market performance** in any of the carbon market scenarios outlined in the analyses. **"No-regret options"** for design harmonization such as registries, monitoring, verification and reporting (MRV) guidelines, and the treatment of credits and allocation procedures can be subject to **increased communication between different emission trading systems**. The development of **best-practice standards on critical design features** is helpful to facilitate linking of ETS and to reduce costs and harmonization efforts.

The recently established **International Carbon Action Partnership (ICAP)** is an appropriate platform for such an exchange. A strategic work program for ICAP in order to address the "no-regret options" can help accelerating the development of a global carbon market. As linking may reduce the control of regulators over an ETS, **coordination of market regulation** will be necessary in a common carbon market. Therefore, functional requirements of linking agreements or a joint regulatory body like an **international clearinghouse** are discussed to enable common regulation of a system of linked trading systems. In a global trading approach, this role can be fulfilled by the UNFCCC secretariat. In a "bottom-up", gradual linking scenario, **ICAP could be the nucleus for such an international clearinghouse.**

Finally, the report identifies certain **criteria for assessing the desirability of linking systems**. Above all, partner systems should display a **comparable level of ambition**, mainly determined by a region's overall climate policy target (such as the EU 2° C goal) and the burden-sharing rule translating into mandatory caps. In case of different levels of ambition, conflicts on appropriate emission caps and other design features of ETS that affect their economic and environmental efficiency may arise. Still,

cooperation at an early stage on critical ETS design features even with schemes on a lower level of ambition is an option to persuade such systems to assume more stringent targets. On the basis of a qualitative assessment of regional abatement costs and a comparison of the existing and proposed design for a number of ETS, the analysis develops **key criteria** how to select preferable **linking partners** for the EU ETS.

# 1. Introduction

The problem of climate change requires a comprehensive response by the international community. There is need for a Global Deal addressing a wide range of issues, including reduction of emissions, fostering low-carbon technology research and development, reducing deforestation, and implementing adaptation policies where required. These issues are currently negotiated in the UNFCCC framework, with the objective of signing an international climate policy accord at the 2009 Conference of Parties at Copenhagen.

Emission trading is considered an important market-based instrument to control emissions and is an essential element of the 1997 Kyoto Protocol. The EU Emissions Trading System (EU ETS) is the largest existing cap-and-trade system in the world and commenced operations in 2005. It covers about 2Gt of $CO_2$ emissions at more than 10,000 installations across the 27 EU member states. Following the EU ETS, an increasing number of world regions are currently introducing cap-and-trade systems that establish a price for greenhouse gas emissions. These include New Zealand, Australia, the Regional Greenhouse Gas Initiative (RGGI) of ten US-States in northeastern USA, California, the Western Climate Initiative (eight US-State and two Canadian Provinces), and the Midwestern Regional Greenhouse Gas Reduction Accord (nine US-States and one Canadian Province). In Japan, the cities of Tokyo and Hiroshima as well as the Kyoto prefecture intend to introduce mandatory emissions trading systems (Point Carbon, 2008). This development is underlined by the establishment of the International Carbon Action Partnership (ICAP)[1] by several EU member states, the European Commission, California and other WCI members, several RGGI member states, New Zealand, and Japan (as an observer). ICAP sets up an expert forum to support the implementation and linking of emissions trading systems (ETS).

Emission trading is expected to constitute a building block of any post-2012 international climate policy. This report devises four different carbon market scenarios that could emerge as part of a future climate policy regime. First, a global trading architecture agreed upon in a Global Deal would build on the Kyoto approach by establishing reduction targets for major emitters and envisage emissions trading at the governmental level. Trading activity can be devolved to the private sector through the establishment and subsequent linking of domestic ETS. Second, if no global trading system is implemented, emerging regional carbon markets may be formally linked to each other, with the EU ETS as the potential nucleus of a global carbon market that is established in the mid- to long-term. Third, in absence of a top-down emissions trading architecture or formal links among regional ETS, indirect linkages occur if different ETS accept certificates from the same credit-generating mechanisms like CDM or JI. While transaction costs of establishing such indirect linkages are low,

[1] See http://www.icapcarbonaction.com

emission price equalization is not guaranteed, and this approach entails no perspective for creating an efficient integrated global market. Finally, Global Deal negotiations may result in a mixed approach comprising elements of these three stylized options: a comprehensive trading system could be established in 2013 that is open to the inclusion of other economies or domestic emissions trading systems that may join at later dates.

While the general implications of a global trading structure are well-known, the other three options are less well explored. In this report, we focus on the option of formally linking domestic ETS because it offers an alternative route towards a global carbon market. In the mid- to long-term, a comprehensive carbon market is desirable because it allows to control global emissions at least cost. This report builds on a previous study (Edenhofer et al, 2007) which found that from an economic perspective, formal linking should reduce the costs of climate policy, enhance carbon market liquidity and eliminate international distortions of competition due to different carbon prices. An international clearinghouse was proposed to coordinate market linkages, and harmonization requirements with regard to ETS design features were identified.

This report extends the scope of analysis as follows. In Chapter two, different carbon market scenarios are identified, and the relation of the global trading and formal linking options within international climate policy negotiations is briefly analyzed. Chapter three compares critical design features of the EU ETS and the four emerging schemes of RGGI, New Zealand, California and Australia as they are presented in specific proposal documents for these schemes. A qualitative assessment of regional abatement costs provides a tentative indication of the relative level of ambition of these ETS. Then, linking the EU ETS to other systems is discussed in general terms, concluding that environmentally ambitious ETS should preferably link to systems with similar levels of ambition. Building on these considerations the prospect of linking the EU ETS to the four proposed systems is briefly assessed, concluding that some obstacles may exist for linking the EU ETS to some of them in their proposed form. Finally, functional requirements of an international clearinghouse regulating a common carbon market that is created by linking are discussed. Chapter four identifies working program options for ICAP given the uncertainty on the structure of future carbon markets, proposing 'no-regret' working program options that would need to be addressed in any scenario. In addition, future institutional affiliation options of ICAP under different carbon market scenarios are discussed. Chapter five concludes with a summary and outlook.

The Annexes contain the underlying analysis informing this report. They comprise a systematic discussion of crucial design issues for linking (Annex I), summaries of proposals for the analyzed ETS (Annexes II and III), and a qualitative assessment of expected abatement costs in the respective regions (Annex IV).

# 2. Options for constructing an international carbon market

This chapter sets the stage for the remainder of the report by distinguishing four options for constructing an international carbon market. While Section 2.1 provides a definition of the four scenarios[2], Section 2.2 briefly discusses the relation of two of these options within international climate policy negotiations from a European Union point of view.

## 2.1 Four scenarios

***1. Global trading***

A global emissions trading system building on the Kyoto approach can be established from the top-down as follows: an international treaty establishes national emission targets for all Annex-I (and possible other) countries for specified periods post-2012. Parties to the treaty receive emission allowances representing the amount they are allowed to emit. These allowances can then be traded among parties to the agreement. From an economic point of view a global trading system is a first-best policy instrument that will ensure that the costs of achieving given reduction targets are minimized.

Within this overarching framework, governments can devolve responsibility for allowance trading to the private sector by establishing domestic ETS and linking[3] these to the domestic ETS of other regions. Thus governments will only have to engage in international emissions trading on behalf of sectors that are not covered under a linked domestic ETS. By implementing its EU ETS where companies trade allowances across country borders, the European Union has demonstrated the feasibility of this approach.

Developing countries that do not participate in the global cap-and-trade mechanism can implement credit schemes, e.g. by implementing new approaches or continuing the current CDM. Options for new mechanisms include (no lose) economy-wide and sectoral intensity targets that generate credits for sale if emission intensity is reduced below a certain threshold (see Schmidt et al, 2006), or programmatic CDM (Winkler et al, 2002). The credits generated in such programs can be sold into the emerging international carbon market.

[2] The option of linking domestic ETS to international *sectoral* ETS is not discussed. Also, harmonized emission taxes are often advocated to establish an international price for emissions (e.g. Stiglitz, 2006) but are not further discussed here.

[3] The term "linking" is defined as mutual or unilateral recognition of allowances or credits in different ETS or credit systems.

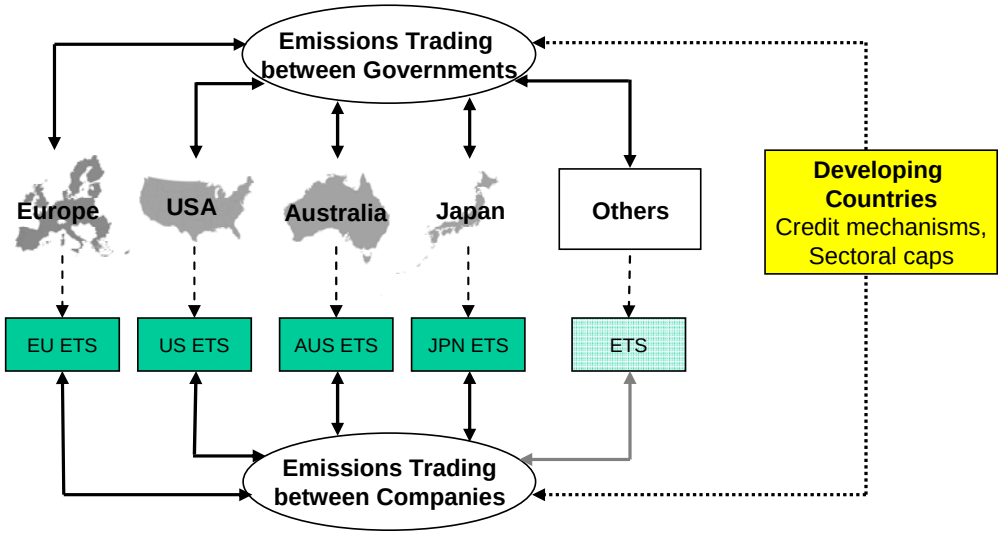


*Figure 1: Global cap-and-trade approach. Governments devolve emissions trading activity to companies by implementing and linking domestic ETS. Developing countries participate through credit schemes.*

### *2. Formal linking of domestic ETS*

If post-2012 negotiations within the UNFCCC do not lead to a global cap-and-trade consensus, nations and regions can establish domestic carbon markets and link these, thus constructing an international carbon market bottom-up (e.g. Tangen and Hasselknippe, 2005; Browne, 2004; Victor, 2007; Pizer, 2007). A major advantage of this approach is that if no agreement on a global trading system is achieved within UNFCCC negotiations by 2009, linking offers an opportunity to keep and build political momentum for constructing a global carbon market in the mid- to long term. In principle, linking regional trading systems will enhance the efficiency of reduction efforts, increase liquidity of carbon markets, and reduce competitiveness concerns that could arise from different allowance price levels across systems (Edenhofer et al, 2007). Unlike the global trading approach, however, the linking of regional trading systems does not allow controlling global emissions.

Most of the issues arising when negotiating a global trading system remain important when linking bottom-up (e.g. defining a global policy target, and agreeing on burden-sharing rules). However, these issue are negotiated only between the linking partners. Again, developing countries can participate in international emissions trading through credit schemes.

As a special case, ETS may enable unilateral (one-way) linking: an ETS A would allow the use of allowances from another scheme B for compliance, but not vice versa. If the allowance price in A is lower than in B, no trading occurs. If the price in

A is higher, firms in A buy allowances from B until the prices of the systems converge.

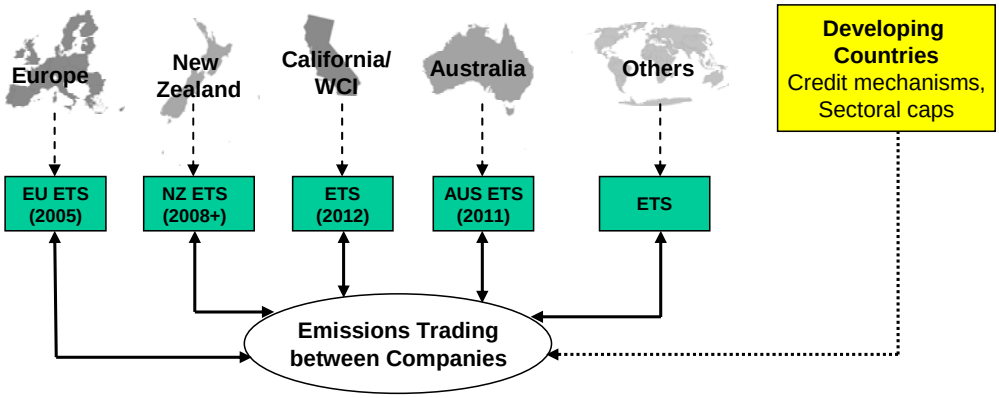


*Figure 2: Formal linking of regional ETS.*

This report focuses on the formal linking approach for three reasons. First, the global trading scenario is already well-explored in economics. Second, a global trading system may not be agreed upon in political negotiations and therefore a fallback option for developing the international carbon market should be available. Third, unlike the approach of indirect linking discussed in the next section, unrestricted formal linking of ETS guarantees that allowance prices are equalized across systems, thus increasing efficiency of climate policy. In addition, subsequent linking of ETS can create momentum for the bottom-up implementation a global carbon market that is considered a first best policy instrument even if it cannot be implemented top-down by 2013.

### *3. Indirect linking*

Even if there is no agreement on formally linking regional emissions trading schemes, there will still be indirect linkages if national and regional domestic ETS accept credits from the same credit schemes like CDM (see e.g. Egenhofer, 2007; Jaffe and Stavins, 2007). In this case, trading systems are not formally linked as they do not accept each other's allowances for compliance. Instead, companies from different domestic ETS demand credits on the respective world markets that are voluntarily generated in crediting mechanisms as outlined above.

There will be some convergence in ETS price levels due to indirect linking. The levels of price convergence will depend on the supply curve of credits, import restrictions for credits, marginal abatements cost (MAC) curves and cap levels in the regional ETS.

An example will illustrate the process of price convergence due to indirect linking: if an ETS A with a very high price level (e.g. due to a stringent cap and/or a steep MAC curve) enters the CDM market, it will be willing to pay more for credits on the international primary or secondary markets than another ETS B with a lower allowance price that is an incumbent player on the CDM market. Indirect linking, that is, buying of credits will lower the allowance price in A, increase the international market price of credits, and drive upwards allowance prices in ETS B.

However, this mechanism cannot guarantee that allowance prices across domestic ETS are completely equalized. More specifically, the degree of convergence of ETS allowance prices should be higher, the larger the available amount of credits and the less restrictive the limits for the import of credits into the ETS.

In the indirect linking scenario all ETS that enable the use of a certain credit type need to agree on its design features. This particularly concerns monitoring and verification and the additionality requirements that ensure emission reductions take solely place due to the financing obtained from the credit scheme.

However, even if an ETS A does not accept credits from a specific scheme X while an ETS B accepts these, and both ETS accept credits from other crediting schemes (Y, Z), there will be an impact of ETS B's acceptance of X on allowance prices in ETS A: depending on precise market constellations, availability of credits from scheme X in ETS B can reduce Bs demand for credits from Y, Z. This can lower their price, which may lead to an increasing inflow into ETS A, decreasing allowances prices therein.

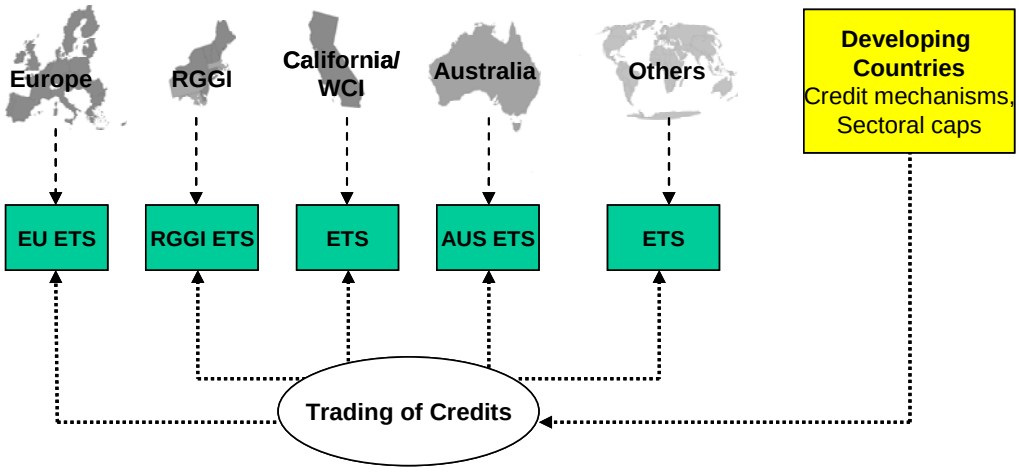


*Figure 3: Indirect linking of domestic ETS through common acceptance of credits.*

While a major advantage of the indirect linking approach is that it requires little coordination across different ETS and is thus easy to implement, it does not hold the promise of developing an efficient global carbon market like formally linking ETS.

Also, there is no guarantee that allowance prices are equalized across systems. Therefore, although understanding the level of price convergence across systems due to indirect linking represents an interesting field for further research, this report focuses on the formal linking approach.

***4. Mixed approach***

Finally, mixed approach is conceivable containing elements of each of the stylized three approaches outlined above. If, for example, UNFCCC negotiations evolve towards agreement on a multilateral climate policy architecture by 2009, but not all major emitters are willing to join a global cap-and-trade system immediately, the treaty may comprise a provision that enables reluctant countries or possibly sub-national regions to join this scheme later. It is conceivable that the acceding regions would join the international trading system with their full economy or with some sectors only – that is, only their domestic ETS may be integrated into the global trading structure. It is also conceivable that developing countries gradually join such a trading system with specific sectors only, e.g. starting with the electricity sector. Figure 4 illustrates the basic structure of such a mixed approach.

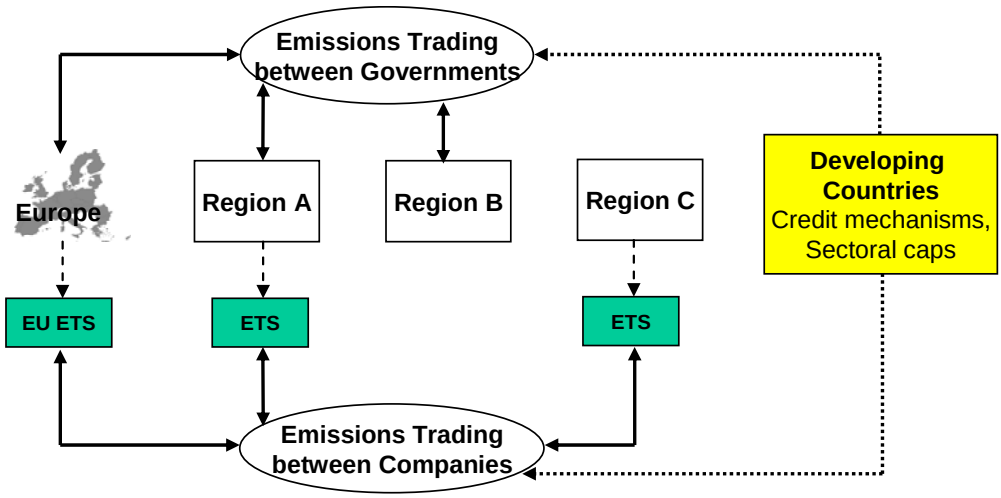


*Figure 4: Structure of a mixed approach.*

## 2.2 Formal linking as an element of EU post-2012 negotiation strategy

This section briefly discusses the relation of the global trading and formal linking approaches within negotiations for a climate policy agreement up to 2009, focusing on the position of the European Union.

Given its 2°C target and the currently uncertain situation in international climate policy negotiations (Grubb, 2008; Ott et al, 2008), for the EU the question arises which strategy for the development of a global carbon market it should pursue in the negotiations on a post-2012 treaty. It seems that currently the EU employs a mixed approach, where on the one hand a global cap-and-trade approach is embraced, while on the other hand the opportunity of building a global carbon market bottom-up by linking emerging emissions trading systems to the EU ETS is emphasized. Is this a sensible approach?

Given the reluctance of major players to adopt binding and tradable emission budgets, supporting the development of regional ETS e.g. in the US by fostering cooperation with such initiatives in the context of ICAP appears to be a strategy that is supportive to the global trading approach: bottom-up implementation of emissions trading systems will advance the understanding and acceptance of the concept of emissions trading, thus building support for a global trading approach. Setting regional and national emission caps for a domestic ETS reduces the barriers to accepting such caps in the context of an international agreement.

In addition to these considerations, even if global trading represents the best way forward to achieve the EU's 2°C target as it enables global control of emissions, a second best fallback option is required if no agreement on such a comprehensive approach can be reached.

Thus it appears to be rational from a European Union point of view to prepare the formal linking of domestic ETS within ICAP, while negotiating for a global trading agreement within UNFCCC. However, care should be taken that emphasizing the opportunities of the formal linking approach does not reduce the chances of striking a more encompassing deal on global emissions trading, which should be superior to a formal linking approach as regards overall efficiency and levels of emission reductions.

# 3. Linking emerging systems to the EU ETS

The previous chapter showed that there are several ways forward for international emissions trading. While global trading is a first best approach from an economic point of view, it may be politically difficult to implement. Indirect linking of regional ETS occurs if these accept the same credits e.g. from CDM. This will lead to some convergence in allowance prices across systems, thus enhancing the efficiency of the overall reduction effort. However, price equalization is not guaranteed, and indirect linking does not lead to the development of an encompassing and efficient international carbon market. Therefore, this chapter will explore the opportunity of formally linking emerging emissions trading systems to the EU ETS.

While the EU ETS has been operating since 2005, a number of ETS are currently being implemented and designed in other world regions. To which of these systems should the EU ETS preferably link to, and what are the criteria for such an assessment? Based on the overarching climate policy target of the European Union, the fundamental criterion guiding the analysis in this chapter is whether formal linkages will contribute to achieving the EU's target of limiting global warming to 2°C above pre-industrial levels in an economically efficient manner.

The environmental and economic outcome of an ETS or a system of linked ÉTS will crucially depend on its design features. Therefore, Section 3.1 compares the design features relevant for linking in five existing and emerging ETS.[4] In order to enrich the analysis of the level of ambition of these trading systems, Section 3.2 provides a qualitative analysis of expected abatement costs in these systems. In more general terms, Section 3.3 analyzes which kind of systems the EU ETS should preferably link to given the climate policy goals of the EU. Building on these findings, a brief assessment of the prospect for linking the EU ETS to emerging schemes is provided in Section 3.4. Finally, we argue that a system of linked ETS requires coordinated regulation of the common carbon market that can be achieved by an International Clearinghouse. Section 3.5 discusses issues that require some regulatory coordination.

## 3.1 Comparison of emerging ETS

In order to ensure that a system of formally linked ETS will deliver the environmental and economic outcome envisaged by policymakers, e.g. ambitious emission reductions at low cost, it needs to be designed accordingly. As the design of a combined market will result from the combination and interplay of the features of participating systems, this section compares and analyzes the design feature of the

[4]The analysis of the emerging systems builds on a number of particular government or expert commission documents, and does not take into account any other developments or discussions that may have occurred in these regions since the publication of these studies. They include NZ MfE (2007) for New Zealand, MAC (2007) for California, and Australian Government (2007) for Australia.

ETS considered in this report.[5] The analysis is guided by the criteria of environmental and economic outcome as well as institutional and technical compatibility.[6] Before comparing the outlines of the five ETS, a brief overview on their current status is given.

***Status of ETS***

The *EU ETS* is the largest existing cap-and-trade system in the world and commenced operations in 2005. It covers about 2Gt of $CO_2$ emissions at more than 10,000 installations across the 27 EU member states. The *Regional Greenhouse Gas Initiative (RGGI)* consists of ten northeastern US states that plan to introduce a regional cap-and trade scheme for power plants exceeding 25MW thermal capacity by 1 January 2009. The participating states are currently adopting legislature to introduce the scheme. In *New Zealand*, a government framework paper communicating in principle-decisions of the government on core design features of a NZ ETS was released in September 2007 by the Ministry for the Environment and the Treasury (NZ MfE, 2007). Starting in 2008, the framework paper foresees a stepwise inclusion of all sectors of the economy and all relevant greenhouse gases into a national ETS until 2013. In *California* a Market Advisory Committee has proposed a plan for a statewide cap-and-trade system that is scheduled to start in 2012 (MAC, 2007). California is also part of the Western Climate Initiative (WCI) that intends to propose a joint regional ETS by August 2008[7]. In *Australia* a Prime Ministerial Task Group on emission trading released a report in June 2007 proposing a national emission trading scheme for Australia starting by 2011 (Australian Government, 2007).

***Compatibility***

This subsection compares the design of the analyzed proposals with regard to key issues when linking. The discussion starts with issues considered fundamental to linking and proceeds to less crucial topics. It concludes with a table summarizing compatibility and relevant differences of emerging ETS and the EU ETS.

*Level of the cap*

The level of the cap is of crucial importance when linking ETS for three reasons: First, policymakers will want to avoid that other ETS relax their cap to create additional revenue (Helm, 2003; Rehdanz and Tol, 2005). Second, the overall cap of an international carbon market should correspond to the overarching climate policy goal of the EU. Finally, ETS with more ambitious climate policy goals will want to persuade regions with less stringent targets to adopt their tighter goals. Therefore, they will be reluctant to link unless cap levels are in line with some accepted burden-sharing rule. In general, cap-levels are a key determinant of allowance prices, the size

[5] For a more detailed description of these ETS, see Annex II.
[6] For a more detailed conceptual analysis of the interplay of certain design features when linking, see Annex I.
[7] See http://www.westernclimateinitiative.org

of efficiency gains from linking, and distributional effects from linking. Linking ETS of regions that share a common understanding of the overall climate policy target and international burden-sharing rules will facilitate linking, as caps can be derived from such common overarching targets. Sections 3.2 and 3.3 further analyze the role of caps when linking ETS.

Except RGGI no ETS discussed for this report has defined specific mid- to long-term caps. Therefore, we use the general emission reduction targets of the regions as a proxy for expected cap levels. Against the background of its 2°C target, the European Union climate strategy aims at reducing EU emissions by at least 20% below 1990 levels in 2020 (or 30% if other major emitters join the EU's effort) and 60-80% in 2050 (European Council, 2007). This implies a reduction of emissions by 25% to 35% below the BAU case by 2020 (own calculations based on EC, 2006a). RGGI will commence operations in 2009 with a cap roughly 5% above 2004 levels, which will remain constant until 2015. In the period 2015-19, this cap will be reduced by 2.5% per year, which should result in reduction of a little less than 20% compared to the business-as-usual scenario (RGGI, 2006). New Zealand's government has set out the ambitious target to achieve carbon neutrality in electricity generation by 2025, in stationary energy by 2030, and in transport by 2040 (New Zealand Government, 2007). California's declared goal is to reduce its GHG emissions to year 2000 levels by 2010, to year 1990 levels by 2020 and to 80% below 1990 levels by 2050 (MAC, 2007). These reduction goals correspond to a 40% reduction of emissions below BAU forecasts by 2020. The Australian government has committed itself to stabilizing $CO_2$ emissions in the period 2008-12 at levels 8% above the 1990 baseline year emissions. Under the assumption that the envisaged cap for 2012 will be maintained until 2020, the announced target translates into a 19% reduction below the BAU case.

When using the reductions below calculated BAU emissions in 2020 as assessment criterion for relative stringency, RGGI and Australia's reduction level is slightly smaller than the EU's. Compared to the EU, California's targets are comparable or more ambitioned, and New Zealand's target to become carbon neutral by 2040 represents a very aspiring goal (for a schematic overview, see also Figure 5 in the following section).

It is worth noting that New Zealand considers the introduction of a 'progressive unit obligation' in the starting phase of its NZ ETS, meaning that due to competitive and distributive concerns regulated installations would have to cover only a certain fraction of their emissions under the ETS: For example, with a 50 per cent obligation, one allowance or credit would entitle them to emit two tonnes of GHG emissions. In effect, this modifies the nominal cap of the system as well as its unit of measurement: overall, more emissions would be allowed than suggested by the nominal cap and one NZ ETS allowance would represent emissions of more than 1t $CO_{2eq}$. This appears problematic with regard to linking to other ETS: an exchange rate would need to be introduced and the overall cap of an NZ ETS would require re-estimation.

*Linking Kyoto-parties and non-parties*

Linking Kyoto-parties and non-parties prior to 2012 represents a problem: in the ETS of Kyoto regions, allowances correspond to AAUs (e.g., a EUA in the EU ETS corresponds to one AAU). Transferring EUAs across national borders implies a corresponding transfer of AAUs across national registries. However, Kyoto non-parties cannot issue AAUs, and allowances in their ETS do not correspond to AAUs. Therefore, linking Kyoto parties and non-parties prior to 2012 faces severe problems (see Annex I for more details and the one-sided gateway solution). In particular, linking the EU ETS to RGGI and California before 2012 would be problematic as net allowance inflow into the EU ETS needs to be zero (RGGI and California allowances are not valid under the Kyoto Protocol). Linking the EU ETS to the NZ ETS and an Australian ETS would not represent a problem in this regard.

*Price cap*

The report on the Australian ETS proposes a price cap to avoid high allowance prices by introducing a low penalty fee for non-compliance. When linking, such a price cap applies to all linked systems due to arbitrage trading. The RGGI scheme features a two-stage safety valve arrangement, triggered when the allowance price exceeds 7 or 10 US-$ (adjusted by an index), respectively. When the $7 trigger is reached, an installation may cover up to 5% of its emissions through CDM or JI credits. When the second safety valve trigger is reached, the given compliance period may be extended by one year, i.e. for a maximum compliance period of 4 years. In addition, credits and allowances from international trading programs (most likely CDM, JI, EU ETS) may be used. Also, the percentage of usable credits per installation increases to 10% (RGGI, 2006). While the NZ government does not plan to introduce a price cap in the short-term, it is proposed that if there is no post-2012 international climate policy agreement the government should consider introducing a price cap to avoid excessive burden on New Zealand's economy. EU officials have repeatedly stated that the EU rejects a price cap, as it would undermine the environmental integrity of a cap-and-trade system. The Californian proposal adopts the same position. In general, a price cap as foreseen by the Australian system represents the most obvious barrier to linking.

*Registries*

Registries of ETS should be compatible in order to enable the transfer or allowances across linked systems. While this study does not assess the technical compatibility of the EU Community Independent Transaction Log (CITL) and registries to be developed for emerging ETS, it should be possible to achieve technical compatibility of registry software given the political willingness to do so.

*Monitoring, Reporting and Verification (MRV)*

MRV standards are important for the integrity of an emissions trading scheme in order to avoid emissions exceeding the defined cap level as well as later corrections arising from measurement errors or irregularities. They should at least be comparable across

emerging schemes. Only the EU ETS and RGGI have developed detailed MRV procedures so far. An in-depth comparison of the MRV provisions of the EU ETS and RGGI is beyond the scope of this report.

*Penalty system*

Concerning the penalty system, the EU ETS requires issuing the amount of non-delivered allowances at a later date and in addition payment of a fine (€100 per tonne in the EU ETS). This should ensure compliance and decouple the allowance price and penalty fee. The same regulation applies in the NZ ETS (penalty fine NZ$ 30 per missing allowance). In addition, the make-up amount can be raised to a ratio of 2:1 if a participant knowingly does not meet the obligation (with the penalty rising to NZ$ 60). In RGGI, three times the non-delivered allowances are deducted from an installation account at the next compliance date, which should also suffice to ensure integrity. The proposal for a California ETS highlights the approach applied by the RGGI system. The Australian report aims at introducing a price cap by introducing a low penalty fee for non-compliance, without requiring a later issuance of non-delivered allowances.

*Compliance Enforcement*

Concerning enforcement of compliance, in the EU ETS member states are responsible for compliance and have introduced a variety of penalties for non-compliance ranging from fines to imprisonment (EEA, 2007). No major breaches of compliance undermining the overall integrity of the scheme have been reported. In the RGGI scheme, compliance enforcement rests with the implementing state authorities. The NZ system and the Californian proposal states that civil and criminal penalties shall be established for intentional violations of program requirements. The Australian report does not address this issue.

*Credits and AAUs*

Next to the setting of the cap, the decision on the acceptance and import limits for *credits*[8] *and AAUs*[9] critically influences the price level of an ETS and thus the amount of domestic emissions reductions. Concerning problems with regard to the acceptability of credit types or allowances, the following applies: if an ETS A does not accept certain types of credits because it e.g. refuses the underlying additionality concept (e.g. the EU does not accept credits from LULUCF measures, or nuclear power), but a linked system B does so, these credits still become available indirectly in A because their use in B sets domestic allowances in B free for sale. This issue may become relevant for several reasons. First, California, RGGI and Australia intend to introduce domestic credit systems, and New Zealand discusses the possibility to do

[8] We use the term credits (often also referred to as offsets) to distinguish them from allowances: credits are generated in credit schemes such as CDM and JI, while allowances are issued in cap-and-trade schemes.

[9] AAUs – Assigned Amount Units are issued to parties to the Kyoto Protocol, representing their emission allowances in the international Kyoto cap-and-trade system.

so.[10] The project types they will establish would thus need to be recognized by linking partners as they will be available indirectly. Second, a limit on the import of credits is sometimes introduced in the context of supplementarity, that is, import quotas for credits shall ensure a certain amount of domestic abatement. The EU in its second trading period will employ an overall import limit of 13.4%[11] of the overall EU cap for CDM and JI credits. RGGI does not allow the import of credits unless the safety valve is activated (see above). The majority of the Californian Market Advisory Board recommends allowing the unlimited import of credits from other regions and from a domestic credit system, while some members favour restrictions on credit imports from certain regions. No restrictions on imports are suggested by the Australian PM Task Group.

Third, apart from credits from CDM and JI, the NZ ETS intends to allow unrestricted use of AAUs for compliance. While AAUs are no credits, the permission to allow these for compliance has similar implications as the inclusion of credits: by using AAUs, allowances (NZUs) are set free that can be sold to a linked system. The EU ETS prohibits use of AAUs to preclude the inflow of low-cost ‚hot air' AAUs that could lead to a collapse of EUA prices. Therefore, linking the NZ ETS and EU ETS could be problematic as AAUs would indirectly become available in the EU ETS. If AAUs were available at a lower price than EUAs, participants under the NZ ETS could sell NZUs to the EU ETS and use purchased AAUs for domestic compliance instead.[12]

*Unit of measurement*

Concerning the *unit of measurement*, all systems but RGGI apply metric tonnes of $CO_2$ equivalents ($CO_2$-eq). RGGI uses short tons $CO_2$eq (1 short ton equals 0.907 metric tonnes). Therefore, if RGGI was linked to one of the other schemes, an exchange rate would have to be applied, introducing the problem of how to treat decimal numbers and residuals in the registries. Also, it should be assured that a consistent method is chosen for calculating the Global Warming Potential (GWP) of non-$CO_2$ greenhouse gases, e.g. the latest IPCC methodology.

*Banking*

Banking refers to the possibility of using allowances from earlier trading periods in later periods. If one system allows banking, this option will also be available to a linked ETS even if it does not allow banking. Except the Australian scheme, all of the ETS considered here envisage unrestricted banking. The EU ETS did effectively not allow banking from the overallocated first to the second trading period in order to avoid the carry-over of "hot air" into later trading periods. The Australian PM Task

[10] Domestic credit systems can address sectors of an economy that are not covered by the cap-and-trade system. The underlying idea and mechanism is similar to the CDM.

[11] This figure is derived from own calculations using the data provided in EU (2007). The 13,4% are the weighted average of national import quotas.

[12] Arbitrage trading would be possible maximally up to the amount of issued NZU, i.e. in the order of magnitude of less than ~98Mt $CO_{2eq}$.

Group recommends considering limits to or prohibition of banking in early trading periods especially if a price cap is introduced, in order to avoid 'warehousing' of allowances that are acquired through the price cap in order to be used later, when the price cap is eliminated. In absence of a price cap, banking is recommended for an Australian ETS.

*Borrowing*

Borrowing means that companies can use future allocations for their compliance. There can be two problems to borrowing between trading periods: first, the possibility to lend on future allocations to individual companies means that full auctioning cannot be introduced. Second, if companies borrow heavily this will lead to considerable reduction burdens in future periods. In face of such costly obligations for companies there will be pressure on governments to relax caps in order to reduce economic impacts on companies. In effect, therefore, inter-period borrowing could comprise the environmental integrity of an ETS. However, none of the ETS proposals considered here envisages borrowing from future trading periods.

*Allocation method*

While the method of allocation bears significant implications for its distributive and environmental effects (Grubb and Neuhoff, 2006), there should be no major implications when it comes to linking. This is because the impacts of different allocation mechanisms across systems will equally occur both in absence and presence of linking. Only in the sense that linking will change allowance prices of ETS, there can be distributive effects that depend on the method of allocation: In case of grandfathering or benchmarking, sellers in a high-price ETS and buyers in a low-price ETS lose, while buyers in a high-price ETS and sellers in a low-price win. In case of updating (allocations based on emissions in trading periods), existing incentives for companies to increase their emissions in order to benefit from larger allocations in subsequent periods can be intensified. If the ETS use (full) auctioning, there will be distributive effects among the authorities that receive the revenue from the auction: the authority in the ETS with a lower pre-linking price will receive more revenue, while the authority in the high price region will receive less. The distributional impacts of the price changes on firms inter alia depend on their ability to pass on allowance costs and the recycling of revenues from the auction.

*Point of regulation*

Regarding the point of regulation, one has to avoid that products are either covered twice or not at all by an ETS. This can occur when two systems regulate a product at different stages in the process chain while the respective products are traded between different systems. For example, if there are no provisions to avoid such effects, upstream treatment of transportation fuel in system A and downstream treatment in system B would lead to pricing the $CO_2$ content of the fuel twice in case of trade from the upstream to the downstream system, and no pricing at all if trade occurs in the other direction. However, excluding the exports of products regulated upstream in one

region to a downstream one would avoid this problem. Vice versa, products covered downstream in one region but upstream in another would have to be excluded from ETS coverage in one of the two systems. In general it should be possible to avoid double or zero counting even if points of regulation differ. California, New Zealand and Australia may introduce upstream regulation for the transport sector and possibly other fossil fuels. In fact, this issue needs to be addressed even without linking to avoid the exclusion of emissions or penalizing exporting companies. The harmonization of points of the points of regulation would avoid this issue altogether.

*Sectoral coverage*

Sectoral coverage is an important aspect when designing an ETS as it will impact the international competitiveness of affected companies as well as the availability of low-cost mitigation options. However, in general this issue arises irrespectively of whether schemes are linked or not. Linking can affect distributional effects resulting from differences in coverage across ETS only to the extent that it will likely alter the allowance price: rising (falling) allowance prices will pronounce (reduce) existing adverse competitiveness impacts. Therefore, from the point of view of linking only there is no imperative to harmonize the sectoral coverage between ETS. The exception to this rule may be the inclusion of land-use-change into a domestic ETS, as planned in the NZ ETS. Before linking to the NZ ETS, it would need to be assessed whether the design of the deforestation coverage (e.g., MRV rules) is acceptable to other linking partners.

*Trading and compliance periods*

Differences in trading and compliance periods do not present a major problem. Differing trading and compliance periods will increase the complexity of the overall system in terms of the existence of different relevant dates (e.g. compliance dates, start or end dates of trading period) in the operation of the interlinked systems, but does not undermine overall market functioning. Financial products will be available that will establish forward prices for allowances taking into account the relevant dates in the linked ETS system.

Table 1 provides an overview of the compatibility and barriers to linking emerging schemes and the EU ETS.

| | EU | RGGI | New Zealand* | California* | Australia* |
|---|---|---|---|---|---|
| **Emission target** | Depending on international agreement – ambitious | Not very ambitious | Potential use of 'progressive compliance obligation' | To be decided | To be decided |
| **Kyoto status** | Ratified | No linking before 2013, or gateway required | Ratified | No linking before 2013, or gateway required | Ratfified |
| **Price Cap** | None | Safety valve mechanism | Potential price cap if no international agreement after 2012 | To be decided | Plans price cap |
| **Registry** | Not analyzed | | | | |
| **MRV** | Not analyzed | | | | |
| **Penalties** | Requires delivery later + penalty | | | | Penalty fee introduces price cap |
| **Credits** | Import limit on CDM credits | Depending on design of domestic credit system | AAUs would become available indirectly in EU ETS | Depending on design of domestic credit system | Depending on design of domestic credit system |
| **Unit of Measure-ment** | CO2eq | Short tons | | | |
| **Banking** | Allowed without restrictions from Phase II on | Potential 1st period overallocation bankable | Potential 1st period overallocation bankable | Potential 1st period overallocation bankable | Potential 1st period overallocation and price cap purchase bankable |
| **Inter-period Borrowing** | No | | | | |
| **Point of regulation** | Downstream | Assuming appropriate provisions | Assuming appropriate provisions | Assuming appropriate provisions | Assuming appropriate provisions |
| **Coverage** | Several sectors with large point sources | | LULUCF coverage needs to be accepted by EU | | |

*Table 1: Compatibility and potential or prohibitive problems when linking emerging emissions trading systems to the EU ETS. The EU ETS regulation serves as a benchmark for evaluating the compatibility of other systems.*
**Note that except RGGI only the following documents inform this assessment: NZ MfE (2007), MAC (2007), Australian Government (2007).*
*Indicators:*
*White: compatible*
*Light grey: potential problems*
*Dark grey: prohibitive differences*

## 3.2 Expected abatement costs

The level of the cap is an important indicator for the ambition of an emissions trading system. When analyzing both the reduction target and the abatement opportunities of a region, an estimate of abatement costs can be derived. As no system but RGGI has defined caps for future periods yet, we use announced economy-wide reduction targets in 2020 relative to business as usual as a proxy for future ETS caps. This provides a hint for the level of ambition of an ETS in terms of how much a region is willing to invest to reduce emissions. It can be expected that industrialized countries will strive for a fair distribution of these costs, and that they will expect comparable effort from each other. If a region considers the efforts of another region's ETS as insufficient, this can be a barrier to linking.[13] Also, abatement costs give a first hint on expected allowance prices and allowance trade flows across systems. In this section we assess domestic abatement costs for the five investigated regions assuming they would have to reduce their emissions domestically without any linkages to other ETS or credit mechanisms (for details see Annex IV). We emphasize that for a more reliable analysis e.g. of allowance flows or distributive effects from linking, model-based analysis is required taking into account, inter alia, regional abatement cost curves and the interactions of allowance and merchandise trade. The qualitative results presented here are thus intended as very preliminary indicators only.

Given the relatively ambitious goal of the *European Union* to reduce emissions by 20% or 30% below 1990 levels by 2020 (corresponding to reductions below BAU of 25-35%[14]), and taking into account the scope of measures already implemented, we conjecture that concentrated efforts that go far beyond simply picking the low hanging fruits and that comprise a major transformation of the EU's energy system will be necessary. Therefore, abatement costs for the EU can be expected to be among the highest of all the regions under study in the short, medium as well as in the long run.

Considering the high carbon content of electricity generated in the *RGGI* states, the agreed cap (which will decrease emissions by a little less than 20% with respect to the business-as-usual scenario) appears to be of relatively low ambition (own calculations based on EIA, 2007; Environment Northeast, 2007; and RGGI, 2006). However, achieving this goal will not be possible without major shifts in the electricity generation sector. Overall, we tend towards the conclusion that there exist a relatively large number of opportunities and sufficient flexibility to reach the proposed abatement at relatively low costs (at least in comparison to the other regions included in this study) by 2019.

[13] In general, the issues of sharing mitigation costs by setting caps should be resolved in a burden-sharing agreement that is global in scope and negotiated in the context of the UNFCCC.
[14] Own calculation based on EC (2006).

Keeping in mind *New Zealand's* ambitious goals as well as the projected increase in energy demand by 2030 and the somehow limited scope to significantly reduce emissions below a certain threshold, achieving carbon neutrality will require major efforts to transform the country's energy system. For this reason, we expect that abatement costs for New Zealand will clearly exceed those of most other regions considered in this study.

Given the already rather high energy efficiency and relatively widespread use of low-carbon and renewable energy sources in *California*, we assume that many of the cheapest carbon abatement policies have already been implemented. However, there is still ample scope to reduce emissions by the measures described above. Given the large increase in energy demand, the proposed reduction goals correspond to a 40% reduction of emissions below BAU forecasts by 2020 (CEC, 2005). Thus, they can be regarded as quite ambitious in the short and medium run (until 2020), and one can expect abatement costs to increase significantly with the even more ambitious goals set for the 2020-2050 period.

Taking into consideration the comparatively high emissions due to *Australia's* energy intensive industries as well as the high carbon content of primary energy carriers in conjunction with the availability of renewable energy options, we expect a rather generous supply of mitigation options that can be implemented at low costs. Under the assumption that the envisaged cap for 2012 will be maintained until 2020, the announced target translates into a moderate 19% reduction below the BAU case (own calculations, based on Australian Government, 2007). Therefore, we expect the abatement costs for Australia to be among the lowest of all countries under study.

Figure 5 summarizes these findings. If the EU will prefer to link its EU ETS to trading systems with similar levels of ambition, New Zealand and California appear to be desirable linking options, while RGGI and Australia seem less preferable from this point of view.

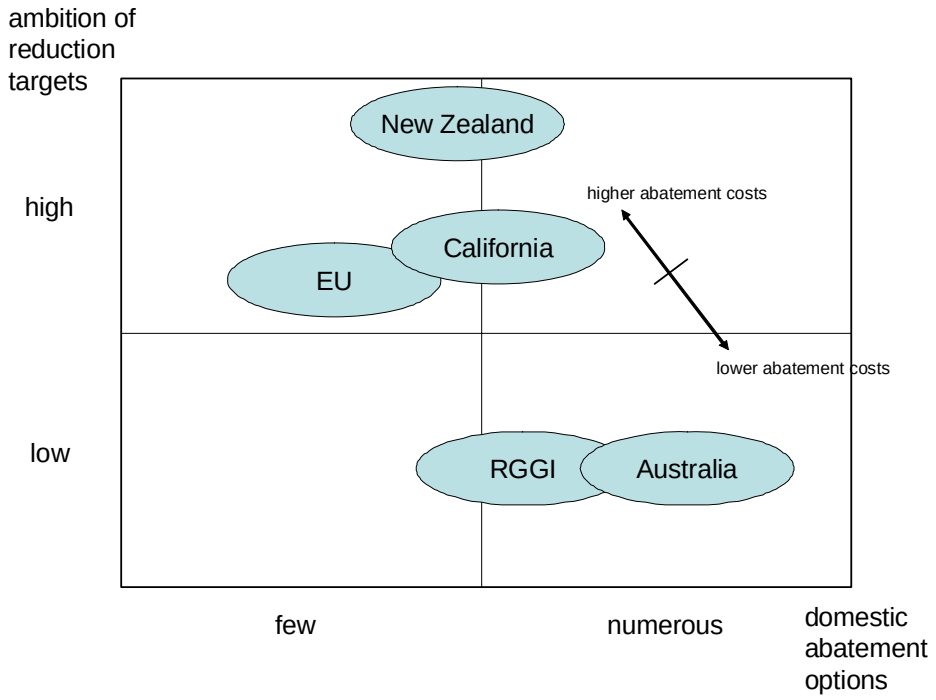


*Figure 5: Qualitative assessment of expected domestic abatement costs (assuming no linkages)*

## 3.3 Key issues for linking

Concerning the rationale that should guide linking decisions e.g. of the EU ETS, we find that there are four reasons why linking partners for a player with the EU's set of climate policy targets should preferably share these goals. These reasons are:

(1) Key design features of the combined carbon market should be in line with the EU's strategic goals,

(2) the incentive to relax caps when linking should be minimized,

(3) the overall cap of the emerging international carbon market should correspond to a global emissions trajectory that is in line with the EU's climate policy target and the adopted burden-sharing rule, and

(4) linking should entail an incentive for reluctant regions to adopt the EU's strategic climate policy goals.

These conclusions can be derived by conducting a thought experiment on the question which kind of ETS the EU ETS should be linked to, given the European Union's climate policy targets:

In general, policymakers need to make two key decisions in climate policy. They have to set a long-term climate policy goal such as the EU 2°C target, and they need to

determine a global burden-sharing rule[15] that determines regional emission levels. We define this set of targets as the 'strategic climate policy goal' of a region and assume that such strategic goals can be compared with regard to their ambition. This refers to (a) the ambition of the global climate policy target and (b) the reduction target a region sets for itself under the adopted burden-sharing rule.[16] The choice of such a set of goals will crucially determine the design of an emissions trading system, in particular the stringency of the cap.

It can be assumed that the EU can link its EU ETS to three kinds of partners, differing in their strategic climate policy goals: first, a player who is not negatively affected by climate change and does not care about negative climate impacts on others, thus lacking a strategic climate policy altogether; second, a partner with strategic climate policy goals that are less stringent than the EU's; and third, a region with a similar or more stringent strategic climate policy goal. By discussing each of these three possible linking constellations, we derive the four statements outlined above.

(1) *Linking to partner without strategic climate policy target*: Game theoretic analyses suggest that when linking ETS there is an incentive for players to relax the cap of their ETS compared to the non-linking case in order to sell resulting additional allowances into the other system (Helm, 2003; Rehdanz and Tol, 2005; see also Victor, 2007). If the EU considers linking to the ETS of a region that has not adopted a long-term climate policy goal and a similar burden-sharing rule, linking can lead to an increase in the combined emissions as the other ETS has a strong incentive to relax its cap in order to sell allowances. In addition, there are two more arguments against linking to such a partner: first, current and future caps of its ETS will not be in line with the caps envisaged by the EU burden-sharing rule. Therefore, if formal linking of ETS shall lead to the establishment of an international or even global carbon market, its overall cap would not correspond to the long term target of the EU if some participant exceed their emission budget. Second, a precedence case where the EU links to a reluctant climate policy player not sharing the EU targets will reduce the EU's possibilities to persuade other reluctant players to adopt its targets: when linking unconditionally, the EU would compromise its credibility and thus bargaining power in other negotiations (in the first place, bargaining power stems from the efficiency gains and positive reputation

[15] 'Burden-sharing' means that given an annual global emission budget, this budget has to be distributed among countries according to some 'burden-sharing rule'.

[16] As shown in the previous section, the availability of abatement options would also have to be taken into account in a comprehensive assessment of the level of ambition of an ETS. In general, without internationally shared strategic climate policy goals the outcome of international climate policy efforts is completely uncertain. Scientific evidence suggests that the risk of large-scale irreversible changes in the climate system becomes unacceptably high if the rise in global mean temperature exceeds 2°C (see e.g. Lenton et al, 2008). Therefore, the European Union has adopted the 2°C target (EU Council, 2007). The current UNFCCC negotiations should preferably lead to a global agreement on both a long-term goal and burden-sharing agreement.

effects of linking). Altogether, linking to an ETS lacking a comparable strategic climate policy is therefore not desirable for a player like the European Union.

(2) *Linking to a partner with a less stringent strategic climate policy target*: When linking to a player that has adopted less stringent strategic climate policy goals than the European Union, this will compromise the overall cap of an emerging international carbon market and reduce bargaining power as well. In addition, less stringent targets can manifest themselves in the design of an ETS (e.g. a price cap, or less stringent rules for the eligibility of credits), leading to conflict.

It may be argued that the EU should link nevertheless, in order to foster international cooperation on climate policy and with the aim of persuading the other system to adopt more ambitious targets later on. For example, a link may be established under the condition that caps are revised a few years later, or exchange rates could be introduced discounting the value of allowances from systems with lower stringency and leading to different allowance price levels across systems[17]. If another region does not want to lose the efficiency and reputational benefits from linking, it may thus be persuaded to adopt a cap that is in line with the EU target at a later date. However, whether such a strategy will play out depends on many factors and thus the desirability of linking to such a partner requires case-specific analysis.[18]

(3) If another region adopts a comparable or even more stringent long-term target than required under a strategic climate policy goal adopted e.g. by the EU as a potential linking partner, the game theory incentive outlined above is reduced and the combined carbon market should comprise a cap and key design features that are in line with the common climate policy goal. Agreement on the global burden-sharing rule would be desirable to facilitate the joint negotiations with further linking partners. This type of region would represent the ideal linking candidate for the EU ETS.

This thought experiment and the analyses in the previous sectors illustrate that a number of aspects needs to be taken into account when assessing the desirability of linking e.g. the EU ETS to other systems. Most importantly, these include the overall climate policy target and the burden-sharing rule, translating into ETS caps and key ETS design features. Also, if linking partners want to ensure that they assume equitable levels of ambition, their energy system structures need to be taken into account in any comprehensive assessment of linking.

[17] Different allowance prices across systems would reduce the efficiency gains from linking.
[18] It is worth noting that when linking to a system with a different strategic climate policy goal, this should also make joint linking negotiations with third partners more difficult. The differences in targets will complicate the evaluation of the desirability of linking to third regions.

While standard economic partial equilibrium analysis suggests that the desirability of linking two ETS depends on the size of the potential efficiency gain that rises with the difference in allowance prices, the previous analysis shows that price differences cannot be the single criterion for assessing the desirability of linking. This is because allowance prices depend on a number of design issues: If a system has a low emissions price because it displays design features unacceptable to another scheme, this can impede linking even if there would be large benefits from linking in theory. Most notably, from the point of view of the European Union, linking partners should agree on caps that correspond to a global emissions trajectory that allows achieving the 2° C target.[19] In addition, a number of design features should be harmonized to avoid adverse effects from linking (see Section 3.1). While it is both conceivable that links to less ambitioned systems are established for strategic reasons or exchange rates are introduced, linking to a likeminded partner appears preferable.

Building on these findings, the following section attempts a preliminary assessment of the prospect for linking emerging ETS to the EU ETS.

## 3.4 Linking options for the EU ETS

Given the early development stage of most domestic ETS and the general uncertainty surrounding the future development of climate policy and international carbon markets, only a preliminary and tentative assessment of linking options for the EU ETS under a formal linking scenario is possible. Again, it should be noted that this assessment builds on particular documents proposing outlines for ETS that are currently being implemented, and that any other political developments or statements concerning their design are not taken into account here.

With regard to *RGGI*, linking prior to 2013 would only be possible through a one-sided gateway where a net inflow of allowances into the EU ETS is prohibited because RGGI is not part of the Kyoto cap-and-trade system. With lower expected allowance prices in RGGI than the EU ETS (see Figure 5, as well as Section 3.1 on the safety valve provisions, and Point Carbon, 2007), it is likely that there would be no trading activity at all in this case. The less ambitious cap and low level of safety valve prices indicate that RGGI and EU ETS have different views on the level of the overall effort.

The longer term emission reduction target of *New Zealand*, that is, reaching carbon neutrality by 2040, is in line with the EU 2°C target. From this point of view, the NZ ETS represents a very desirable linking candidate for the EU ETS. However, accepting AAUs for compliance within a NZ ETS could be a barrier to linking to the

[19] Indicatively, the EU has set itself an unconditional GHG emission reduction target of 20% by 2020 (compared to 1990 levels), and 30% if other major emitters join a global reduction effort (EU Council, 2007). Based on IPCC findings the Ad-hoc Working Group on further Commitments of Annex-I Parties under the Kyoto Protocol (AWG) at Bali stated that Annex-I countries as a group should reduce emissions by 25-40% by 2020 compared to 1990 levels (UNFCCC 2007a).

EU ETS at least prior to 2012 as this may lead to the inflow of 'hot air'. Also, an unlimited inflow of credits can be problematic if rejected by the EU ETS (the EU currently allows only 13.4% of the emissions under its phase two cap to be covered by CDM and JI credits). In addition, progressive compliance obligations modifying the nominal cap would render linking difficult. If a price cap was introduced post-2012 in absence of an international agreement, this would also impede linking to the EU ETS. Finally, the mechanism for the inclusion of the agriculture and forestry sectors into the NZ ETS would need to be accepted by the EU.

The reduction targets of *California* are also in line with the European Union's 2°C target, rendering it a desirable linking candidate for the EU ETS. Linking prior to 2013 would only be possible through a one-sided gateway where a net inflow of allowances into the EU ETS is restricted because California is not part of the Kyoto cap-and-trade system.

Even if the nominal cap of an *Australian* ETS would be in line with the 2°C target, a price cap would jeopardize its environmental integrity and that of any linked ETS, thus impeding linkage to the EU ETS.

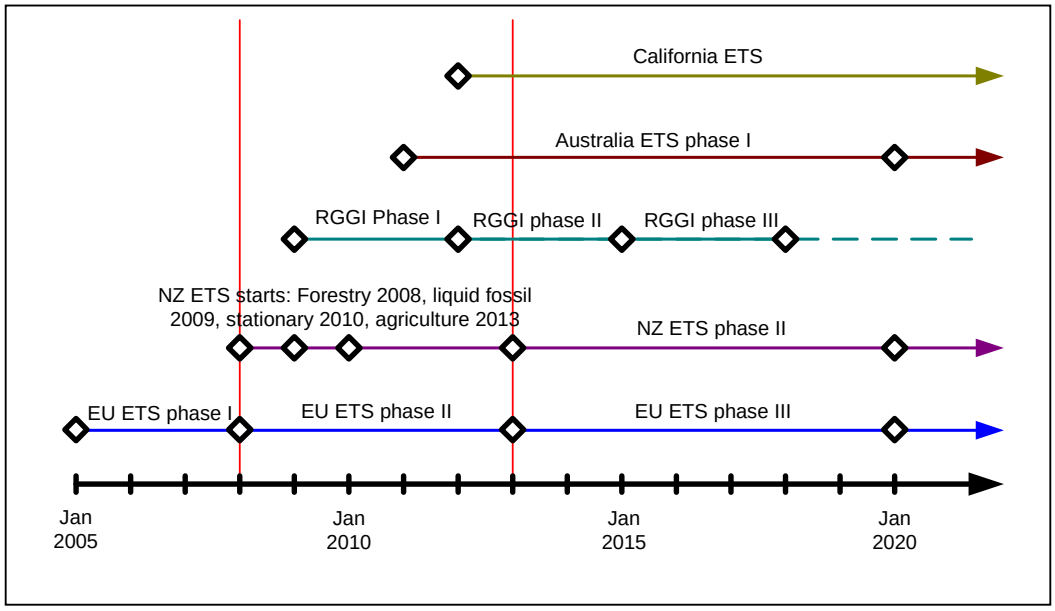


*Figure 6: Timeline for emerging ETS.*

For several reasons it currently appears rather unlikely that the EU ETS and another ETS will be linked prior to 2013. Still, it is necessary to start the harmonization process now to ensure that emerging systems are designed in a way that enables linking, and to allow existing systems to adjust to necessary changes. Therefore, the period from 2008 to 2012 can be regarded as a 'harmonization period' for preparing formal linkages that may take place post-2012 if a global trading system is not implemented. Also, linkages can occur in the context of a global trading system.

The following reasons speak against linking the EU ETS prior to 2013: First, the outcome of international climate policy negotiations is decisive for the general practicality of the formal linking option, and key decisions cannot be expected before the end of the year 2009. After 2009, there would be little time to implement linkages prior to 2013. Second, the EU ETS will be kept busy with its internal expansion and harmonization process in the next few years. Third, bearing in mind experiences with its own test phase it is likely that the EU will want to observe 'stand-alone test runs' of other ETS to observe their performance before linking up to them. Fourth, the prospect of a national US ETS or larger regional ETS (e.g. a WCI ETS) suggests waiting for US developments before implementing linkages to regional US systems. Also, the non-party status to the Kyoto system of the US would render linking prior to 2013 difficult. For RGGI, the expected price differentials in combination with a one-sided gateway could very likely render linking obsolete. Finally, before linking ETS there can be harmonization requirements as discussed above (Section 3.1), taking time for their implementation.

However, given the political willingness to do so formal linking of domestic ETS to the EU ETS is possible in principle even before 2013. Overall it seems more likely though that this option will be important in the mid- to long-run if no global cap-and-trade system is implemented in the UNFCCC process.

## 3.5 An international clearinghouse

Section 3.1 has shown that ETS regulators give up some control when linking to other systems. Decisions on design features such as price caps, import restrictions for credits, penalties, and MRV standards taken by one system will affect the others. Therefore it is sensible to coordinate the regulation of common carbon markets. There are several institutional options for implementing such coordination. Article 25 of the EU ETS Directive (EU 2003) explicitly states that the EU can negotiate linking agreements with Annex B countries that have ratified the Kyoto Protocol. This may be a viable option when linking the EU ETS to few and smaller systems only, when joint regulation may be easier to coordinate. If however, in the mid- to long-term a multitude of major ETS are to be linked, an international clearinghouse would provide an explicit forum for coordinating crucial regulatory issues in a system of interlinked trading systems. It also provides the infrastructure and information basis required for a smooth functioning of the combined ETS. In particular, linking of ETS raises the following issues regarding coordination of regulation:

- *Common registry*: A joint consolidated registry maximizes the speed and ease of transactions, trackability and transparency of original allocations and transactions based on them. It reduces uncertainties concerning possible errors (such as double counting) as well as the risk of manipulation, hence reducing the probability for ex-post (distorting) corrections. The International

Transaction Log (ITL) developed by the UNFCCC secretariat can constitute the starting point for a global system of interconnected ETS registries.

- *Cap-setting*: The clearinghouse develops best practice methodologies for setting regional ETS caps that correspond to the agreed global climate policy target and the burden-sharing rule. The clearinghouse regularly checks if updated regional caps are in line with these principles and are not altered unilaterally.
- *MRV standards*: the clearinghouse reviews the application of MRV standards in participating (and candidate) regions. It organizes the development and implementation of best practice MRV standards.
- *Enforcement check*: the clearinghouse monitors (and makes public) whether governments enforce compliance in cases of misconduct.
- *Assess joining systems*: the clearinghouse assesses the emissions trading system and climate policy of potential linking partners with regard to the targets of the carbon market coalition.
- *Negotiate credit treatment*: ETS administrators negotiate the standards for and admission of credit types and coordinate import restrictions.
- *Review domestic credit systems*: if participating regions implement domestic credit mechanisms (comparable to the CDM) in sectors not covered by the ETS, the clearinghouse conducts independent reviews of these domestic systems in order to ensure trust in the generated credits. These reviews can be based on commonly adopted best practice standards.
- *Implement exchange rates*: if exchange rates should be introduced the clearinghouse can set and administer these in its central registry. Exchange rates may become necessary if regions use different metrics, or as a penalty mechanism.
- *Administer gateway reserve*: if the clearinghouse is established in the 'global trading' or 'mixed approach' scenario, it can keep a gateway reserve if this is established for linking ETS of 'global trading' parties and non-parties.
- *Publish sensitive market information*: sensitive market information (such as reform proposals and decisions, and possibly emissions data) should be published in a coordinated fashion to avoid market distortions.
- *A forum for administrators and regular reviews of linkages*: the clearinghouse serves as a forum for regular consultations between representatives of the participating schemes, for the coordination of ongoing operations, reforms, linking with additional schemes, or harmonization of crucial system features. Haites and Wang (2006) and Ellis and Tirpak (2006) suggest periodic reviews

of the linkages with the option of de-linking if ETS changes by some partner(s) are not acceptable to other participants.

- *Scientific expertise and public debate*: the clearinghouse assembles and issues contracts for developing scientific expertise regarding important aspects of international emissions trading, including economic and juridical aspects of linking. Also, it informs the public and policy makers on the functioning of international carbon markets.

It is in principal conceivable that a clearinghouse could in the future take on further (or less) responsibilities, e.g. on market stabilization or establishment of a price corridor for allowances (Hepburn, 2006; Newell et al, 2005). This would give it the character of a carbon central bank.

In the case of the EU ETS, the European Commission is presently providing some of the functions of a clearinghouse by maintaining the Community Independent Transaction Log (CITL) and harmonizing the design of interlinked national ETS schemes.

# 4. Options for the International Carbon Action Partnership (ICAP)

The International Carbon Action Partnership (ICAP) constitutes an expert forum that explores design issues and linkages of regional emissions trading systems. As outlined in Section 2.1, linking of ETS may become part of a framework for international climate policy post-2012. To share information that can facilitate the design of effective systems and in order to avoid early lock-ins in the design of regional ETS that may inhibit linking at a later stage, ICAP investigates the relevant issues and proposes solutions where barriers are identified. The 'ICAP Political Declaration' (ICAP, 2007) states:

> "The International Carbon Action Partnership (ICAP) will create an international forum of governments and public authorities that are engaged in the process of designing or implementing carbon markets. ICAP will establish an expert forum to discuss relevant questions on the design, compatibility and potential linkage of regional carbon markets. The forum will convene regularly and define a work program, including joint research and studies. It will identify barriers, including barriers posed by applicable state, federal and national laws, and it will identify solutions with the view to developing recommendations for consideration by each of the signatories hereto. ICAP aims to support the United Nations process on climate change by facilitating working relationships among governments and public authorities engaged in developing and implementing programs to combat climate change."

Concerning the mid- to long-term role of ICAP, the uncertainty surrounding the further evolution of international climate policy and carbon markets renders a more specific program definition difficult. Depending on which of the carbon market scenarios outlined in Section 2.1 will unfold, ICAP will need to evolve differently both with respect to its agenda and institutional setup. In particular, in the formal linking scenario ICAP could evolve to become the international clearinghouse for a carbon market established by linking domestic ETS.

In the following two sections, we first propose options for a short-term working program of ICAP. Then, possible mid- to long-term institutional settings for ICAP in each of the four scenarios are briefly discussed.

## 4.1 Working program

In order to deal with the uncertainty on the evolution of carbon markets and thus the future role of ICAP, Table 2 identifies critical design issues that are relevant in the global trading, formal linking, mixed approach and indirect linking scenario, respectively[20]. Issues that arise in all direct linking scenarios represent preferable short-term options for an ICAP working program because they would need to be addressed in any direct linking case. Depending on which carbon market scenario

[20] Table 2 summarizes findings the discussion of each issue under each scenario presented in Annex-I.

ICAP intends to explore in more detail, other issues (e.g. as indicated in Table two) can be addressed in the ICAP working program.

| | *Direct linking* | | | Indirect linking |
|---|---|---|---|---|
| | **Global trading** | **Formal linking** | **Mixed approach** | **Linking through credits** |
| **Cap** | (X) | X | X | |
| **(post)Kyoto-status** | X | | X | |
| **Price cap** | (X) | X | X | |
| **Registry** | X | X | X | X |
| **MRV** | X | X | X | X |
| **Penalties** | (X) | X | X | |
| **Credits** | (X) | X | X | X |
| **Unit of measurement** | | X | X | |
| **Banking and borrowing** | (X) | X | X | |
| **Allocation procedures** | X | X | X | X |

*Table 2: Crucial issues when linking ETS in different carbon market scenarios. Symbol X indicates an important issue when linking; (X) indicates a potentially important issue. Lines shaded in grey feature at least three X and represent no-regret options for a short-term ICAP working program. Lines with at least two X and one (X) represent additional working program options.*

Table 2 suggests that the compatibility of registries, MRV standards, treatment of credits and allocation procedures represent "no-regret" short-term working program options for ICAP if it intends to explore direct linking options. In addition, the setting of emission caps, price caps, penalties and banking and borrowing provisions are issues that are of some importance in all direct linking scenarios.

ICAP should work towards making *registry softwares* compatible to enable future transactions of allowances and credits, both among domestic ETS registries and with the International Transaction Log (ITL) of the UNFCCC secretariat. Harmonized *MRV standards* for ETS based on best practice can be commonly developed that eliminate concerns regarding the environmental integrity of ETS as the chances of underreporting are minimized. The *treatment of credits* is a relevant issue in all carbon market scenarios, with three main questions bearing a number of complex implications: (1) Which credit mechanisms meet the additionality criterion in a satisfactory manner? (2) Which credit types should be eligible (e.g. afforestation, avoided deforestation, nuclear and hydro power)? (3) Should there be restrictions to credit use in the cap-and-trade systems (supplementarity provisions or import quotas)? ICAP can work towards a clear and of possible common understanding concerning these issues. Concerning *method of allocation,* sharing or jointly developing best

practice on allocation rules, e.g. on the technicalities of auctioning or development of benchmarks, is conceivable.

In addition, ICAP can discuss issues that are likely to be important in direct linking scenarios:

- Advantages and disadvantages of *price caps*. ICAP should work towards finding a common view on whether to implement these in ETS.
- The *penalty regime and compliance enforcement provisions* that are planned for emerging ETS can be checked against experience from existing ETS.
- Concerning *cap-setting,* three aspects could be treated in the context of ICAP: First, caps of sectors covered under an ETS can be assessed regarding their compatibility with some overarching climate policy goal (e.g. 2°C target) and an envisioned burden-sharing rule. Second, to avoid efficiency losses and distribution effects and to ensure that the overall environmental target is met, caps should be tuned to the reduction burden on sectors of the economy that are not covered by an ETS (Alexeeva-Talebi and Anger, 2007). Thus, appropriate burden-sharing rules between ETS and non-ETS sectors of a region need to be developed.
- *Banking* provisions in initial trading periods warrant discussion if there is the possibility of overallocation or price caps in early periods, as they may inhibit linking at later dates.
- *Borrowing* can be problematic if future reduction burdens become perceived as economically untenable and thus caps are relaxed. The implications of both issues can be discussed within ICAP.

ICAP can work towards identifying best practice standards for its working program issues by conducting joint workshops, expert meetings, and by contracting studies where necessary. These processes can mount into joint publications on particular ETS design aspects. This procedure should also contribute to avoiding that the design of emerging ETS mainly follows domestic political economies – relevant issues for linking should be taken into account already in the design phase. In general, internationally established best practice standards will facilitate the design of new ETS. Publication of such standards creates transparency and enables comments by experts and stakeholders that will improve the procedure of linking ETS.

The contours of the international climate policy architecture post-2012 will begin to emerge in 2009. Under the condition of reduced uncertainty, ICAP members can then define further tasks of ICAP according to the requirements of the emerging international carbon market architecture.

## 4.2 Institutional setup

For implementing its short-term (2008-09) working program as outlined in the previous section, it seems that ICAP does not require a sophisticated institutional setting. Regular meetings of representatives from parties, expert workshops and the publication of joint papers suffice to implement this working program and can be organized e.g. by a project manager. In the mid- to long-term, however, this will change depending on the carbon market scenario and the role that its members envisage for ICAP. For example, in a formal linking scenario ICAP can evolve into the international carbon market clearinghouse as outlined in Section 3.5. We briefly discuss options for the institutional setup of ICAP in each of the scenarios identified above.

If a global or near-global trading agreement is negotiated by 2009, linking of regional ETS would very likely occur in the framework of international emissions trading where the UNFCCC secretariat with its International Transaction Log (ITL) can serve as the clearinghouse for the international carbon market. To avoid institutional overlaps, the coordination of linking domestic ETS should become a task of the UNFCCC secretariat. In this sense ICAP should be incorporated into the UNFCCC secretariat.

If formal linking of regional ETS emerges as the European Union's and other regions' international climate policy strategy in absence of a global trading agreement, the future relation of ICAP and the UNFCCC secretariat is less clear. The UNFCCC is a multilateral treaty between nation-states, while formal linking represents a plurilateral approach involving sub-national entities as well. Thus, there may be conflicts: First, it is questionable whether the international community as a whole would support the formal linking approach by enabling ICAP to be located at the UNFCCC secretariat. Second, the secretariat is controlled by nation-states, and these would have direct influence on the linking process if ICAP was based at the UNFCCC secretariat. If ICAP partners want to avoid a situation where national governments preclude linking of e.g. state or city-level ETS, ICAP would need to be established independently or affiliated with some other organization where these issues do not arise.

In case of indirect linking through credits, there is mainly the need to ensure the environmental integrity of the credit scheme(s) and the generated credits. The UNFCCC secretariat and its CDM Executive Board currently oversee the CDM procedure and are in charge of assuring its environmental integrity. In order to ensure broad acceptance and legitimacy, schemes that generate credits by which emissions trading schemes are linked indirectly should preferably be overseen by the UNFCCC secretariat, as it is subject to multilateral control which increases legitimacy. However, similarly to the CDM Executive Board, ICAP could further the development of best practice standards and establish a supervisory board that

independently reviews domestic credit systems in order to ensure market confidence in these credits.

If ETS are to be linked step-by-step in the framework of a multilateral Global Deal negotiated within the UNFCCC framework (mixed approach), it would be straightforward to incorporate ICAP and its respective functions into the UNFCCC secretariat which would oversee the implementation of the treaty as well as linking procedures, thus serving as the international carbon market clearinghouse.

# 5. Summary and Outlook

The international carbon market currently faces considerable uncertainties regarding its future architecture. There are a number of options for further development, including a global trading approach building on Kyoto, formal linkages of domestic ETS leading to a global $CO_2$ market, and indirect linkages through credits if domestic ETS remain otherwise unconnected. Also, a mixed approach is conceivable. This report has focused on the option of formally linking ETS because it provides an alternative way towards a global $CO_2$ market.

Action is needed now to prepare both existing and emerging systems for the case that formal linking turns out to be a fallback option to the global trading approach. When linking systems bottom-up, some harmonization of trading systems will be required. Due to the inertia of reforming established systems, it is crucial for existing systems to start considering the implications of linkages early on. For emerging ETS, linking requirements should be taken into account in the early design phase to avoid lock-in effects. In addition, basing the design of emerging ETS on internationally developed best practice standards building on existing experience will generally improve the functioning of carbon markets. Also, there are no-regret options for the harmonization of systems that can improve carbon market performance in any of the foreseeable carbon market scenarios.

This report has analyzed key determinants for assessing the desirability of linking domestic ETS in a formal linking scenario. We conclude that when linking the ETS of a region with an ambitious climate policy target like the EU 2°C target to other trading systems, linkages to systems with a comparable level of ambition are preferable. In particular, regions should share a common understanding on the overall climate policy goal (e.g., the 2°C target) as well as a burden-sharing rule translating into ETS caps. These two fundamental issues will crucially determine the level of ambition of an ETS as expressed in (a) the emission cap, which in combination with amount and costs of available abatement options of a region crucially determines the allowance price level; and (b) ETS design features also exerting influence on the allowance price level and environmental outcome. Overall, the level of ambition of an ETS can be interpreted as the amount of the investment a region is willing to undertake in order to reduce emissions by the means of an ETS.

When linking to less ambitious systems, four concerns arise. First, the design features of the combined market may not enable achievement of the goals of an ETS, e.g. controlling emissions at minimum cost. Second, when linking domestic ETS there is an incentive to relax caps in order to generate revenue from selling allowances. If linking partners share fundamental climate policy targets, this incentive is reduced and changes in emission caps can be observed. Third, when formal linkages are meant to lead to the establishment of a global carbon market that enables control of emissions as required e.g. under a 2° C target, the overall cap of that emerging market

needs to be in line with a corresponding emissions trajectory. This will only occur if individual caps are coordinated through a common overall target and a burden-sharing rule. Fourth, linking should entail an incentive for reluctant regions to adopt ambitious climate policy goals. While linking to less ambitious ETS is possible in principle and may be an option to persuade regions to adopt more stringent targets later, the outcome of such a strategy is uncertain. Therefore, for a player with ambitious environmental targets it should be preferable to announce that it will link only under the condition that another system displays a similar level of ambition, thus using the efficiency and potential reputational benefits from linking as a bargaining chip. Linking to less ambitious regions would undermine the credibility of such announcements.

In addition to these principal considerations, this report has identified barriers to linking the EU ETS to the emerging RGGI, New Zealand, California and Australia ETS based on a comparison of specific design proposals. The main barriers to linking to the EU ETS are price caps (Australia), a lack of ambition as regards caps (RGGI, possibly Australia), and possibly the treatment of credits and Assigned Amount Units (New Zealand). Also, expected abatement costs for these schemes were qualitatively assessed. Building on these analyses, we find that from the point of view of the expected level of ambition New Zealand and California are preferable linking partners for the EU ETS after 2012. However, certain design features such as acceptance of Assigned Amount Units in the ETS of New Zealand that may lead to an inflow of 'hot air' can represent obstacles to linking if not accepted by the EU. In general, however, it is too early to draw final conclusions as most of these systems are in their design phase.

Harmonization of trading systems should start as early as possible in order to enable the option of linking ETS post-2012. For this purpose, this report has identified short-term working options for ICAP, including no-regret options that will need to be addressed in any scenario foreseeing direct linkages of ETS. These include development and implementation of best practice on registries, monitoring, reporting and verification standards (MRV) and allocation procedures, as well as building a common understanding on the treatment of credits.

As formal linking will reduce the control of regulators over an ETS, some coordination of market regulation will be necessary in a joint system. This holds particularly for the structure and connection of registry systems, the setting of caps, and import limits for credits. Therefore, an international clearinghouse is proposed that enables joint regulation of critical aspects of linked trading systems. In a global trading system, this role could be fulfilled by the UNFCCC secretariat. In the formal linking scenario, ICAP could be a nucleus for such an international clearinghouse.

# Annex I – Relevant design issues for linking

In general, the literature on linking[21] suggests that it is possible to link different ETS, but linking will be easier if schemes are similar. There are a number of aspects that must be observed when linking domestic ETS, roughly falling into four groups:

1. Institutional feasibility,
2. Impact on environmental effectiveness,
3. Impact on economic efficiency, and
4. Distributive effects (between companies and between regions).

The following discussion starts with issues considered fundamental to linking and proceeds to topics considered less crucial. However, as the relative importance of these issues will vary with the assessment criterion applied and the assumptions on the ETS design, the order of discussion does not represent a strict hierarchy of issues. While this section covers a wide range of topics, it cannot address and clarify all relevant questions and details.

The focus of our analysis in this section is on issues that are relevant in the formal linking scenario (see Section 2.1). However, relevant issues for linking domestic ETS in the global trading, mixed approach and indirect linking scenarios are also discussed. Where another scenario than the formal linking case is meant this is explicitly stated.

### *Setting the Cap*

If regions would set caps totally independent of each other, cap-setting would not be an issue with regard to linking systems bottom-up: the combined reduction target of two cap-and-trade schemes remains the same when they link up. However, there are environmental, distributional and strategic implications of cap-setting and linking. We discuss three such issues, as well as two more issues that concern cap-setting in general, independently of linking. Then we briefly discuss how these problems can be overcome.

(1) If two schemes are linked, issuing additional allowances in one scheme – that is, relaxing the cap – enables the government (or the companies that receive these allowances for free) to sell these allowances into the other scheme, creating a financial transfer across the regions (Helm, 2003; Rehdanz and Tol, 2005). The additional allowances would not have been issued if there hadn't been the possibility to sell them into the other system. This incentive does only exist if two schemes are linked.

[21] The relevant publications include: Haites and Mullins (2001), Baron and Bygrave (2002), Baron and Pershing (2002), Bodansky (2002), Haites (2003), Blyth and Bosi (2004), IEA (2005), Tangen et al (2005), Haites and Wang (2006), Sterk et al (2006), Egenhofer and Fujiwara (2006), Ellis and Tirpak (2006), Edenhofer et al (2007), Jaffe and Stavins (2007).

(2) If a player like the EU aims at achieving the 2°C target in the long-term and supports formal linking as an approach to the international reduction effort, it should not link its ETS to other systems the long-term caps of which are not in line with the reduction requirements of the 2°C target and a corresponding burden-sharing rule. This is because the resulting overall cap of such an international carbon market would be insufficient to meet the 2°C target.

(3) Linking of ETS creates benefits arising from efficiency gains, as well as reputation effects. In this context, regions with more ambitious climate policy targets will be reluctant to link to regions with lenient targets: they will not want to let the other party reap these benefits without adopting the same goals. Instead, they will use the prospect of the benefits as a bargaining chip to persuade the other system to adopt the same or a similar climate policy target.

(4) To avoid efficiency losses and distribution effects, the cap of an ETS has to be tuned accordingly to the reduction burden of the sectors of an economy that are not covered by an ETS. In order to avoid efficiency losses, this is also relevant when linking domestic ETS in a global cap-and-trade scenario.[22]

(5) The procedure for setting the cap of an ETS should bear small transaction costs. The bottom-up approach of using National Allocation Plans (NAPs) in the EU ETS has displayed the high transaction costs of this approach.

To address these issues, the cap of an ETS should be set in line with an overarching climate policy goal (e.g. the 2°C target) and an emissions reduction path for an economy that is derived from a global burden-sharing rule.[23] This would address the aforementioned issues in the following respect: (i) the incentive to relax a cap when linking is reduced if parties share the same overall target, and would become measurable to some extent; (ii) the resulting overall cap of an international carbon market would correspond to the common climate policy goal; (iii) partners that share the same targets would be willing to link their schemes because their level of ambition would be in line with the shared overall target; (iv) the burden-sharing rule of sectors covered by an ETS and sectors covered by other measures could be applied systematically with regard to the overall goal; and (v) a transparent procedure for setting caps in a systematic way would reduce transaction costs of the cap-setting procedure.

[22] Alexeeva-Talebi and Anger (2007) show how an unequal burden-sharing rule among the sectors covered by an ETS and non-covered sectors hampers the efficiency of linking ETS.

[23] Today, no such widely accepted burden-sharing rule exists. Indicatively, the EU has set itself an unconditional GHG emission reduction target of 20% by 2020 (compared to 1990 levels), and 30% if other major emitters join a global reduction effort (EU Council, 2007). Based on IPCC findings the Ad-hoc Working Group on further Commitments of Annex-I Parties under the Kyoto Protocol (AWG) at Bali stated that Annex-I countries as a group should reduce emissions by 25-40% by 2020 compared to 1990 levels (UNFCCC 2007a).

***Linking Kyoto (or post-2012 accord) parties and non-parties***

In a global trading or mixed approach carbon market scenario (see Section 2.1), or during the Kyoto compliance period 2008-2012 , there will be problems when linking the domestic ETS of a treaty (Kyoto) party to a non-party ETS: imported allowances from a non-party domestic ETS do not have the status of trading units under the treaty (e.g. Assigned Amount Units AAU). That is, the non-party allowance used for compliance by a company in the coalition ETS cannot be used for compliance by that government under the coalition system (Kyoto Protocol). There are three ways to address this issue:

- First, a unilateral link only enables the export of allowances from the coalition system.
- Second, a one-sided gateway enables mutual trading between the systems, but net imports and exports need either be equal or there can only be a net export of allowances from the coalition system.
- Inclusion of the non-party ETS sectors into the coalition ETS. The cap of the coalition system would thus be expanded by the cap of the ETS sectors of the joining region.

A unilateral link can be established by allowing the use of allowances from the coalition system for compliance in the non-party scheme, but not the other way around. This can be achieved even without a formal linking agreement. If a facility in the non-party system can comply in its system by simply cancelling e.g. a EUA and the attached AAU in the EU and UNFCCC registries (e.g. through an affiliated company or financial service company), there is an incentive to use EUAs for compliance if these are cheaper than allowances in the non-party system. The RGGI system, for example, may allow for the use of EUAs if the RGGI allowance price exceeds a certain threshold.[24]

The gateway approach (Baron and Pershing, 2002; Sterk et al, 2006) enables allowance trade in both directions, but the net trade balance is required to be neutral or positive for the coalition party ETS; overall, it cannot import more allowances than it exports. In this sense, the gateway approach implies one-sided trading. Some technical provisions are required. Assuming the current structure of the EU and Kyoto trading systems, each EUA corresponds to an AAU. The AAU can be 'stripped off' the EUA property when exiting the coalition system and put into a gateway reserve account. If an allowance is imported from the non-party system, it can be 'upgraded' with an AAU and then enter the Kyoto party system. This ensures the integrity of the overall coalition cap: AAUs allow emissions either in the coalition or in the partner ETS. Imports from the non-party system can only take place when there are AAUs in

[24] See Annex I for a description of RGGI.

the gateway reserve. However, this decreases the predictability of transfers and increases transaction costs.

Both of these approaches preclude the inflow of allowances that do not correspond to AAUs into coalition regions. There is no change in the overall coalition cap. In contrast, the third option entails inclusion of the ETS sectors of the non-party scheme into an overall post-2012 cap (Bodansky, 2002; Blyth and Bosi, 2004). The respective non-party government(s) and coalition parties would have to agree on the future cap of the non-party ETS. If this cap is acceptable for both parties, AAUs can be issued accordingly to the non-party ETS, allowing unrestricted trade in both directions. If the non-party system should exceed the negotiated cap and issue additional domestic allowances setting free additional AAUs for sale, the link can be closed.

***Price cap***

Emissions trading systems can comprise safety valves that cap the price of allowances at a pre-defined level. A government can implement such a policy by selling an unlimited amount of allowances at the safety valve price, or by setting a specific penalty for non-compliance: a company has to pay a penalty for each tonne of emissions for which it does not surrender an allowance. The size of the penalty fee then establishes the price cap.

Safety valves crack the emission cap and thus change the environmental outcome of an ETS: While the intention behind cap-and-trade emissions trading schemes is to control the absolute quantity of emissions, the issuing of additional allowances through a price cap mechanism undermines precisely this objective. Moreover, if a price ceiling is set too low, it reduces the incentive to develop low-emission technologies.

The linking of a system with a price cap to a scheme without one spreads the price cap to both: As long as the allowance price is above the threshold price, companies from the scheme without a safety valve will buy allowances from the partner region. Companies in that region can either pay a penalty fee and sell allowances, or buy allowances from the government and sell them off until the price evens out due to such arbitrage trading. This will also lead to a financial transfer to the authority that (directly or indirectly) issues the additional allowances.

Thus if one of the schemes to be linked rejects the concept of a price cap, the other scheme must not have a price cap either. A price cap can therefore represent a barrier to linking.

Intergovernmental emissions trading as implemented in a global trading or ‘mixed approach’ scenario may also entail a price cap. However, the same principal issues arise: price caps undermine the environmental target. Therefore, they are contested as an element of global cap-and-trade system.

It seems very unlikely that a country that is party to a global trading system without a price cap will implement this instrument in its domestic ETS. The government would need to acquire allowances issued to the company sector through the price cap on international markets. If the domestic ETS was linked to other domestic schemes making use of the price cap through arbitrage trading, the burden on the government could become unacceptable.

***Compatibility of registries***

An institutional minimum requirement for linking emissions trading schemes is the transferability of allowances between the accounts of participating entities. The less compatible registries are the slower and more costly the transfer of allowances will be. Therefore harmonisation of registry structures will enhance the efficiency of linking. A joint consolidated registry maximizes the speed and ease of transactions, trackability and transparency of original allocations and transactions based on them. It reduces uncertainties concerning possible errors (such as double counting) as well as the risk of manipulation with resulting distributive effects, thus reducing the probability for later (distorting) corrections.

Under the EU Emissions Trading Scheme, the European Commission maintains the Community Independent Transaction Log (CITL), which contains a record of the transactions of national registries. The International Transaction Log (ITL) developed and maintained by the secretariat of the UNFCCC for trading under the Kyoto Protocol could in principle fulfil this function in a future system of interconnected domestic ETS or in any other carbon market scenario.

***Monitoring, reporting and verification (MRV) procedures***

If the MRV regime is not sufficiently robust, there can be an incentive to underreport annual emissions. Underreporting firms would benefit because they would have to surrender less allowances. Concerning environmental effectiveness, more emissions than envisaged by the regulator would occur and the environmental target would be missed. Also, there would be more allowances on the market, leading to lower allowance prices and an ineffective price signal.

Slight deviations should not present a problem as long as errors or irregularities in monitoring and reporting do not necessitate later adjustments of the emissions data and/or compromise the confidence of the market players in the validity of the allowances. If there is a possibility of ex post corrections of emissions data, this will lead to price volatility and a loss of confidence by market participants. Thus harmonization of MRV standards based on best practice is desirable in order to ensure the environmental effectiveness of the schemes as well as market confidence and efficiency.

In a global trading and mixed approach scenario, coherence of MRV provisions for the overall national reporting and ETS facilities needs to be ensured to avoid data inconsistencies.

***Penalty system and compliance enforcement***

The EU ETS applies a penalty system ruling out an impact on the allowance price: it requires a company with excess emissions to pay a penalty *and* surrender the missing amount of allowances during the following calendar year.[25] Therefore, there is no connection between the penalty fee and the allowance price. If such a penalty system is adopted by a joining system, the exact amount of the penalty fee on top of the allowances to be issued later can differ among systems. Another approach adopted by RGGI is to ask for issuance of three times the non-delivered amount of allowances at a later date. This approach should also decouple penalty level and emission price and suffice to ensure compliance.

For the integrity of an emissions trading scheme it is crucial that the penalty regime is actually enforced by the regulator/government. Lenient enforcement undermines the credibility of the system, which is vital to its efficient functioning. Non-compliance also undermines the environmental effectiveness and increases the supply of allowances, which lowers prices. Enforcement of compliance provisions is therefore required by all linking parties in order not to undermine the validity of the price signal as well as trust in the overall system. If a system considers the enforcement practice of another scheme to be insufficient, this can be a barrier to linking or a reason for de-linking the schemes.

While in the global trading and 'mixed approach' scenario overall environmental integrity is ensured by the national compliance obligations, severe lack of enforcement on the company trading level could still result in distortions of the carbon market, depending on the accounting methodology on the national level.

***Treatment of Credits and AAUs***

Credits from credit mechanisms such as Joint Implementation (JI) or Clean Development Mechanism (CDM) are likely to continue to be tradable in the future. New crediting mechanisms could be implemented in developing regions to foster large-scale energy system transformations. Also, regions with a domestic cap-and-trade system can introduce such mechanisms at a regional level to enable emission reductions in sectors outside the emissions trading scheme. When linking domestic ETS, arrangements governing generation, recognition and import quotas of these credits should be harmonized to some degree, as their inflow will affect emission levels in the sectors covered by the ETS as well as the allowance price and thus the incentive to develop low-carbon technologies.

[25] The EU ETS penalty amounts to EUR 40 (trading period 2005-2007) and EUR 100 (trading period 2008-2012) per tonne of $CO_2$.

When linking ETS, the standards[26] for the generation of credits should be comparable and credible in order to ensure environmental effectiveness. That is, each partner has to accept the rules governing generation of credits. This is necessary because credits imported to one system will be available in the partner system as well. Even if one system refuses such credits for compliance, their use for compliance in the other scheme will set allowances free for sale.

The same applies for the recognition of certain types of projects, e.g., LULUCF activities or nuclear power projects. If one partner refuses to accept credits from such schemes, it consequently cannot accept their use in the partner system as they will be available indirectly.

Import quotas for credits are an important determinant of the allowance price. If large volumes of cheap credits are available, ETS allowance prices will sink. Restricting their availability will drive market prices upwards, making necessary more abatement by ETS participants. Therefore, if one of the partner systems unilaterally increases or decreases its import quota for credits, this has an impact on the overall allowance price. To avoid conflicts, there should be an agreement on import quotas and consultations mechanisms on how to achieve such agreements. Failure to agree on the provisions regulating credit use could possibly impose a barrier to linking or become a reason for de-linking of schemes.

When linking domestic ETS indirectly through credits, high import quotas and a large supply of credits should lead to stronger convergence of allowance prices in the indirectly linked ETS. Credibility of credits concerning their additionality will be key to enable their common acceptance in a wide range of regions. In general, the relation of credit markets and mechanisms and indirect linking of domestic ETS deserves more research.

In the global trading and 'mixed approach' scenario, Assigned Amount Units (AAUs) are a further emission "currency" that may or may not be allowed in an emissions trading scheme: it is conceivable that companies buy AAUs from governments and use them for compliance in their ETS. In the EU ETS, the use of AAUs that do not have the status of EUAs is not allowed. If regulators are worried that using AAUs does not lead to reductions in emissions in another region (due to "hot air" e.g. in Russia in the 2008-2012 Kyoto compliance period), they may not allow their use. If other systems allow the use of AAUs and a link is established, AAUs will be available indirectly. New Zealand intends to allow the use of AAUs in its ETS.

***Unit of measurement***

If the RGGI scheme was to be linked with the EU ETS, an exchange rate would be needed between the two emissions trading schemes since the unit of measurement

[26] Such standards have been developed in the context of the implementation of the Kyoto Protocol. Ensuring the additionality of emission reductions is the eminent challenge for crediting standards.

differs: While the EU ETS measures emissions in metric tonnes, allowances in RGGI are based on the unit "short ton" (1 short ton = 0.907 metric tonnes). Such an exchange rate will lead to the problem of treating decimal numbers in registries.

Also, if trading systems use $CO_2$-eq as their trading unit they should use consistent conversion metrics such as those defined by the IPPC. Otherwise exchange rates would have to be applied as well to avoid inconsistencies. In general, it seems desirable to harmonize the definition of emission metrics in order to avoid exchange rates and the related increase in complexity.

It can be expected that in a global trade and 'mixed approach' scenario governments will harmonize units of measurements for intergovernmental trading and domestic ETS in order to facilitate data management.

***Banking***

The concept of trading periods usually implies the possibility of intra-period banking: allowances issued in a trading period can be used at any compliance date within that period. Inter-period banking means that companies can bank allowances from earlier trading periods for use in later periods. This reduces price volatility between trading periods and thus enhances certainty for planning companies. If companies expect rising allowance prices in the future (e.g. due to increasingly demanding caps), this will increase the net present value of allowances and increase the current market price. Therefore, banking can increase the environmental effectiveness of an emissions trading scheme as (i) the allowance price may increase, making more abatement profitable, and (ii) companies have an incentive to reduce emissions quickly in order to carry allowances forward into later periods and then sell them at a profit (Newell et al, 2005; Stern 2006 (332f); Burtraw et al, 2006).[27]

If one of the participating regions limits or does not admit the inter-period transfer of allowances, its linkage with emissions trading schemes that do permit the (unlimited) transfer of allowances will enable all companies to transfer their allowances: they can sell their allowances to companies in the respective other region before the end of their trading period and can then buy them back later.

A limitation of banking can make sense in the first trading period of a trading system, in order to prevent the use of allowances from earlier trading periods marked by over allocation, in other words, to prevent the banking of "hot air" that may threaten the environmental effectiveness of a scheme in later trading periods. This has happened in the first trading period of the EU ETS 2005-2007, where serious over allocation took place but was not be transferred to later periods as banking was not allowed.

[27] Burtraw et al (2006) argue that the transferability of allowances (banking) increases the political stability of emissions trading schemes: Through banking companies can accumulate assets; in the event of abolition of the emissions trading scheme they would have to write off these assets. They consequently have an incentive to support the continued existence of the scheme.

Banking rules for domestic ETS in a global trade and 'mixed approach' scenario would very likely follow the rules adopted for the overarching trading structure.

***Borrowing***

Borrowing allows a facility to use allowance allocations of future trading periods for present compliance (under 100% auctioning, borrowing is not possible). If companies heavily rely on borrowing and forego emission abatement measures, this carries the risk of increasing their future compliance costs; the increased compliance burden creates a strong interest to lobby for relaxing caps targets later. Hence, borrowing can compromise the environmental effectiveness of a scheme (Sterk et al, 2006). In addition, companies or facilities may cease to exist after having received their future allocations (Haites and Mullins, 2001). Therefore, borrowing provisions in a partner scheme can be unacceptable for an ETS if it is perceived to carry the potential for weakening the environmental effectiveness of the scheme.

Borrowing rules for domestic ETS in a global trade and 'mixed approach' scenario would very likely follow the rules adopted for the overarching trading structure.

***Point of regulation***

The compatibility of ETS with different points of regulation is commonly discussed in terms of upstream vs. downstream coverage and direct vs. indirect coverage. *Upstream* coverage refers to producers and importers of fossil fuels having to deliver allowances representing the emissions embedded in the resources, while *downstream* coverage means that emission producing facilities have to deliver allowances; the concept of *direct* coverage implies that facilities producing emissions are liable for delivering allowances. *Indirect* coverage refers to emissions embedded in a good such as electricity, where some entity trading the good is held liable for delivering allowances that represent the emission content of the good as defined in a standard.

Linking ETS with different points of regulation is possible in principle. However, when not taken into account problems can arise if there is trade in affected goods, such as transport fuels. If, for example, such a good is exported from a scheme with upstream coverage to a system with downstream coverage, the GHG content of the good would be priced twice. If such situation were to arise, it can be addressed e.g. by excluding coverage of products exported from an upstream scheme into a scheme that regulates the later stages of the process chain. Such exclusions may be implemented by issuing allowances to the exporting company. In fact, such provisions would be necessary even without linking to avoid penalizing the exporter. Alternatively, the systems can harmonize their approaches (MAC, 2007, p35).

If – the other way around – electricity or another affected good is exported from e.g. an indirect scheme to an upstream/downstream/direct scheme, there will be no emission pricing at all (Baron and Bygrave, 2002; Sterk et al, 2006). Again, this issue would also have to be addressed if there was no link between the systems.

When linking domestic ETS in a global trading or mixed approach scenario, there should be no problem with regard to different points of regulation as long as the overarching system ensures that all emissions actually occurring in a country are counted as emissions of this country. In a domestic ETS with e.g. upstream coverage of fossil fuels it needs to be ensured that fuel exporters do not need to surrender allowances for the exported fuel but only for fuel that is delivered for final consumption in the respective region. Such a provision should be easy to implement and would be required even in the absence of linking.

***Allocation***

While the method of allocation is a key feature of any cap and trade system and bears significant implications for its distributive and environmental effects (see e.g. Grubb and Neuhoff, 2006), there should be no major implications arising from allocation when it comes to linking. This is because the impacts of different allocation mechanisms across systems will equally occur both in absence and presence of linking.

However, it can be argued that when linking there will be distributive effects depending on the method of allocation insofar as linking will lead to changes of allowance prices. If an ETS applies grandfathering (allocation based on historical emissions) or benchmarking, there will be winners and losers across companies: net sellers in the high price ETS and net buyers in the low price ETS will lose, while net buyers in the high price and net sellers in the low price ETS will win due to the change of the price level (Haites and Mullins, 2001). In case of updating (allocations based on emissions in a previous period), a possibly already existing incentive for companies to increase their emissions in order to benefit from larger allocations in subsequent periods can be intensified (Jaffe and Stavins, 2007). If an ETS applies auctioning, there will be distributive effects among the authorities that receive the revenue from the auction: the authority in the ETS with a lower pre-linking price will receive more revenue, while the authority in the high price region will receive less. The distributional impacts of the price changes on firms inter alia depend on their ability to pass on allowance costs and the recycling mechanism for revenues from the auction.

In general, in the formal linking, mixed approach and indirect linking scenarios free allocation (e.g. based on benchmarking) can be an instrument to address competitiveness concerns for sectors that may be particularly exposed to competition with regions that do not introduce carbon pricing.

***Sectoral and Gas coverage***

When designing an ETS, sector coverage is an important aspect with regard to international competitiveness of the affected firms. Companies that face an emissions price and that compete with firms that do not face such a price will suffer a loss in

international competitiveness. However, this effect arises irrespectively of whether schemes are linked or not. Linking can affect these distributive effects only to the extent that it will likely alter the allowance price, thus pronouncing (reducing) international competitiveness effects for the covered sectors if emissions prices rise (fall) due to linking. Therefore, from the point of view of linking only there is no need to harmonize the coverage between ETS.

However, sectoral and gas coverage can be an issue when it comes to monitoring related emissions, such as for emissions from land-use change and forestry (LULUCF), and ensuring the permanence of avoided emissions. Therefore, linking partners need to accept MRV and regulatory provisions of the inclusion of LULUCF and possibly other gases that are difficult to monitor.

***Duration of trading and compliance periods***

Differences in trading and compliance periods do not present a problem in a formal linking scenario. Sterk et al (2006) argue that such differences are beneficial as they improve market liquidity: temporary market shortages in one scheme at the end of the compliance period can be credit by purchases from another scheme that is at the beginning of its compliance period. While differing trading and compliance periods will increase the complexity of the overall system in terms of the existence of different relevant dates in the operation of the interlinked systems, this will not represent a problem. Financial products will be available that establish forward prices for allowances taking into account the relevant dates in the linked ETS system.

# Annex II – Description of ETS

## II.1 European Union

***Context***

The EU ETS is the cornerstone of the European Union's climate policy. It is the largest cap-and-trade system implemented across the globe and the first to regulate $CO_2$ emissions. The legislation establishing it was adopted in 2003 (EU, 2003) and operation of the system started in January 2005. Its first trading period 2005-2007 was considered a learning phase and has seen a volatile price development. After an all-time high in 2006, first trading period prices plummeted towards zero as it became increasingly clear that the scheme was overallocated in the first trading period. Forward prices for the second "Kyoto" trading period 2008-2012 have been relatively stable so far. The EU ETS shall be linked to Norway, Iceland and Liechtenstein, Further linking candidates are EU applicants like Croatia and Turkey.

The EU Commission will come up with proposals for a reform of the system for the third trading period after 2012 in January 2008, following an extensive review process including several stakeholder consultations. These proposals could not be taken into account in this study. The following passages describe the design of the EU ETS in the first two trading periods until 2012.

***Coverage***

The EU ETS regulates emissions downstream at the point of emission and covers combustion installations over 20 MW (e.g., the power and heat sector), oil refineries, coke ovens, ferrous metal production (excluding aluminum), cement, glass and ceramics, as well as pulp and paper production. The transportation sector and direct emissions from the commercial and residential sector are not included. Overall, 10.075 installations were covered in October 2006 (EEA, 2007a), representing ~2Gt $CO_2$.

The overall cap in the first trading period amounted to 2298,5 Mt $CO_2$, compared to actual emissions of 2122,16 Mt $CO_2$ in the year 2005, indicating an overallocation of 176,34 Mt in that year. The overall cap for the second trading period has been set at 2080.93 Mt $CO_2$ (EU Commission, 2007).

***Cap***

Cap-setting is a decentralized process in the EU ETS, with revisions applied centrally by the EU Commission. For each trading period, member states submit National Allocation Plans (NAPs) indicating the amount of allowances that they will hand out to the facilities covered under their jurisdiction. The NAPs are then reviewed by the European Commission, which either accepts the plan or proposes corrections based on calculations that take into account several factors. EU Commission decisions on

NAPs for the second trading period have been challenged before court by several member states as their allocation has been cut by the Commission, with decisions still pending.

***Allocation***

In the first trading period, the EU ETS required 95% of allowances to be allocated by member states for free to the regulated entities. In the second phase (2008-2012) this requirement decreases to 90%. Increasing the amount of auctioned allowances is subject to intense discussions in the context of the ongoing review of the system for the trading period after 2012.

Member states have applied very different methods for allocating allowances in the first trading period, including grandfathering, benchmarking (based on different concepts), and – to a limited extent – auctioning.

***Monitoring, reporting and verification (MRV)***

Firms report their emissions annually and must have a third-party verifier attest the accuracy of the emissions data. Only 27 installations in seven member states have applied continuous emissions measurement (EEA, 2007a). After inconsistent implementation of MRV provisions across member states in the past due to a lack of detail in EU regulation, the EU has issued revised MRV guidelines in 2007.

***Registry and unit of measurement***

After some difficulties in the beginning of the trading scheme, the EU ETS features a registry structure where national emission registries are linked to the Community Independent Transaction Log (CITL) that serves as a clearinghouse to verify allowance transfers between national registries. Thus, a bilateral trade between two different member states involves communication between three different electronic data systems.

The CITL is currently in the process of being linked to the UNFCCC's International Transaction Log (ITL), to enable both the transfer of CDM and JI credits into EU ETS accounts as well as the transfer of the AAUs that are attached to the EUAs across EU member states registries for member state Compliance with Kyoto and/or the internal EU burden sharing agreement.

The unit of measurement is 1 metric tonne of $CO_2$-eq.

***Price cap, price floor***

The EU ETS has no provisions for price controls. In several statements EU Commission representatives have made it clear that the Commission will not accept a price cap in the EU ETS.

***Penalty system and enforcement***

Companies that fail to comply have to deliver the amount of missing EUAs in the following calendar year and pay a penalty of €40 per tonne of $CO_2$ in the first trading period, rising to €100 in the second trading period. A penalty regime of this kind consequently implies no price ceiling, and there is no correlation between breaches by companies and the market price for allowances. The Directive also requires the publication of the names of operators who are not in compliance. Each Member States has implemented its own national legislation in case of breach of obligation by the operators covered under the EU ETS, with penalties ranging from fines to imprisonment (EEA, 2007a).

***Credits***

The EU Linking Directive (EU, 2004) allows companies within the EU ETS to use credits generated under the Kyoto flexible mechanisms JI and CDM for compliance. Limits on the use of JI and CDM credits are set in the NAPs and are subject to review by the EU Commission. The weighted EU average import quota after final Commission decisions on NAPs for the second trading period is ~13.4%[28]. As individual installations may only use a maximum amount of credits as indicated by national limits, the full national and EU-wide potential for using credits will not be achieved if some installations do not use their full credit potential. Credits from nuclear and sink projects are not accepted in the EU ETS.

***Banking and borrowing***

From the second trading period on, the EU ETS will allow unlimited banking. Banking was effectively prohibited in the first trading period, allowing the allowance price to fall towards zero but preventing the banking of the allowances exceeding the actual emissions (the overallocation, or "hot air") into later periods.

Borrowing is not allowed in the EU ETS.

***Duration of trading and compliance periods***

While the first trading period lasted from 2005 to 2007 (three years), the second will run from 2008 to 2012 (five years). It is currently subject to discussion if longer trading periods will be implemented in the future, as some argue that this will increase investment certainty for companies.

Compliance is due in the first four months following the calendar year for which allowances have to be issued, that is, until 30 April.

***Linking to other ETS***

In Article 25 the EU ETS Directive (EU, 2003) explicitly states that the EU ETS can be linked to Annex B parties that have ratified the Kyoto protocol. Linking would

[28] Own calculation based on data in European Commission (2007).

occur through recognition of the other parties' allowances within the EU ETS. Formally, a bilateral agreement is envisaged between the EU and such a country.

In addition, the EU has repeatedly stated clearly that it considers the EU ETS to be the potential nucleus of an international carbon market (European Commission, 2006b; Runge-Metzger, 2006).

## II.2 RGGI

***Context***

RGGI goes back to an initiative by New York Governor George E. Pataki. In April 2003 he proposed to 11 Governors of North-Eastern states to discuss the implementation of a regional cap and trade program, covering $CO_2$ emissions from power plants. At this date all North-Eastern and Mid Atlantic states were in different stages of designing and implementing programs to reduce their greenhouse gas emissions. Initially the states of Connecticut, Delaware, Maine, Massachusetts, New Hampshire, New Jersey, Rhode Island and Vermont sent positive responses. Once discussions were underway, Pennsylvania and Maryland as well as New Brunswick and the Eastern Canadian Provinces Secretariat (Eastern Canadian Provinces are: New Brunswick, Prince Edward Island, Nova Scotia, Quebec, Newfoundland and Ontario) sent observers to the process.

In December 2005, seven governors, including those from the states of Connecticut, Delaware, Maine, New Hampshire, New Jersey, New York, and Vermont signed the memorandum of understanding (MoU) for implementing a regional greenhouse gas emission trading scheme. In March 2006 the draft model rule was opened for public discussion and was finally released in August 2006. The model rule provides a set of regulations for the structure and functioning of RGGI. In order to participate, each state intending to take part has to adopt the model rule under its legislation no later than 31 December 2008 (RGGI, 2007a). In January 2007 the governors of Massachusetts and Rhode Island committed their states to join the scheme; Maryland followed in April 2007.

Currently ten states (Connecticut, Delaware, New Hampshire, New Jersey, New York, Maine, Maryland, Massachusetts, Rhode Island, Vermont) plan to introduce a cap-and trade emission trading scheme under RGGI starting on 1 January 2009. Additional states, as for example Pennsylvania, the District of Columbia or Canadian provinces (e.g. New Brunswick), could follow later.

***Coverage***

RGGI covers $CO_2$ emissions of power generators with a capacity of at least 25 MW. As an additional condition, facilities are only included if they feed more than 10% of

their electricity generation into the grid and are fuelled with more than 50% fossil fuels.

At present 629 facilities are covered under RGGI (RGGI, 2007b). Table 3 shows the reporting status of covered states. As various states report in different resolutions, for this report facilities are counted that have a capacity of 25 MW or higher and are reported as 'operating' by the states.

| State | Operating | Retired/ Closed | Deferred | Standby | Planned/ Future/ Under Con-struction | Other/ Undefined |
|---|---|---|---|---|---|---|
| Connecticut | 36 | 7 | 2 | 0 | 0 | 0 |
| Delaware | 34 | 0 | 0 | 0 | 0 | 0 |
| Massachusetts | 83 | 9 | 0 | 0 | 0 | 0 |
| Maryland | 45 | 6 | 0 | 0 | 0 | 1 |
| Maine | 25 | 8 | 0 | 0 | 1 | 8 |
| New Hampshire | 11 | 0 | 0 | 0 | 0 | 0 |
| New Jersey | 123 | 31 | 0 | 0 | 0 | 41 |
| New York | 253 | 16 | 0 | 3 | 2 | 41 |
| Rhode Island | 16 | 5 | 0 | 0 | 0 | 0 |
| Vermont | 3 | 0 | 0 | 0 | 0 | 0 |
| **SUM** | **629** | **82** | **2** | **3** | **3** | **91** |
| District of Columbia | 2 | 0 | 0 | 0 | 0 | 0 |
| Pennsylvania | 193 | 12 | 4 | 0 | 3 | 6 |
| **SUM** | **195** | **12** | **4** | **0** | **3** | **6** |
| **OVERALL** | **824** | **94** | **6** | **3** | **6** | **97** |

*Table 3: Covered Power Plants under RGGI by Sub-Regions.*
*Note: States that are highlighted in grey only have an observer status in RGGI.*
*Source: RGGI (2007b)*

***Cap***

Emissions will be capped at BAU level until 2014 (including). The exact allocation is illustrated in Table 4. In the period from 2015 – 2018 an annual reduction of 2.5% is intended, summing up to 10% over the whole period. The system includes a safety valve regulation, which might lengthen the commitment period; a description of this feature is given below.

Until 2014 emissions in the RGGI states are capped at 170.6 Mt $CO_2$. From 2015 to 2018 an annual reduction of approximately 4.3 Mt is envisaged.

A working group is established to monitor whether there will be leakage of emissions under the RGGI scheme, i.e. whether there is any increase in electricity imports into the RGGI region, and consider potential options for addressing such leakage (RGGI 2005).

| State | Emissions in the year 2003 | Annual cap 2009-2014 | Annual Reduction 2015 – 2018 |
|---|---|---|---|
| New York | 49.5 | 58.3 | 1.46 |
| Maryland | 30.0 | 34.0 | 0.85 |
| Massachusetts | 24.5 | 24.2 | 0.61 |
| New Jersey | 19.8 | 20.8 | 0.52 |
| Connecticut | 7.7 | 9.7 | 0.24 |
| New Hampshire | 5.3 | 7.8 | 0.2 |
| Delaware | 4.9 | 6.9 | 0.17 |
| Maine | 4.9 | 5.4 | 0.14 |
| Rhode Island | 2.6 | 2.4 | 0.06 |
| Vermont | 0.02 | 1.1 | 0.03 |
| **Total** | **149.22** | **170.6** | **4.28** |

*Table 4: $CO_2$ emissions (Mt $CO_2$) of electric power plants (≥25MW) in RGGI states in the year 2003 and their envisioned cap for the first period 2009-2014 (Environment Northeast (2004), RGGI (2005), Aburn and Woolf (2007) converted into millions of metric tonnes).*

***Allocation***

The choice of method for distributing emission allowances is in principle left to the states. However, they are obliged to auction at least 25% of the allowances and use the proceeds from the auction to finance energy efficiency programs, renewable energy funds, tax relief or other public benefit programs. Additionally, the proceeds are supposed to fund the administration of the scheme. Various states (e.g. Connecticut, New York, Massachusetts, Maine and Vermont) have proposed to auction 100% of the allowances, while other states (e.g. New Jersey) consider to auction "up to" 100% of the allowances.

***Monitoring, Reporting and Verification (MRV)***

The RGGI model rule outlines detailed specifications for monitoring and reporting requirements in accordance to 40 CFR part 75[29]. Certification will be a matter of the regulating agencies in accordance to the requirements of 40 CFR part 75.

Entities are obliged to report quarterly to the regulating state agency, e.g. the ministry for environment. Monitoring regulations outlined in 40 CFR 75 basically rely on the detailed measurement of emissions, which generally implies monitoring of emissions instead of calculating them on the basis of emission factors. However, exceptions are outlined for facilities primarily using oil and natural gas allowing the use of fuel specific emission factors in order to calculate the overall emissions. It can be assumed that a larger part of entities covered under RGGI can use facilitated monitoring regulations based on emission factors.

[29] CFR stands for "Code of Federal Regulation" in the USA, being divided in a total of 50 parts. Part 40 is generally captioned with "Environmental Protection". Part 75 regulates "continuous emissions monitoring".

***Registry and unit of measurement***

Generally the US Environmental Protection Agency (EPA) is responsible for maintaining the national GHG registry according to international guidance by the UNFCCC. However, the EPA does not produce state level estimates leaving this responsibility to state environmental agencies (Tatsutani, 2004). Therefore a common registry for RGGI states with harmonized standards is not in place. Some efforts to create a regional greenhouse gas registry (RGGR) have been taken in the past but are now summarized in The Climate Registry, a voluntary initiative aiming to establish a common greenhouse gas emission registry[30]. All participating RGGI states are members of The Climate Registry.

Emissions under RGGI are measured in short tons (1 short ton ≈ 0.907 metric tonnes). In order to calculate the global warming potential (GWP) of greenhouse gases other than $CO_2$ the RGGI scheme uses GWP definitions outlined by the IPCC's 3rd assessment report. Even though the RGGI ETS initially covers $CO_2$ emissions only, GWPs are necessary for integrating credits that might also include other greenhouse gases.

***Price cap, price floor***

The scheme provides for a two-stage safety valve arrangement: A "Credits Trigger Event" is deemed to have occurred if the average regional spot price for $CO_2$ allowances equals or exceeds a specified threshold price (initially US$ 7 per tonne) for a period of twelve months. A "Safety Valve Trigger Event" is deemed to have occurred if, over the course of the preceding twelve months, the average regional spot price for $CO_2$ allowances equals or exceeds US$ 10, plus 2% per year as of 2006, as adjusted by the Consumer Price Index (CPI) (RGGI, 2007a). When the first safety valve trigger is reached, an installation may use CDM and JI credits to cover up to 5% of its emissions (RGGI, 2006). When the second safety valve trigger is reached, the given compliance period may be extended by one year, i.e. for a maximum compliance period of 4 years. In addition, credits and allowances from international trading programmes (most likely CDM, JI, EU ETS) may also be used. Also, the percentage of usable credits per installation increases to 10% for the compliance period (RGGI, 2006). The safety valves are each only triggered for a period of one year.

The RGGI scheme does not foresee a price floor.

***Penalty system and enforcement***

In case a participant does not hold not sufficient allowances to cover its emissions at the end of a compliance period, the regulatory agency will automatically deduct allowances for the next compliance period equaling three times the missing amount. It is not possible for the participant to cover the missing amount by credits. The

[30] For more information see http://www.theclimateregistry.org

authority for enforcement of compliance rests with the state authority implementing the program.

***Credits***

A new credit scheme will be established under RGGI, allowing credits from credit projects located in participating states or other U.S. states or jurisdictions[31] (RGGI 2007a, pp. 104). In general 3.3% of a facility's emissions can be covered by credits. In average this is equivalent to 50% of the required reduction efforts. The following types of projects are eligible under the RGGI program:

- Landfill methane capture and destruction
- Reduction in emissions of sulphur hexafluoride ($SF_6$)
- Sequestration of carbon due to afforestation
- Reduction or avoidance of $CO_2$ emissions from natural gas, oil or propane end-use combustion due to end-use energy efficiency
- Avoided methane emissions from agricultural manure management operations

It is conceivable that further project types follow. Projects that commenced after 20 December 2005 are eligible, if they satisfy certain additionality requirements; e.g. they have to be motivated by the RGGI scheme and not by other domestic legislation. The eligibility expires if credit programs are covered by any other legislation at a later time (RGGI 2007a, p. 106), for example if a third party state where a credit project is situated implements a cap and trade regime.

In general, no credits from CDM and JI are allowed for compliance. If the safety valve trigger is activated (see respective Section above), these and possibly EUAs become eligible for compliance (see price cap above).

***Banking and borrowing***

The scheme foresees unlimited banking of allowances between trading periods (RGGI 2005, 2007a). Borrowing is rejected.

***Duration of trading and compliance periods***

The compliance period in RGGI lasts a minimum of three years. Participants are obliged to send a compliance certification report to the regulating agency not later than March 1 of the year following the end of the compliance period. Based on this report the regulating agency deducts $CO_2$ allowances from a participant's compliance account.

Specific regulations are in place in case of a safety valve event as outlined below, which can lead to an extension of the compliance period of up to four years.

[31] Credits from states outside of RGGI are eligible if those states have established a cap and trade regime for $CO_2$ or have signed a memorandum of understanding regarding credits with the RGGI state.

***Linking to other ETS***

RGGI has expressed its interest in linking to other schemes, e.g. an emerging WCI scheme. Some RGGI states (Maine, Maryland, Massachusetts, New York and New Jersey) represent the scheme in the International Carbon Action Partnership (ICAP).

## II.3 New Zealand

***Context***

From December 2006 to March 2007 the New Zealand (NZ) government started consultations on various climate policy options, including emission trading, carbon taxes, incentives, subsidies, direct regulatory measures and voluntary approaches. The outcome of the consultations showed broad support for an emission trading scheme. As a response the government decided in principle to adopt an emission trading scheme in New Zealand with the goal to reduce the country's greenhouse gas emissions below business as usual levels.

The framework paper for an upcoming NZ ETS was released in September 2007 by the Ministry for the Environment and the Treasury (NZ MfE, 2007). It communicates in-principle decisions of the government on core design features of an NZ ETS as well as preferred options for more detailed issued. These are all meant to be subject to further public debate until legislation to enact the core elements of a NZ ETS is introduced and passed in the Parliament, which is scheduled for the current Parliament legislation session. The framework paper foresees to eventually include all sectors of the economy and all relevant greenhouse gases until 2013.

Apart from promoting emissions trading, New Zealand is implementing other policies that are supposed to curb greenhouse gas emissions including energy efficiency programs and promotion of renewable energies. Aiming to be carbon neutral in the energy sector by 2040 the government has set ambitious general goals, including 90% of electricity generation coming from renewable sources by 2025 and reducing per capita transport GHG emissions by half compared to those in 2007 by 2040 (NZ MED, 2007).

***Coverage***

The NZ ETS is supposed to eventually cover all major sectors and all major greenhouse gases mentioned in the Kyoto Protocol. The first sector to be included is the forestry sector in 2008. In a second stage 2009, liquid fossil fuels mainly used by the transport (including national flights) sector will follow. In 2010 emissions from stationary energy defined as coal, natural gas and geothermal power plants as well as industrial process emissions are planned to be included in the scheme. Finally, agriculture, waste and other emissions shall enter the NZ ETS in 2013.

| | Covered Sectors | Number of Participants | Preferred Point of Regulation | Absolute Emissions in 2005 [Mt $CO_2$eq] |
|---|---|---|---|---|
| **Stage 1 (2008)** | Forestry | > 1000 | Downstream | N/A[32] |
| **Stage 2 (2009)** | Liquid Fossil Fuels (mainly transport) | ~ 5 | Upstream | 15 |
| **Stage 3 (2010)** | Stationary Energy | ~ 45 | Upstream | 22.8 |
| | Industrial Processes | ~ 35 | Downstream | |
| **Stage 4 (2013)** | Agriculture | ≥ 35 | Upstream | 39.2 |
| | Waste | ~ 60 | Downstream | |
| | Others | N/A | N/A | |
| ***Sum*** | -- | > 1180 | -- | 77 |

*Table 5: Coverage of NZ ETS*

The detailed design of the NZ ETS is still under discussion. However, one guiding principle of the NZ government is to minimize the number of participants in the scheme (NZ MfE, 2007). Therefore, a strong preference for upstream coverage is expressed, while a final decision has still to be taken.

In the forestry sector landowners owning forests that existed before 1990 being still forested are obligatorily included in the NZ ETS. Others can choose to join on a voluntary basis. Deforestation and afforestation post 1989 will be subject to crediting. Emissions occurring from deforestation of a pre-1990 forest need to be covered by emission credits or allowances. Allowances will be handed out for Afforestation activities. Landowners holding less than 50 hectares of pre-1990 forest land will be excluded. As it cannot be foreseen how many landowners decide to join the scheme voluntarily, it is difficult to estimate the number of landowners that finally will be covered. The NZ government estimates a coverage ranging from the at least 1000 participants that will be obliged to enter the scheme to up to 9000.

The NZ government decided to regulate the entire energy sector consisting of liquid fossil fuels and stationary energy upstream. Participants with obligations will thus be located at the point of fuel supply, production or import. Liquid fossil fuels that are supposed to be included in the scheme being mainly used in the transportation sector include petrol, diesel, aviation gasoline, jet kerosene, light fuel oil and heavy fuel oil. Lubricating oils shall be excluded from the scheme due to administrative difficulties. The oil companies importing refined liquid fossil fuels to New Zealand or removing them from a refinery are expected to be the five companies BP, Caltex, Gull, Mobil

[32] The NZ government foresees allowances representing 21 Mt $CO_2$ eq in the forestry sector for the period between 2008 and 2012.

and Shell. Fuel that is intended to be exported or to be used on international trips shall be excluded from the NZ ETS.

In the case of stationary energy the NZ government pictures two major options. The first one would include importers and miners of fossil fuels (coal, natural gas), geothermal electricity generators or direct users of heat from geothermal sources and industrial producers obtaining used oil for purpose of combustion. The second option is a combination of up- and midstream regulation that targets coal wholesalers and gas distributors, for example. The government also discusses to include large energy users (e.g. large electricity generators or industrial producers) directly into the scheme, carving out their emissions from upstream points of regulation. The administrative burdens of such an approach are however considered to be high.

Producers of industrial products shall be covered directly as emitters of process emissions. Producers of steel, aluminum, cement, burnt lime, glass, gold and paper as well as producers of lime fertilizer shall be included. In order to face the loss of inert synthetic gases, electricity and refrigeration industry entities that import relevant gases are also supposed to be covered by the scheme.

The agricultural sector is a major source of GHG emissions in New Zealand. Especially $N_2O$ emissions from fertilizer use and $CH_4$ emissions from enteric fermentation and manure management play a pivotal role. The NZ government prefers to include the agricultural sector into the NZ ETS on a company/processor level point of obligation, even though it expresses some interest in further discussing this issue. It is proposed to include fertilizer companies and dairy processors in the scheme, while for other animal agriculture the primary (meat) processor level shall be covered.

The NZ government proposes to include landfill operators. Occurring emissions (especially Methane) are supposed to be calculated based on the volume of waste received at a landfill. Methodologies to calculate emissions shall be developed in cooperation with the sector.

***Cap***

The NZ government does not specify an overall cap for the NZ ETS. However, the allowances being issued in the NZ ETS will relate to the country's Kyoto commitment and any possible commitment established under a post-2012 regime. In the Kyoto protocol New Zealand pledged to cap its GHG emissions at the 1990 emissions level; this would be equivalent to 61.9 Mt $CO_2$ eq. Currently New Zealand is far from reaching this goal as for the year 2005 the UNFCCC reports total greenhouse gas emissions of 77.2 Mt $CO_2$ eq. for New Zealand, a change of + 24.7% compared to 1990 (NZ MfE, 2007a).

For the purpose of protecting certain sectors' profits and international competitiveness, the government report discusses the option of introducing "progressive unit obligations" for the stationary energy and industrial process sectors

(and possibly agriculture) for transitional periods (NZ MfE, 2007, pp.38): participants would have to surrender allowances or credits only for a fraction of their emissions. For example, with a 50 per cent obligation, one allowance or credit would entitle them to emit two tonnes of GHG emissions. This provision would be phased out over time. Such a provision leads to a de facto increase of the overall cap, and should thus lead to a reduction in allowance prices. In effect, it changes the unit of measurement of the scheme: overall, more emissions would be allowed than suggested by the nominal cap and one NZ ETS allowance would represent emissions of more than 1t $CO_{2eq}$. This appears problematic with regard to linking to other ETS: an exchange rate would need to be introduced and the overall cap of an NZ ETS would require re-estimation. While the New Zealand government has expressed that it favors free allocation over progressive unit obligations as an instrument for addressing distributive and international competitiveness concerns, it states its openness to discuss the introduction of such a provision in the NZ ETS.

***Allocation***

Auctioning of emission allowances is considered to be the simplest method of allocation by the NZ government. However, considering significant financial shocks for participants, free allocation is seen as assistance for participants in a transition period. In the industrial process and agriculture sectors, a free allocation pool of 90% of 2005 emissions is envisaged. Until 2025, any free allocation shall be linearly phased out.

The forestry sector is the first sector to be included into the NZ ETS. The government plans to allocate emission allowances to landowners by application. Therefore it foresees to freely allocate 21 million emission allowances in the period from 2008 to 2012 and another 34 million allowances in the period from 2013 to 2020 to cover emissions from deforestation activities. In addition, allowances will be issued for afforestation activities. Whether privately owned indigenous forests will be included in the scheme is still under discussion. If included, NZ government plans to issue 3.1 million allowances in the period from 2008 to 2012. In addition to that another five million are foreseen for privately owned indigenous forests for the period from 2013 to 2020 (NZ MAF, 2007).

In the energy sector (liquid fossil fuels and stationary energy) allowances shall be sold, e.g. through auctions.

Allowances for industrial processes will be freely allocated on basis of their recent historical emissions (grandfathering). The government sees administrative benefits of a grandfathering approach in comparison to benchmarking.

When the agricultural sector enters the scheme, 90% of the credits based on 2005 levels shall be allocated for free. Therefore the NZ government distinguishes three options:

1. to allocate allowances directly to farmers on the basis of historical emission levels or some other proxy for emissions,
2. to allocate allowances to processors, based on the historical emissions of throughput,
3. to allocate allowances to sector bodies based on historical production throughput.

Even though the NZ government is still discussing the detailed modalities, it is obvious that some form of grandfathering in the agricultural sector is envisaged.

Free allocation to industrial emitters and agriculture (not: forestry) will be phased out linearly from 2013 to 2025. New emission sources that begin emitting during the period of the initial free allocation will not be granted access to the pool of free allocations.

The NZ government is not planning any free allocation in regard to landfill operators. As it is the case in the energy sector, an auction is considered to be the simplest method of allocation.

***Monitoring, reporting and verification (MRV)***

No detailed rules for MRV are outlined in the framework document. However, some general remarks are given. It is recognized that monitoring and reporting is an essential element in the scheme to ensure effective compliance. It is discussed to distinguish between generic aspects and specifications for participating sectors or sub-sectors. In principle the reporting guidelines in the NZ ETS shall be consistent with the UNFCCC national inventory reporting system and with the accounting guidelines specified in the Kyoto protocol. Reporting shall be at least on a yearly basis, but is proposed to be more frequent. Thus, in the framework document mandatory quarterly reporting is proposed with a voluntary option to report monthly.

The NZ government plans to include methodologies how participants should calculate their emissions in regulations instead of legislation so they can be modified without having to pass the legislative process in Parliament. Emissions shall be determined on the basis of emission factors related to the output (e.g. liters of petrol).Therefore emission factors for specified activities that shall be integrated in the scheme are outlined in the framework paper's appendix. Where standard emission factors are not eligible the possibility for participant-specific emission factors is discussed.

In regard to verification various issues shall be discussed with stakeholders, including independent third-party verification of participants' annual reports. In principle the government expresses its preference for the administering agency to verify the participants' compliance with their obligations.

***Registry and unit of measurement***

In its framework document, the New Zealand government proposes to build on the existing registry infrastructure implemented for Kyoto compliance. The Climate Change Response Act 2002 (CCRA) basically implements New Zealand's obligations under the Kyoto Protocol, including the establishment of a national registry and a national inventory of GHG emissions. It is proposed to modify the CCRA using synergies between the act and an upcoming ETS, especially in regard to the registry.

The unit of measurement will be tonnes of $CO_2$ eq. GWPs outlined in the Kyoto Protocol[33] are used for calculating the impacts of various GHG. The trading unit will be named New Zealand Unit (NZU).

***Price cap, price floor***

In general, there shall be no price cap or price floor in the NZ ETS. However, for the case there is no international climate policy agreement post-2012, it is proposed that the government should retain the power to introduce a price cap to avoid excessive burden on the New Zealand economy.

***Penalty system and enforcement***

The NZ government outlines detailed rules in case a participant fails to meet its obligations. Any failure will lead to an obligation to make up for the shortfall within 90 days at a ratio of 1:1. Furthermore the failure will lead to a financial penalty of NZ$ 30 per emission unit that has not been surrendered. The identity of the participant not meeting its obligation will be published.

The make-up amount can be raised to a ratio of 1:2 in case a participant knowingly fails the obligation. In this case the financial penalty rises to NZ$60 per missing emission unit, and participants (or their directors, in the case of companies) will face the possibility of criminal conviction (NZ MfE, 2007, p55).

***Credits***

Kyoto units will be allowed in the NZ ETS, namely AAUs, CERs (CDM) and ERUs (JI). The government has decided in-principle that it will retain powers to restrict the use of some kinds of credits and has already decided that CERs and ERUs from nuclear projects, as well as lCERs and tCERs are not eligible under the NZ ETS. Also, it is considered to exclude credits from HFC-23 CDM programs. A domestic credit program is under discussion.

Importantly, New Zealand considers allowing AAUs to be used in its ETS. While AAUs are no credits, the permission to allow these for compliance has similar implications as the permission of credits: by using AAUs, allowances (NZUs) are set free that can be sold to a linked system. The EU ETS does not allow the use of AAUs,

[33] GWPs used in the Kyoto Protocol are those defined by the IPCC's 2nd assessment report.

which can be seen against the background of overallocation of AAUs to Economies in Transition (EITs) such as Russia and Ukraine in the Kyoto Protocol, commonly referred to as "hot air". When allowing AAUs for use in the EU ETS, it can well be expected that the allowance price would fall due to the overallocation in the Kyoto system. In the context of the EU refusal of enabling the use of AAUs, linking the NZ ETS and EU ETS could become problematic as AAUs would indirectly available in the EU ETS. Through arbitrage trading participants under the NZ ETS could sell NZUs to the EU ETS and purchase AAUs for domestic compliance instead (maximally up to the amount of issued NZU, i.e. in the order of magnitude of less than ~98Mt $CO_{2eq}$).

***Banking and borrowing***

Unlimited banking between trading periods shall be allowed. On the other hand borrowing is recommended to be rejected.

***Duration of trading and compliance Periods***

Compliance periods are supposed to be one year. In the forestry sector the initial compliance period will last for two years.

The first trading period is supposed to end with termination of the Kyoto period 2012. Depending on the point in time a sector enters the scheme, the trading period therefore varies from sector to sector. A second trading period is envisaged from 2013 to 2020.

***Linking to other ETS***

The NZ government expresses strong interest in linking the NZ ETS to other ETS. In this context a major interest is expressed for linking to an upcoming ETS in Australia due to the strong economic relationship between the two countries. Other regions as for example the EU are considered as well (NZ MfE 2007, pp42). The potential for bilateral linking prior to 2012 is considered to be limited. The framework document also outlines the potential harmonization of MRV between ETS in the long run.

## II.4 California

***Context***

On June 1st 2005 Governor Schwarzenegger signed the Executive Order S-3-05, comprising the following future emission reduction targets for California:

- 2000 levels by 2010
- 1990 levels by 2020
- and 80% below 1990 levels by 2050

The California Global Warming Solutions Act of 2006 sets an enforceable target for the state of California to reduce its greenhouse gas emissions[34] to 1990 levels by 2020. The California Air Resources Board (CARB) is responsible for developing and implementing a plan that achieves this target.

In 2006, Governor Schwarzenegger directed the Secretary for Environmental Protection to create a Market Advisory Committee (MAC) to advise the California Air Resources Board on developing a greenhouse reduction plan until 2020. The Secretary for Environmental Protection then charged the Market Advisory Committee to develop a plan for a California cap-and-trade system, which it delivered on June 30, 2007 (MAC, 2007). This report is summarized in the following Sections of this chapter.

Apart from developing an emissions trading scheme that could commence operation on 1 January 2012 (MAC, 2007), California is implementing other regulation to reduce its carbon footprint. Concerning the power sector, Senate Bill 1368 directs the California Public Utilities Commission (PUC) and the California Energy Commission to set a GHG performance standard for base-load power plants providing electricity to Californian users (this includes power plants outside California). This emissions standard is set at the GHG rate of a combined cycle natural gas power plant (~500g $CO_2$ per MWh) and applies for utilities in- and outside California (MAC, 2007). Concerning short- to mid-term regulation of the Californian transportation sector, Governor Schwarzenegger in January 2007 pledged to implement a low-carbon fuel standard to transportation fuels sold in California, with the aim of reducing the carbon content of passenger-vehicle fuels in the state by at least 10% by 2020 (MAC, 2007).

In addition to these domestic efforts, California has taken a leading role in the Western Climate Initiative (WCI). WCI is a sub-national level collaboration of states and provinces aiming at jointly reducing GHG emissions. WCI comprises six U.S. states (California, Arizona, New Mexico, Oregon, Utah, and Washington) and two Canadian provinces (British Columbia, Manitoba) as full members. Their combined emissions in 2005 were ~910Mt $CO_2$eq (WCI, 2007). Observers include Colorado,

[34] The Act covers all GHGs defined in the Kyoto Protocol: $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, $SF_6$

Kansas, Nevada and Wyoming in the U.S., Ontario, Quebec and Saskatchewan in Canada, and the state of Sonora in Mexico. On 22 August 2007 the eight WCI full members announced their goal to reduce combined emissions 15% below 2005 levels by 2020 (WCI, 2007). They also determined criteria[35] for regions wishing to join WCI and agreed to establish a decision-making process on adopting joining regions. WCI members declared that they will propose a design for a regional market-based multi-sector mechanism, such as a load-based cap and trade program, to achieve the regional GHG reduction goal by August 2008 (WRCAI, 2007). The MAC (2007) proposal for a Californian ETS is also to be seen in this context. Furthermore, governor Schwarzenegger clearly expressed his intention that the envisaged regional WCI ETS "will provide a powerful framework for developing a national [US] cap and trade program" (California, 2007).

***Coverage***

Concerning coverage of a Californian ETS, the Market Advisory Committee has proposed four options that are subsequently discussed. Table 6 provides a synopsis of the options.

*Program 1: Similar to EU ETS.*

Scope: Medium and large scale sources of $CO_2$ from electricity, refining, cement production and other industrial process sources (threshold e.g. 10,000 metric tonnes $CO_2e$); and sources of $N_2O$, HFCs, PFCs, and $SF_6$. Transport not included.

Point of Regulation: Downstream coverage (at point of combustion), and inclusion of imported electricity.

Coverage: ~39% of 2004 Californian GHG emissions (193Mt $CO_2e$). ~450 facilities, excluding agents responsible for embodied emissions in imported electricity.

*Program 2: Program 1 with upstream coverage of transportation*

Scope: All sources of program 1 plus transportation sector. Gasoline and diesel exports would be exempted by a special provision.

Point of Regulation: Upstream coverage (petroleum refiners and importers of refined products) of transportation sector, downstream coverage for all other sources (at point of combustion), and inclusion of imported electricity.

[35] These criteria include:
1. An economy-wide GHG reduction goal, reflecting the WCI reduction target
2. Development of a multi-sector climate action plan to achieve that goal
3. Commitment to GHG tailpipe standards for passenger vehicles
4. Participation in The Climate Registry, a collaboration between US states (as well as British Columbia and Manitoba in Canada, and Sonora in Mexico) aimed at developing and managing a common greenhouse gas emissions reporting system.

Coverage: ~72% of 2004 Californian GHG emissions (356 Mt $CO_2$e). ~450 combustion facilities plus ~30 refiners and importers of petroleum, excluding agents responsible for embodied emissions in imported electricity.

*Program 3: Program 2 plus upstream coverage of $CO_2$ from other sectors*

Scope: all sources of Program 2, plus upstream coverage of $CO_2$ from small industrial and commercial facilities and residential users

Point of Regulation: Points of Regulation like Program 2, plus distributors of natural gas to small industrial, commercial and residential users.

Coverage: ~83% of 2004 Californian GHG emissions (409 Mt $CO_2$e). ~450 combustion facilities, ~30 refiners and importers of petroleum, and ~10 local natural gas distribution companies, excluding agents responsible for embodied emissions in imported electricity.

*Program 4: All fossil fuels upstream, all process emissions downstream*

Scope: all $CO_2$ content of natural gas, petroleum, and coal combusted in California. This includes all sources of programs 1, 2, and 3, including cement production and other process emissions, and sources of $N_2O$, HFCs, PFCs, and $SF_6$.

Point of Regulation: Upstream for natural gas, petroleum, and coal. Downstream for industrial process emissions and $N_2O$, HFCs, PFCs, and $SF_6$. Inclusion of imported electricity.

Coverage: ~83% of 2004 Californian GHG emissions (409 Mt $CO_2$e). ~150 facilities, excluding agents responsible for embodied emissions in imported electricity.

All of the proposed programs exclude emissions from sources such as livestock and agricultural soils (7.5 percent of California 2004 emissions), $N_2O$ from mobile sources (2.5 percent), and methane emissions from landfills (1.7 percent), which is due to monitoring difficulties (MAC, 2007). Also, jet fuel (4.5 percent) is not taken into account because inclusion of jet fuel would lead to jet fuel simply being purchased outside California.

The Market Advisory Committee explicitly proposes inclusion of the transport sector to a California ETS (MAC, 2007, 35), as a more encompassing ETS creates more emission-reduction opportunities. Potentially problematic issues with inclusion of the transport sector include potentially low price-elasticity of transportation fuel demand, the question whether other regulation (e.g., low-carbon fuels standard, motor vehicle GHG standards) is not sufficient to reduce emissions from the transport sector, and the administration costs of ETS-inclusion of road transport. However, discussing these issues the MAC concludes that they do not represent significant arguments

against the inclusion of transportation into a cap and trade system (MAC, 2007, pp 35).

| | Sectors and Point of regulation | | | | Absolute Emissions in 2004 in Mt $CO_2$eq | Share of total GHG emissions | Number of Facilities |
|---|---|---|---|---|---|---|---|
| | Electricity, refining, cement, and other industrial processes above 10k $CO_2$eq | Sources of $N_2O$, HFCs, PFCs, and $SF_6$ | Transport | Small industrial, commer-cial facilities, residential | | | |
| Program 1 | Downstream | Downstream | | | 193 | 39% | ~450 |
| Program 2 | Downstream | Downstream | Upstream | | 356 | 72% | ~480 |
| Program 3 | Downstream | Downstream | Upstream | Upstream | 409 | 83% | ~490 |
| Program 4 | Upstream | Downstream | Upstream | Upstream | 409 | 83% | ~150 |

*Table 6: Scope and point of regulation of the four program options proposed by MAC (2007).*

A majority of MAC members propose to start implementation of a California trading scheme with program 1, and gradually increase coverage to programs 2 and 3 over time. Some MAC members prefer to implement program 4 from the beginning (for a discussion see MAC 2007, pp 37).

California imports ~20% of its electricity from neighbor states, only five of which are members to WCI (and thus subject to a potential regional WCI ETS). Emissions from imported electricity represent 12% of overall California GHG emissions. In order to avoid leakage of emissions from power production to neighbor states that are not parties to a California or WCI ETS, the MAC recommends indirect coverage of emissions from power generation. That is, an entity has to deliver allowances embedded in the generated or traded electricity, no matter whether the electricity stems from power plants in- or outside the state. Two points of regulation are discussed:

- In a *load-based approach* the obligation for compliance would rest with an electricity load-serving entity (LSE). LSEs are companies that purchase power on the wholesale market and deliver it to customers (Californian LSEs include municipal utilities, investor owned retailers, co-ops, and other entities). That is, LSEs are responsible for surrendering allowances for both imported electricity and power generated in California.
- In a *first-seller approach* the obligation for compliance is placed on the first seller of power into Californa, i.e. the owner or operator of a California power

plant or the importing contractual party (e.g., a wholesale power marketer, not necessarily a LSE).

In both approaches, emissions embedded in the electricity need to be defined as an emissions standard. Such a standard can be defined for electricity from specific plants for about 56% of imported power. The remainder of imported electricity would probably have to be assigned an emission intensity standard, e.g. average emission intensity for the originating control region, or a high default intensity corresponding to the intensity of the highest polluting sources in the region.

Comparing the two approaches with respect to their environmental integrity, implications for consumer prices, cost-effectiveness, and ability to serve as a model for broader (multi-state or national) ETS, the MAC recommends to adopt the first-seller concept due to its relative simplicity and ease of emissions accounting.

***Cap***

Concerning the specification of the cap, the MAC (2007) proposal does not propose a specific cap. However, the MAC analysis provides some guidance on the level of the ETS cap if the overall Californian reduction effort is to be achieved.

Table 7 indicates the contribution of sources covered under the four ETS scope options to the overall Californian GHG reduction goal (1990 emission levels in 2020) for different assumptions on the CAL ETS reduction goal. Reduction levels are calculated against a BAU emission scenario for 2020. Note that if option 3 or 4 were implemented with a 20% ETS reduction target, sectors outside the California ETS (e.g., $N_2O$ from agriculture) would have to reduce their emissions by 73% in order to meet the overall target. Discussing these figures MAC (2007, 33) "suggests" that a CAL ETS should aim at reduction levels "significantly higher than 20%". More precise guidance on the suggested ETS reduction target can be derived when combining the presented data and wording of the recommendation: assuming implementation of program 3 or 4, and business-as-usual emissions in the non-covered sectors, the MAC recommendation would imply a ~35% reduction target (below BAU).[36] The level of stringency would have to be higher if the overall coverage of the CAL ETS was lower (Programs 1 and 2), and depends on the level of emission reductions in non-ETS sectors. The MAC recommends that the ETS should start with a more lenient cap and increase its stringency gradually.

[36] The MAC recommends: "In 2020, the emissions cap in a California GHG trading program should be set equal to total allowable emissions under the Global Warming Solutions Act minus projected emissions from sources and sectors not covered by the cap-and-trade program." (MAC 2007, 38). If this implies business-as-usual emissions (BAU) in the non-ETS sectors, which are projected to be 102.1 Mt $CO_2$e in 2020, the CAL ETS reduction rate can be easily calculated: With an overall target of reducing GHG emissions by 174.2 Mt $CO_2$e compared to BAU in 2020 that would in this case would have to be fully delivered by the ETS sectors, and projected BAU emissions of 498.7 Mt $CO_2$ in the ETS sectors in 2020, the ETS would have to set a reduction target of 174.2/498.7*100=34,9%

| Program | Percentage contribution to overall reduction goal if ETS cap requires reduction of… | | | |
|---|---|---|---|---|
| | 10% | 20% | 30% | 40% |
| 1 | 13 | 27 | 40 | 54 |
| 2 | 25 | 50 | 74 | 99 |
| 3 | 29 | 57 | 86 | 114 |
| 4 | 29 | 57 | 86 | 114 |

*Table 7: Contribution of different programs to California emissions reductions goal (MAC 2007).*

***Allocation***

The MAC proposes to increase the amount of auctioning over time. For sectors able to pass on opportunity costs of allowances to consumers (in particular, the private electricity sector), it is recommended to start with higher rates of auctioning. Some free allocation (using benchmarking to reward early action) is recommended to address competitiveness issues for industries in competition with facilities in other regions that are not subject to emission pricing.

Concerning use of the revenue from auctioning, MAC (2007) recommends to use a considerable share of revenues to promote end-use efficiency among residential, commercial and industrial energy consumers, and to increase assistance to low-income consumers. Other uses proposed for auction revenues include:

1. reductions in income taxes,
2. adaptation measures in California,
3. reduction of the impact of cap-and-trade system by lowering taxes to the general public, e.g. reducing State tax rates, or issuing rebate checks,
4. support workers or firms that suffer competitive pressure from uncapped facilities (industries with substantial GHG emissions, large industrial and commercial consumers of electricity and natural gas).

The MAC concludes that California may convene an advisory group with representatives from the Departments of Finance and the Legislature as well as experts on energy, environmental, tax and budgetary policy to prepare a study on the options for recycling revenues to businesses or individuals.

***Monitoring, reporting and verification (MRV)***

MAC (2007) recommends that a California ETS should rely on monitoring and reporting methodologies established by the California Climate Action Registry (CCAR)[37] to the maximum extent feasible. It may also rely on existing national

[37] California created the CCAR in 2000. CCAR is a public-private partnership project developing industry-specific protocols for emissions reporting. Using the protocols developed by CCAR, CARB

regimes for monitoring $CO_2$ from fossil fuel combustion (developed e.g. under the Acid Rain program). Data auditing should be implemented annually, and could be conducted by state or regional/local jurisdiction.

If an upstream approach is chosen for the transportation sector, California would need to create a system to monitor the amount of carbon sold by refiners and importers in the form of gasoline and transport diesel fuel. MAC (2007) notes that there may be opportunities to take advantage of fuel monitoring procedures created to implement California's Low Carbon Fuel Standard. However, such a system currently does not exist, which is one of the arguments by some MAC members for starting with Program 1, and to only later move to programs 2 and 3 when the required monitoring technology is available.

If an upstream approach is applied to the residential sector and small commercial and industrial sources, a new monitoring and reporting system to include local natural gas distribution companies would also have to be set up (there are about ten of these in California) (MAC 2007).

If emissions monitoring data delivered by companies should be incomplete, MAC recommends substituting it with data that intentionally overestimates emissions in order to create an incentive for complete monitoring.

The MAC stresses that early availability of emissions data is important for the integrity of the ETS, as emissions data represent the basis for setting the cap and allocating allowances to facilities (in case not 100% of allowances are auctioned).

Concerning the unit of measurement, tonnes of $CO_2$-eqivalent are proposed, using the IPCC's 2nd assessment report methodology to convert GHG Global Warming Potentials.

***Registry and unit of measurement***

The Market Advisory Committee recommended that CARB sets up a central electronic registry collecting emissions data from the regulated entities. This registry should build upon the infrastructure developed under the California Climate Action Registry, and experiences in other trading programs. The emission data should be posted on the CARB website quarterly, to provide carbon markets with crucial information regarding emission trends.

***Price Cap, Price floor***

A price cap is rejected on grounds of the reduced certainty to achieve the overall Californian reduction goal and the prospect that with a safety valve, California may be unable to link its ETS to other emissions trading programs (MAC 2007, 67).

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has to create emissions reporting protocols for significant sources of GHG emissions in California by 2008 (MAC 2007).

MAC encourages the consideration of a price floor. A price floor can be introduced by purchases of allowances by the regulator when the price falls to a certain level, or by establishing a reservation price in auctions. In the latter case, if the market price falls below the reservation price, the allowances are not auctioned, thus contracting the supply of allowances.

***Penalty system and enforcement***

It is recommended that penalties for non-compliance should be automatic and non-negotiable. MAC (2007, 76) highlights the penalty system in the US NOx Budget Program, where a company failing to deliver allowances for actual emissions have to deliver allowances worth 3 tonnes of emissions for each 1 tonne excess emissions. This relieves the government from fixing a specific penalty level.

Also, civil and criminal penalties shall be established for intentional violations of program requirements.

***Credits***

The Market Advisory Committee recommends setting up a Californian credit scheme generating credits in sectors outside the ETS in California. This scheme should adopt a standards-based approach, as it is currently being developed in RGGI and under the CDM, thus avoiding the controversial project-by-project approach the CDM has applied so far. Most members of the MAC recommend eligibility of CDM credits (CERs) in a CAL ETS, while some object. Several members support JI credits to qualify.

MAC (2007, 63pp) notes that some interested parties and some committee members urge to restrict geographic scope of usable credits to California. Their arguments include that environmental benefits (reduced air pollution) paid for by Californians should remain in California. Also, there is a desire to keep investment and employment benefits from credit projects within California's economy. In addition, there are concerns that verification of additionality of projects will be hard to ensure in jurisdictions outside California. The MAC recommends that California enter into a memorandum of understanding with any other state from which it accepts credits (mirroring the RGGI approach).

Concerning an import quota for credits into the ETS, some committee members are in favor of such a limit in order to ensure that regulated sectors begin to make the transformative investments that will be needed to meet the state's long-term GHG reduction goals. Also, decreased abatement efforts at facilities in the cap and trade scheme will reduce co-benefits such as reduction in local air pollution. However, most members reject geographical and quantitative restrictions for credit use, arguing that other measures can be taken to address the raised concerns, and that credits from programs ensuring additionality will reduce the overall costs of emission abatement.

***Banking and borrowing***

Unlimited banking is recommended to reduce price volatility and introduce an incentive for reduction actions at the outset of the scheme. Borrowing is rejected as it may delay reduction activities and carries the risk of leading to non-compliance if reduction commitments pile up.

***Duration of trading and compliance periods***

The compliance period – that is, the period after which allowances have to be issued to the regulator, covering actual emissions during the compliance period – is recommended to last three years. MAC (2007) argues that longer compliance periods enhance intertemporal flexibility for business (much like banking), thus reducing volatility and increasing efficiency of the program. No recommendations or considerations on the duration of trading periods are given

***Linking to other ETS***

The MAC explicitly discusses and recommends linking of a California ETS to RGGI and the EU ETS in order to build a global carbon market (MAC, 2007, pp. 69). With regard to RGGI, it is stated that "linkage is likely to be possible", depending on stringency and actual implementation of the RGGI ETS. Concerning the EU ETS it is stated that "linking would be possible", with recognition of CDM credits in the EU ETS and less rigorous monitoring standards being regarded as potential problems for linking. In principal, the following design features of another ETS are identified as impediments to linking:

1. A voluntary regime,
2. dissimilar, lenient monitoring requirements,
3. insufficient non-compliance penalties and enforcement,
4. inclusion of unacceptable credit currencies,
5. a safety valve,
6. a rate-based scheme, and
7. a borrowing provision.

## II.5 Australia

***Context***

Until December 2006, action in regard to the establishment of an ETS could primarily be observed on the level of Australia States and Territories, while the national government initially remained rather passive. Therefore the governments of States and Territories founded the National Emission Trading Taskforce (NETT) in order to establish a national emission trading scheme. In this context the premiers and chief ministers of Australian States and Territories explained that they will take action to establish a nationwide ETS if the national government will not establish an emission trading scheme until the end of 2010 (Council for the Australian Federation (CAF), 2007). In December 2006 the Prime Ministerial (PM) Task Group on emission trading was announced, and released its report in June 2007 proposing a national emission trading scheme for Australia starting in 2011 or 2012 (Australian Government, 2007). Even though the PM Task Group worked separately from the efforts taken on the State and Territory level, it can be presumed that NETT will be included in the efforts taken on the national level. This chapter focuses on the design proposal of the PM Task Group. In general, the current Australian ETS proposal is the least developed from all that are addressed in this report. Future changes appear likely.

***Coverage***

The proposed emission trading scheme for Australia shall cover all greenhouse gases (GHG) defined in the Kyoto protocol. It is proposed to cover all energy sectors (including transportation and electricity generation), industrial processes and fugitive emissions sources in a combined up- and downstream system. Facilities emitting more than 25 kt $CO_2$ eq per annum shall be covered downstream. This would include approximately 900 facilities. Emissions from these facilities amount to around 80% of total emissions outside agriculture, land use and waste or 55% of total emissions (Australian Government 2007, p.106). Smaller entities shall be covered upstream by including fuel suppliers to the scheme. Overall the proposed scheme would cover 70 – 75% of Australia's greenhouse gas emissions. How to deal with emissions from landfill operators is still under discussion.

The Task Group generally states that including a maximum number of entities and sectors to the scheme would be preferable. Exclusions are however justified by difficulties to measure and verify occurring emissions accurately. Therefore agricultural and land use emissions are proposed to be excluded at the beginning.

***Cap***

Australia has committed to stabilize its emissions by 8% above the 1990 levels in the Kyoto protocol, which was ratified in late 2007. However, the ETS is seen as an instrument to manage future international reduction commitments. A cap is therefore

not specified in the proposal. The report explicitly recommends to adopt a long-term climate policy goal for Australia, and that future caps should be set in accordance to this "aspirational goal".

***Allocation***

The PM Task Group outlines three criteria that the Australian allocation methodology should satisfy. These include:

- avoid creating disincentives for early abatement
- avoid providing incentives for 'rent seeking' or opportunities to overturn or undermine the scheme
- minimize transaction costs for business and government and to promote market efficiency

How to compensate firms and facilities for their losses is a pivotal issue for the PM Task Group. Therefore it is proposed to allocate emission allowances freely, based on a benchmark representing the best practice technology. Remaining allowances that are not freely allocated shall be auctioned.

***Monitoring, reporting and verification (MRV)***

Some action has been taken in Australia in order to establish national monitoring, reporting and verification guidelines. In September 2007 the national greenhouse gas and energy reporting act came into force, establishing a single national reporting framework. Covered entities have to report annually beginning 2008. Detailed monitoring regulations are left to a ministerial decision at a later point in time.

One expressed goal of the act is to "underpin the introduction of an emissions trading scheme in the future" (Australian Government 2007a, p3). The Task Group recognizes that current monitoring, reporting and verification standards have to be modified and need to be consistent with the needs of a future emissions trading scheme.

***Registry and unit of measurement***

The national GHG and reporting act establishes a national registry called the national greenhouse and energy register. Emissions are measured in metric tonnes of $CO_2$-eq, and global warming potentials (GWP) of greenhouse gases apply as they are defined in the Kyoto Protocol (Australian Government, 2006).

***Price cap, price floor***

The proposed emission fee described under 'Penalty System and Enforcement' below basically has the effect of a safety valve mechanism.

***Penalty system and enforcement***

In order to enforce participants to hold a sufficient number of allowances by the end of the commitment period, an emissions fee is discussed for the AUS ETS. The Task Group proposes a pre-set fee for every tonne by which actual emissions exceed the amount of allowances held by the participant. Even though the Task Group does not specify the level of the fee, it recommends that the fee shall be established at a low level. Moreover, the Task Group rejects the concept that missing emission permits are surrendered at a later point of time, claiming doing so would be a double penalty for firms (Australian Government 2007, p110). Therefore, this penalty system would introduce a price cap into the emissions trading scheme.

***Credits***

The prime ministerial Task Group recommends making a wide range of credit arrangements unrestrictedly available to the Australian market. These include current international credit schemes established under the Kyoto protocol (CDM, JI) as well as credits generated under an upcoming domestic credit regime. A domestic credit regime is in particular considered for the agriculture and forestry sector.

***Banking and borrowing***

The Task Group recommends considering limits to or prohibition of banking in early trading periods, especially if a price cap is introduced, in order to avoid 'warehousing' of allowances that are acquired through the price cap in order to be used later, when the price cap is eliminated. In absence of a price cap, banking is recommended. Borrowing is rejected as this may threat the credibility and environmental integrity of an ETS in the future.

***Duration of trading and compliance periods***

The PM's Task Group states that emission allowances will be valid for one year (Australian Government 2007, 101). The trading period is proposed to last ten years, until 2020 (if the starting date is 2011).

***Linking to other ETS***

In focusing on the economic efficiency of the scheme, explicit interest in linking the AUS ETS with "as many schemes as possible" is expressed. (Australian Government 2007, pp111) A dialogue with "like-minded" countries for example Canada and New Zealand is envisaged with priority.

# Annex III – ETS Comparison Table

| | EU ETS | RGGI | New Zealand | California | Australia |
|---|---|---|---|---|---|
| **Status** | | | | | |
| *Implementation stage* | Running in 2nd Trading Period | Legislation process in progress | 2007 Final Decisions on the core design and on detailed design features on the government level | 2007 Proposal by MAC expert commission | 2007 Discussion paper by PM Task Group expert commission |
| *(Envisaged) Start Date* | 1 January 2005 | 1 January 2009 | *Stage 1:* 1 Jan 2008<br>*Stage 2:* 1 Jan 2009<br>*Stage 3:* 1 Jan 2010<br>*Stage 4:* 1 Jan 2013 | 1 January 2012 | Scheduled in 2011, or 2012 |
| *Ratification of Kyoto Protocol* | Yes | No | Yes | No | Yes |
| **Participation and Coverage** | | | | | |
| *Participating Sub-regions* | 27 EU Member States | 10 U.S. states: Connecticut, Delaware, New Jersey, New York, Maine, Maryland, Massachusetts, New Hampshire, Rhode Island, Vermont | New Zealand | California | Australian Commonwealth |
| *Regulated Sectors* | Electricity, refining, iron & steel, cement, glass, ceramics, pulp and paper | Electricity generating facilities ≥ 25 MW primarily fired by fossil fuels (coal, natural gas, oil), feeding more than 10% of their generated electricity into the grid | *S1:* Forestry<br>*S2:* Liquid fossil fuels<br>*S3:* Stationary energy; industrial processes<br>*S4:* Agriculture; waste | *Pr 1*[38]*:* Electricity, refining, cement, other processes, non-$CO_2$<br>*Pr 2:* like 1, + transport<br>*Pr 3 & 4*: like 2, + small industry, commercial, residential sources | Electricity and industrial processes emitting more than 25 kt $CO_2$eq per annum, transport, waste to be discussed |
| *Regulated Emissions* | $CO_2$ only | $CO_2$ only | $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, and $SF_6$ | $CO_2$, $N_2O$, HFCs, PFCs, and $SF_6$ | $CO_2$, $CH_4$, $N_2O$, HFCs, PFCs, and $SF_6$ |
| *Point of Regulation* | Downstream | Downstream | Up- and Downstream | Up- and Downstream | Up- and Downstream |

[38] The Market Advisory Committee has proposed four program options (abbreviated Pr here) with differing coverage and point of regulation

| | EU ETS | RGGI | New Zealand | California | Australia |
|---|---|---|---|---|---|
| *Covered Emissions (Mt $CO_2$eq)* | ~2.000 Mt | 149 Mt (2003) | *S1:* 21.8 Mt (expected for the period 2008 – 2012)<br>*S2:* 15 Mt (2005)<br>*S3*: 22.8 Mt (2005)<br>*S4*: 39.2 Mt (2005)<br>Total: 77.6 Mt (excluding S1) | *Pr1*: 193Mt<br>*Pr2*: 356Mt<br>*Pr3&4*: 409Mt | ~ 300 Mt (according to calculations by PM Task Group) |
| *Share of economy-wide emissions ($CO_2$eq)* | ~40% | ~ 24% | *S1:* N/A<br>*S2:* 19%<br>*S3:* 30%<br>*S4:* 51% | *Pr1*: 39%<br>*Pr2*: 72%<br>*Pr3&4*: 83% | ~55% |
| *Number of covered entities* | ~10.000 | ~630 | *S1:* ≥ 1000<br>*S2:* ~5<br>*S3:* ~ 80 (~45 stationary energy; ~ 35 industrial processes)<br>*S4:* ≥ 35 agriculture (Point of Regulation for agriculture not decided); ~ 60 waste | *Pr1*: ~450<br>*Pr2*: ~480<br>*Pr3*: ~490<br>*Pr4:* ~150 | ~ 900 |
| *Regional Expansion Options* | Linking to EEA countries (Norway Iceland, Liechtenstein) agreed. Switzerland is a candidate.<br>Possibly: EU applicants (e.g. Croatia and Turkey) | District of Columbia, Pennsylvania, plus New Brunswick and other Eastern Canadian Provinces | No | WCI member states: 6 US, 2 Canadian.<br>WCI observers: 6 US, 3 Canadian, 1 Mexican | No |
| **Energy System** | | | | | |
| *Total Emissions (incl. non-energy emissions) in Mt $CO_2$eq* | 4979.4 (in 2004, EU25) | 624.9 (in 2003) | 77.2 (in 2005)<br>+ deforestation | 494.3 (in 2004) | 525.4 (in 2005) |
| *Energy mix by sectors* | Industry: 28%<br>Households: 41%<br>Transport: 31% | Industry: 17.5%<br>Commercial: 25.9%<br>Households: 27.5%<br>Transport: 29% | Industry: 30%<br>Commercial: 9%<br>Households: 13%<br>Transport: 44%<br>Agriculture: 4% | Industry: 23%<br>Commercial: 18%<br>Households: 18%<br>Transport: 40% | Industry + Commercial: 50%<br>Households: 30%<br>Transport: 20% |

| | EU ETS | RGGI | New Zealand | California | Australia |
|---|---|---|---|---|---|
| *Energy mix by fuels* | Oil: 37%<br>Solid Fuels: 18%<br>Natural Gas: 24%<br>Nuclear: 15%<br>Renewables: 6% | Petroleum products: 48.9%<br>Coal: 8.6%<br>Natural Gas: 23.2%<br>Nuclear: 11.7%<br>Renewables: 7.1% | Oil: 38%<br>Coal: 13%<br>Natural Gas: 20%<br>Nuclear: -<br>Renewables: 28% | Petroleum products: 46%<br>Coal: 8%<br>Natural Gas: 29.5%<br>Nuclear: 5%<br>Renewables: 11.5% | Oil: 35%<br>Coal: 41%<br>Natural Gas: 19%<br>Nuclear: -<br>Renewables: 5% |
| *Historical emission trends* | EU25: 8% below 1990 levels in 2003;<br>EU15: 1.7% below 1990 levels in 2003 | +7.4% during 1990-2003 period | +23.4% during 1990-2005 period | +14.3% during 1990-2004 period | +4.5% during 1990-2005 period |
| *Future Projections* | 4.7% above 1990 levels in 2030 | 12% above 1990 levels in 2019 (electricity only) | 30% above 2005 levels in 2030 | 40% increase in 1990-2020 period | 27% above 1990 levels in 2020 |
| *Reduction goals* | - 8% below 1990 levels in 2008-12 period<br>- 20% (or 30%) below 1990 levels in 2020<br>- 60%-80% below 1990 levels by 2050 | - 2009 cap: 5% above 2005 levels, will remain until 2015<br>- 10% reduction below this cap by 2019 | Carbon neutrality:<br>- Electricity by 2025<br>- Stationary energy by 2030<br>- Transport by 2040 | - 2000 levels in 2010<br>- 1990 levels in 2020<br>- 80% reduction below 1990 levels by 2050 | - 8% above 1990 levels in 2008-12 period |
| **ETS Design Features** | | | | | |
| *ETS Cap* | Future levels not determined yet. Bottom up emergence of cap through NAP negotiations. Plans for centrally set cap. Overallocation in first trading period | Annual Cap of 170.6 Mt $CO_2$ between 2009 and 2014; annual reduction of 2.5% between 2015 and 2018 | To be linked to NZ commitments under the Kyoto protocol (309.5 Mt in 2012) and an international post-2012 regime, respectively | Not specified | Not specified |
| *Allocation Method* | Grandfathering, benchmarking, max. 10% auctioning | Auctioning minimum 25%; decision over remaining 75% left to individual states | *S1:* Free allocation<br>*S2:* Auctioning<br>*S3:* Some free allocation for industrial processes<br>*S4:* 90% free allocation for agriculture | Auctioning and benchmarking | Free allocation and auctioning |

| | EU ETS | RGGI | New Zealand | California | Australia |
|---|---|---|---|---|---|
| *MRV* | Updated in 2007 | Guidelines for continuing measurement based on CRF 40 Part 75 (Acid rain program regulation) that demands a maximum uncertainty of 10%. Verification by regulating authority. | To be developed | To be developed, building on existing MRV infrastructure of CCAR | To be developed |
| *Registry* | Community Independent Transaction Log (CITL) overseeing communications between national registries | No common registry for RGGI | To be developed building on existing infrastructure established under the Climate Change Response Act (CCRA) 2002 | To be developed, building on existing CCAR infrastructure | Under development; rules clarified under the Australia National Greenhouse and Energy Reporting Act in legislation since September 2007 |
| *Unit of Measurement* | 1 metric tonne $CO_2$eq | 1 short ton $CO_2$eq (1 short ton equals 0.90718474 metric tonnes) | 1 metric tonne $CO_2$eq | 1 metric tonne $CO_2$eq | 1 metric tonne $CO_2$eq |
| *Trading Period* | 3 years in first period, 5 years in second | 3 years | 2008/9/10 - 2012<br>2013- 2020 | No specification | 10 years |
| *Compliance Period* | 1 year | 3 years | 1 year<br>(*S1*: initially 2 years) | 3 years recommended | 1 year recommended |
| *Price Cap* | Rejected | Two stage safety valve arrangement:<br>"Credits Trigger Event" if spot price for emissions exceeds $ 7 for a period over 12 months;<br>"Safety Valve Trigger Event" if spot price for emissions exceeds $ 10 for a period over 12 months | Rejected in principal, but considered if no international climate policy agreement post-2012 | Rejected | Proposed; further specifications to be discussed |
| *Price Floor* | No | No | No | Encouraged for Consideration | No |

| | EU ETS | RGGI | New Zealand | California | Australia |
|---|---|---|---|---|---|
| *Penalty System* | Delivery of the non-delivered allowances + € 100 penalty per tonne (2008-2012) | Three times of the non-delivered certificates to be delivered at next compliance date | Delivery of the non-delivered allowances (can be extended to two times of the non-delivered allowances) + NZ$ 30 – 60 penalty per ton | Not specified, but non-delivery shall be made up + penalty | Emissions fee proposed setting a price cap |
| *Banking* | From 2nd Period on: Unlimited | Unlimited | Unlimited | Unlimited | Limit proposed as long as price cap applies |
| *Borrowing* | Rejected | Rejected | Rejected | Rejected | Rejected |
| **Credits** | | | | | |
| *Domestic credit program* | No | Credits are accepted from programs in RGGI states or any other U.S. state or jurisdiction. | Discussed | To be developed using RGGI experience; programmatic approach proposed | To be developed especially focusing on forestry and agriculture |
| *Eligibility of CDM/JI* | Yes | Generally no; In case of a safety trigger event credit allowances may be awarded for the retirement of allowances or credits from international trading programs | Yes, + *AAUs* | Most MAC members recommend eligibility of CDM | Yes |
| *Import Quota for Credits* | Varying from country to country according to set of criteria. Average (weighted) EU quota for CDM/JI import in trading period II: 13,4% | 3.3% of a facility's emissions can be covered by credits; the number rises up to 10% in case of a safety valve trigger event | No | Most MAC members recommend unrestricted credit import | No |
| **Institutions** | | | | | |
| *Regulating Authority* | EU Commission, National Authorities | Responsible State Authorities | Not Specified | CARB (California Air Resources Board) | Not Specified |
| **Linking** | | | | | |
| *Expressed Interest* | Linking of ETS is an explicit option of EU climate policy, EU Directive Art.25 foresees linking | Expressed strong interest in linking | Expressed strong interest in linking to the Australian ETS in particular, and other ETS | Expressed strong interest in linking to EU ETS, RGGI, and to develop a global carbon market | Expressed strong interest in linking to other ETS and to develop a global carbon market. |

# Annex IV – Energy Systems and Abatement Costs

In this section we briefly analyze each region's energy system in terms of total emissions (in CO2-equivalents), its energy mix by fuel types and the usage of final energy disaggregated by sectors. We further describe historical trends and projected emissions under business-as-usual as well as policy scenarios. From this information, we derive indicative results with regards to expected mitigation costs, which are determined by the stringency of the cap on the one hand and the flexibility of the underlying energy system on the other. For the assessment of regional abatement costs it is assumed that the envisaged regional reduction targets have to be met without international emissions trading. We emphasize that the findings of such a qualitative assessment need to be treated with great care.

## IV.1 European Union

### *Overview*

With 4'979.4 Mt of $CO_2$-equivalents in 2004, the EU25 was one of the world's largest emitters of GHGs (EEA, 2006). $CO_2$ is the single most important greenhouse gas, accounting for around 83% of $CO_2$-equivalents in 2004, followed by $N_2O$ and $CH_4$ with 8% and 7.5%, respectively. Likewise, the combustion of fossil fuels is the dominant source of GHGs, contributing roughly 80% of $CO_2$-equivalent in 2004; agriculture and industrial processes accounted for 9% and 7.6%, respectively (EEA, 2006).

### *Energy Mix*

Disaggregating by fuel-types, the EU25's total energy demand in 2004 was mainly met by oil (37%), natural gas (24%), solid fuels (18%) and nuclear power (16%), while the share of renewables was 6% (of which 66% were bio-mass, 24% hydro, 5% wind, and 5% geo-thermal). On a sectoral level, transport accounted for 31% of total energy consumption, households for 41%, and industry for 28%. Roughly 20% of final energy consumed is provided by the electricity sector, which relies heavily on conventional thermal energy (54.2%) and nuclear power (31%). Hydro-power and electricity generated from wind and biomass account for the rest (13.3%), while solar and geothermal energy play only minor roles (EC, 2006).

### *Emission Trajectories*

In 2003, $CO_2$ emissions for the EU25 were 8% below their 1990 levels, while for the 15 'old' member-states the respective figure was a reduction of 1.7%. As a large portion of the achieved reduction in $CO_2$ emissions can be attributed to the transition from planned to market economies in Eastern Europe, the business-as-usual scenario foresees an

increase in emissions to only 4.7% above their 1990 level in 2030, mainly due to increasing emissions from passenger cars and freight transport (EC, 2006).

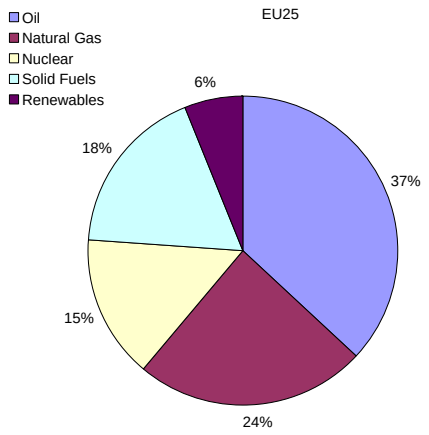
***Reduction Targets***

According to its Kyoto commitments, the EU15 has pledged to decrease emissions in the period 2008-12 by 8% relative to 1990 levels. In recent years, emissions for the EU15 were considerably above (4.7 percentage points in 2004) the target path prescribed to meet Kyoto objectives in 2010 (EEA, 2006). In addition, the EU climate strategy aims at reducing emissions by at least 20% below 1990 levels in 2020 (or 30% if other major emitters join the EU's effort) and 60-80% in 2050 (European Council, 2007). This corresponds to reductions of 25-35% below BAU[39] in 2020 (own calculations based on EC, 2006a). In order to reach these goals, a large range of measures, including energy efficiency measures, increasing the share of renewables in electricity production as well as fuel efficiency standards for vehicles and the use of alternative transportation fuels have been proposed.

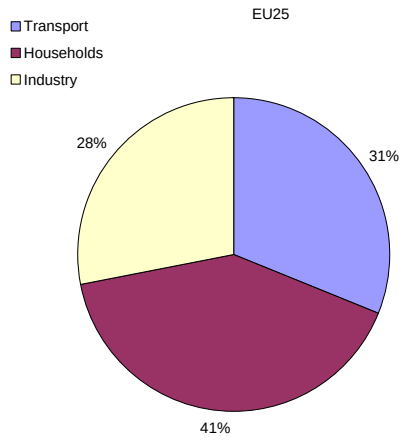
***Mitigation Options and Abatement Costs***

Given the relatively ambitious goal of reducing emissions by 25% to 35% below the BAU case by 2020, and taking into account the scope of measures already implemented, we conjecture that concentrated efforts that go far beyond simply picking the low hanging fruits and that comprise a major transformation of the EU's energy system will be necessary. Therefore, abatement costs for the EU can be expected to be among the highest of all the regions under study in the short, medium as well as in the long run.

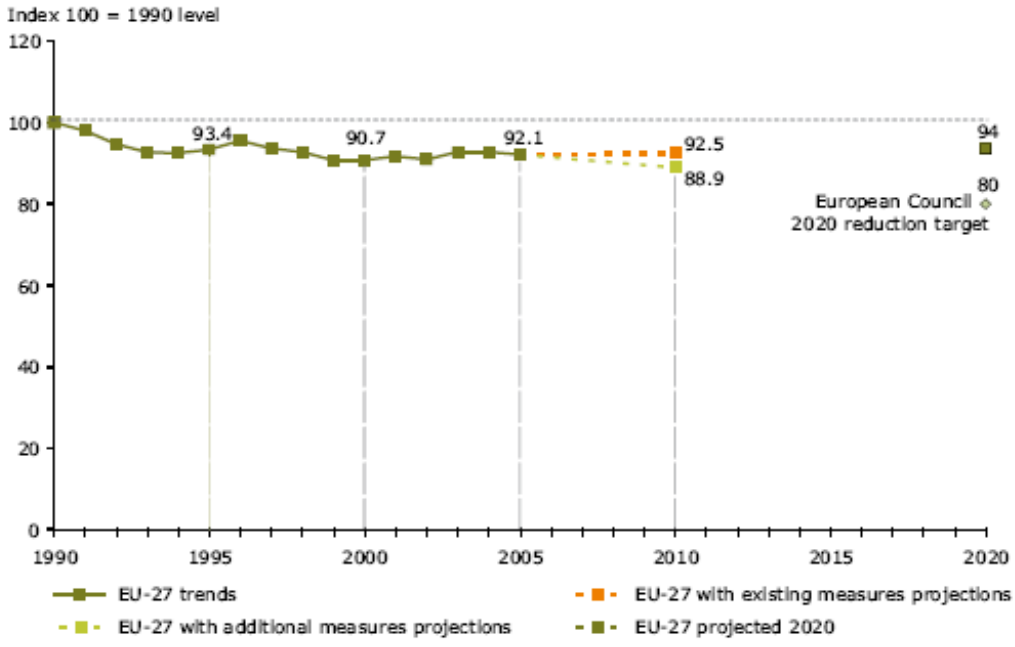
[39] The BAU scenario represents trends and policies as implemented in the member states up to the end of 2004




*Energy Mix by fuel types (source: EC, 2006)*




*Final Energy Consumption by sectors (source: EC, 2006)*




*Historical EU27 emissions 1990-2005 and BAU and policy scenarios for 2005-2020 (source: EEA, 2007)*

## IV.2 RGGI

### *Overview*

In 2003, the ten states that participate in the Regional Greenhouse Gas Initiative (RGGI) emitted a total of 624.9 Mt of $CO_2$, accounting for roughly 14% of US GHG emission, a level comparable to e.g. Germany (CIER, 2007). In addition, there are two observers (Pennsylvania, and the District of Columbia) that might join RGGI later and emitted another 275.3 Mt of $CO_2$ in the same year (EIA, 2007).

### *Energy Mix*

The energy mix of the RGGI states is clearly dominated by petroleum products (48.9%), and natural gas (23.2%). Coal accounts for 8.6% of total energy production, nuclear energy for 11.7%, and renewables for 7.1% (it should be noticed that these shares exhibit considerable variation across regions). With regards to sectoral shares, transport consumes 29% of total final energy, households 27.5%, the commercial sector 25.9% and industry 17.5%. RGGI aims at capping emissions exclusively in the electricity sector, which accounts for approximately 24% of total $CO_2$ emissions.

### *Emission Trajectories*

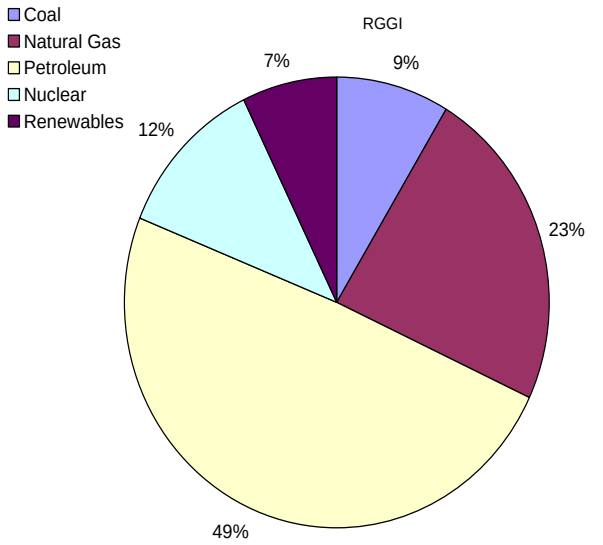
During the period 1990-2003, total $CO_2$ emissions for the ten RGGI states increased by an amount of 7.4% (EIA, 2007). Under the business-as-usual scenario, $CO_2$ emissions from electricity generating utilities (with a capacity greater than 25 MW), on which the cap will be imposed and for which emissions remained almost at their 1990 level in 2003, are expected to increase by approximately 12% by 2019 (Environment Northeast, 2007).

### *Reduction Targets*

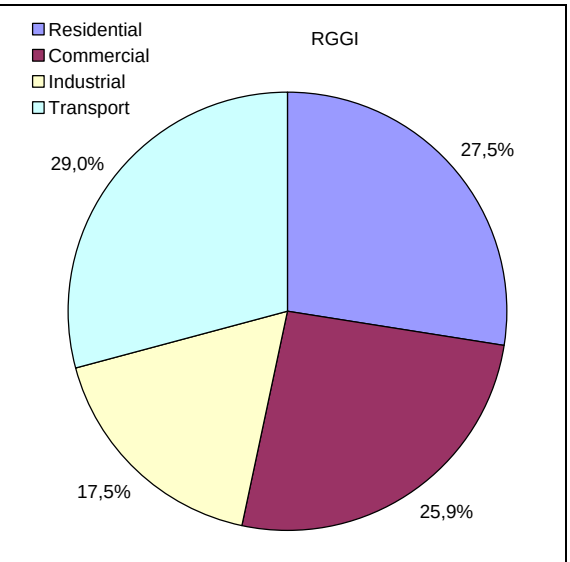
Emissions trading for the electricity sector within RGGI is supposed to commence in 2009 with a cap roughly 5% above 2004 levels, which will remain until 2015. In the period 2015-19, this cap will be reduced by 2.5% per year, which should result in a 20% reduction of GHG emissions from electricity generation relative to business-as-usual assumptions (own calculations based on EIA, 2007; Environment Northeast, 2007; and RGGI, 2006). In order to achieve this reduction target, fuel switching from coal to natural gas and possibly carbon capture and sequestration (especially if Pennsylvania, which relies heavily on coal) becomes a full RGGI member, as well as energy efficiency measures and increasing the share of renewables in electricity generation are possible policy options. Also, curbing the consumption of petroleum products in the transport sector appears to be a feasible option for the future if the covered sectors are extended beyond electricity generation.

***Mitigation Options and Abatement Costs***

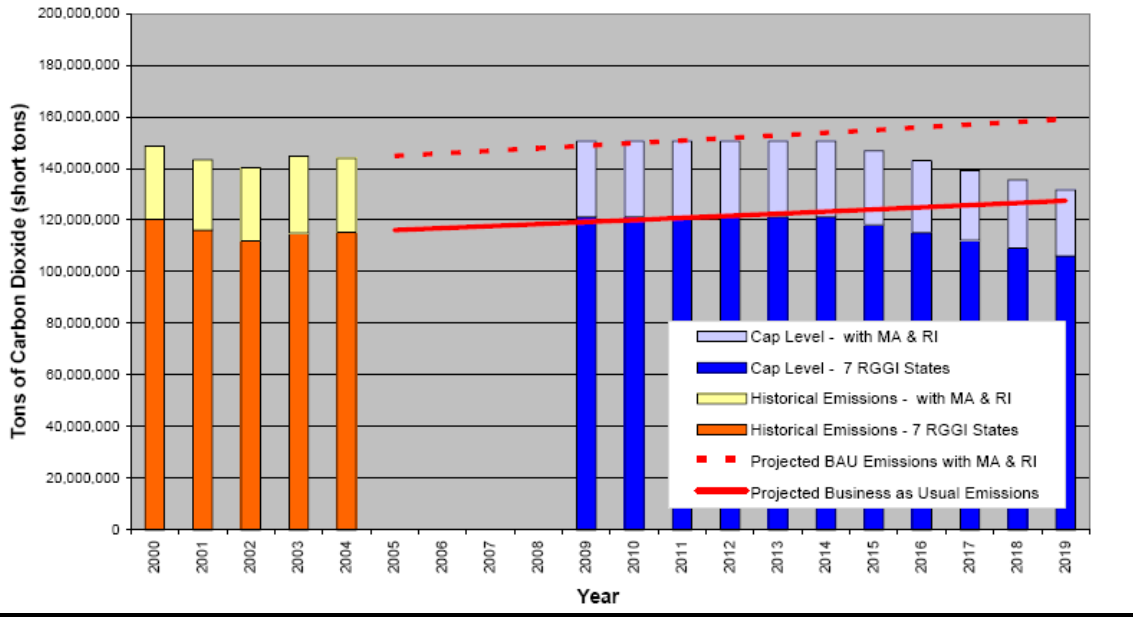
Considering the high carbon content of electricity generated in the RGGI states, the agreed cap (which will decrease emissions by a little less than 20% with respect to the business-as-usual scenario) appears to be of relatively low ambition. However, achieving this goal will not be possible without major shifts in the electricity generation sector. Overall, we tend towards the conclusion that there exist a relatively large number of opportunities and sufficient flexibility to reach the proposed abatement at relatively low costs (at least in comparison to the other regions included in this study) by 2019.




*Energy Mix by fuel types (source: EIA, 2007)*




*Final Energy Consumption by sectors (source: EIA, 2007)*




*Projected Emissions for the electricity sector under BAU and Policy scenarios. Note that Maryland is not taken into account (source: Environment Northeast, 2004)*

## IV.3 New Zealand

### *Overview*

New Zealand's total $CO_2$ emissions were 77 million tonnes of $CO_2$-equivalents in 2005 (UNFCCC, 2007b). Roughly half of this amount was due to the combustion of fossil fuels, while other greenhouse gases (such as methane and nitrous oxides from agricultural sources, which play an important role in New Zealand's economy) accounted for the other half (NZ MED, 2007).

### *Energy Mix*

In 2006, imported oil (and oil products) accounted for the largest share of total primary energy consumption (38%), natural gas for 20%, coal for 13% and renewable sources for 28% (hydro and geothermal each for 11% of the total, and other renewables for 6%). The economy's energy use is dominated by electricity and transport. Of the total energy demand 44% accrues to transport; industry and the commercial sector account for 30% and 9%, respectively; households use 13% and agriculture roughly 4%.

### *Emission Trajectories*

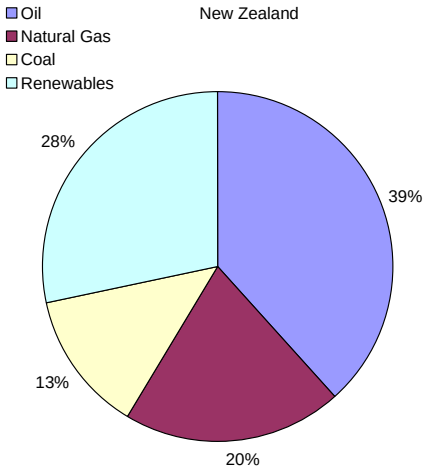
In the 1990-2005 period, total GHG emissions (measured in $CO_2$-equivalents) increased by 23.4%, with the largest part of the increase being due to combustion of liquid fuels and coal (NZ MED, 2006). Under the business-as-usual scenario, energy demand is expected to increase by 40% and total GHG emissions by about 30% in the period 2005-30 (New Zealand Government, 2007; NZ MED, 2006). This increase is dominated by rising electricity demand as well as an increase in fuel demand in the transportation sector.

### *Reduction Targets*

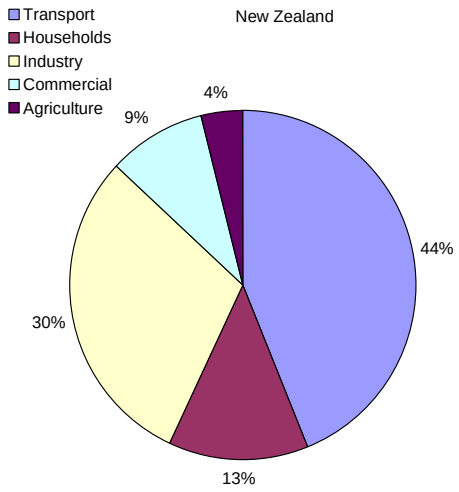
New Zealand's government has set out plans to achieve carbon neutrality in electricity generation by 2025, in stationary energy by 2030, and in transport by 2040 (New Zealand Government, 2007). Appropriate policies to achieve these goals include measures to increase energy efficiency, foster the use of renewable sources (especially wind and geothermal energy seem to be promising options) as well as curbing the increase of fossil fuels used in the transport sector by the introduction of vehicle fuel efficiency standards and promotion of alternative fuels. Furthermore, New Zealand's government has laid out plans to reduce emissions from the agricultural sector and forestry by the means sustainable land management.

### *Mitigation Options and Abatement Costs*

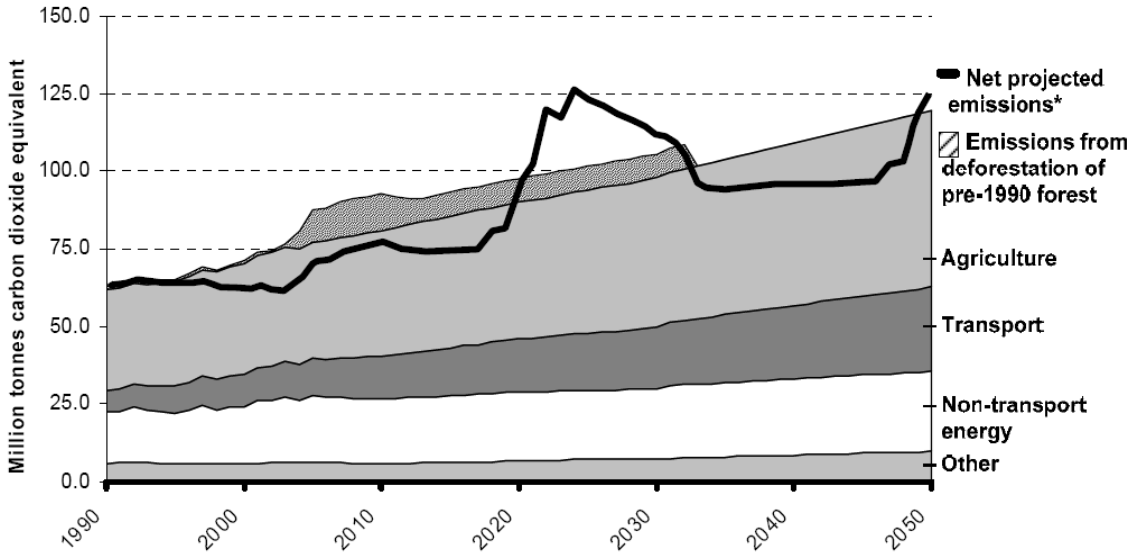
Keeping in mind these ambitious goals as well as the projected increase in energy demand by 2030 and the somehow limited scope to significantly reduce emissions below a certain threshold, achieving carbon neutrality will require major efforts to transform the country's energy system. For this reason, we expect that abatement costs for New Zealand will clearly exceed those of most other regions considered in this study.




*Energy Mix by fuel types*
*(source: NZ MED, 2007)*




*Final Energy Consumption by sectors*
*(source: NZ MED, 2007)*




*Historical Emissions 1990-2005 and projections 2005-2030 for the BAU and policy scenarios*
*(source: NZ MED, 2007)*

## IV.4 California

### *Overview*

The state of California has the second largest energy demand in the US (EIA, 2007) and ranks among the world's 20 largest emitters of GHGs with 494 Mt of $CO_2$-equivalents (CEC, 2005). Among the different GHGs, $CO_2$, which is almost exclusively generated by the combustion of fossil fuels, dominates with 81% of total emitted $CO_2$-equivalents. A number of energy intensive industries, such as chemicals, refining of petroleum, glassmaking, and forestry, are based in California. However, due to past investments in energy efficiency (and partly to favourable climatic conditions) the state's per capita energy demand has remained relatively flat over the last 30 years and ranks among the lowest in the US (CEC, 2005).

### *Energy Mix*

California's energy mix is dominated by petroleum products (46%) and natural gas (29.5%), while coal accounts for 8%, renewables for 11.5% and nuclear for 5% (CEC, 2007). Due to stringent emission laws, California has only very few coal and petrol fired power plants in operation. The largest part of electricity is generated from natural gas (50%) and renewable resources (in total 30%; with 17% from hydropower and 13% from other renewables), while nuclear power accounts for 16% of electricity production[40]. In addition to domestic production, California is a major importer of electricity with high carbon intensities from neighbouring states (CEC, 2006)[41]. One should further note that during the past years, under-investment in the transmission infrastructure has reduced system reliability and increased operational costs in a way that may constitute a serious obstacle for the further inclusion of renewable energy sources into the state's electricity grid (CEC, 2005). From a sectoral point of view, transportation accounts for the lion's share of total energy demand (40%), followed by industry (23%), the commercial sector (18%) and households (18%, EIA, 2007).

### *Emission Trajectories*

During the period 1990-2004, California's total $CO_2$ emissions grew by 14.3%, with the largest increase taking place in the transport sector. Under business-as-usual assumptions (including continued economic as well as population growth), this trend is expected to

[40] Since 1976, the construction of new nuclear power plants has been suspended due to the lack of an appropriate nuclear waste depository

[41] While imported electricity accounts for only 22 to 32 percent of total electricity consumption, out-of-state electricity generation sources contributes 39 to 57 percent of the GHG emissions associated with electricity consumption in California in the period 2000-04 (CEC, 2006)

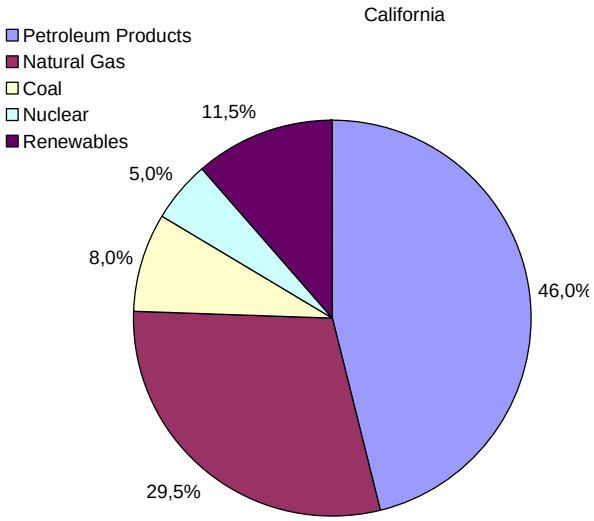
continue, resulting in emissions that are 40% above year 1990 emissions in 2020 (CEC, 2005).

### *Reduction Targets*

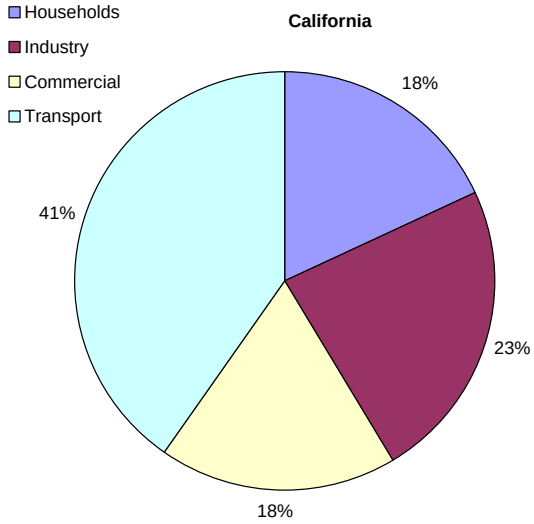
California's declared goal is to reduce its GHG emissions to year 2000 levels by 2010, to year 1990 levels by 2020 and to 80% below 1990 levels by 2050 (MAC, 2007). In absolute terms, this corresponds to an abatement of 68 Mt of $CO_2$ relative to the BAU scenario in 2010 and 177 Mt in 2020 (CEC, 2005). Major options to satisfy the growing demand for energy while reducing GHG emissions include the increased use of renewable energy in electricity generation (especially wind and solar but also geothermal energy are believed to have a large untapped potential), combined heat and power generation, investments in energy efficiency as well as stronger emissions standards and increased reliance on alternative fuels in the transport sector (CEC, 2005).

### *Mitigation Options and Abatement Costs*

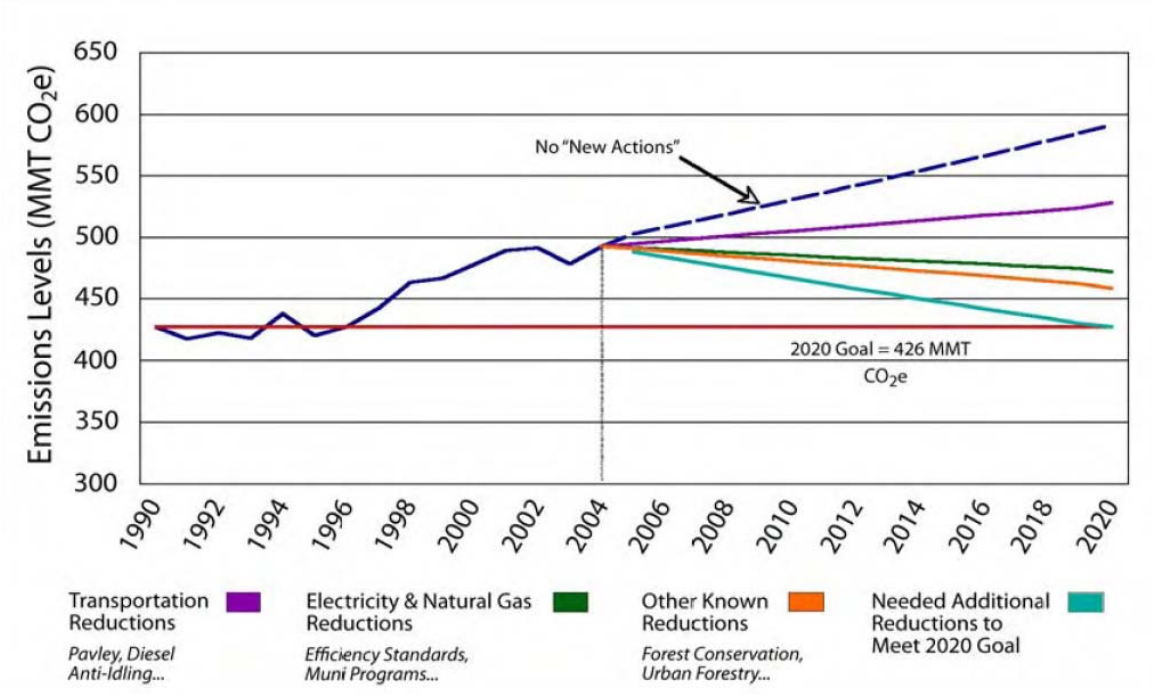
Given the already rather high energy efficiency and relatively widespread use of low-carbon and renewable energy sources, we assume that many of the cheapest carbon abatement policies have already been implemented. However, there is still ample scope to reduce emissions by the measures described above. Given the large increase in energy demand, the proposed reduction goals correspond to a 40% reduction of emissions below BAU forecasts by 2020 (CEC, 2005). Thus, they can be regarded as quite ambitious in the short and medium run (until 2020), and one can expect abatement costs to increase significantly with the even more ambitious goals set for the 2020-2050 period.




*Energy Mix by fuel types*
*(source: CEC, 2007)*




*Final Energy Consumption by sectors*
*(source: EIA, 2007)*




*Historic emissions for 1990-2005 and projected emissions under BAU and policy scenarios for 2005-2020*
*(source: CEC, 2007)*

## IV.5 Australia

### *Overview*

In 2005 Australia's GHG emissions equaled 525.4 Mt of $CO_2$-equivalents (UNFCCC, 2007b). Per-capita emissions were more than four times above world average and 50% above the OECD average in the same year (IEA, 2007). Energy intensive industries, such as extraction of natural resources, aluminum, steel, cement, pulp and paper as well as manufacturing, play key roles in the country's economy and account for more than half of total electricity consumption and more than two thirds of natural gas use (Australian Government, 2007).

### *Energy Mix*

Australia's energy system is heavily geared towards fossil fuels with high carbon contents: Oil and coal provide 35% and 41% of primary energy needs, respectively, while natural gas accounts for 19%, and renewables for only 5%. Final energy is used mainly in industry and the commercial sector (50% of the total), households (30%) and for transportation (20%) (Australian Government, 2004). Electricity is a major transmission channel of energy demand, using around 40% of primary energy, which is consumed by industry and the commercial sector (66%) as well as households (34%). In 2000-01, the main energy carrier used to generate electricity was coal (78%), which is expected to keep its high share in the near future (Australian Government, 2004).

### *Emission Trajectories*

For the period 1990-2005, Australia's net $CO_2$-equivalent emissions increased only slightly by 4.5% (UNFCCC, 2007b). This development can mainly be attributed to substantial increases in stationary energy generation, while at the same time emissions from land use, land use change, and forestry (LULUCF) declined considerably (without the contribution of LULUCF, the total increase of $CO_2$-equivalent emissions would have amounted to as much as 25.6%). Under business-as-usual assumptions, future projections assume that the continued growth of energy demand (especially electricity demand, which is expected to increase to 84% above 1990 levels by 2020) will result in year 2020 emission that are 27% above those in the year 1990 (Australian Government, 2007).

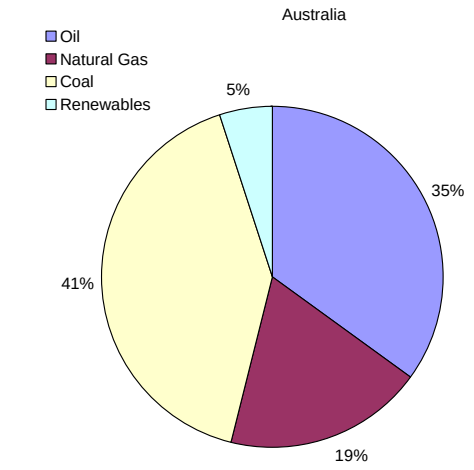
### *Reduction Targets*

The Australian government has committed itself to stabilising $CO_2$ emissions in the period 2008-12 at levels 8% above the 1990 baseline (Australian Government, 2007). In order to reach the declared mitigation goal, Australia disposes of a variety of possible options: Firstly, as the economy is highly intensive in its energy as well as carbon throughput, fuel switching to natural gas as well as energy efficiency measures and a

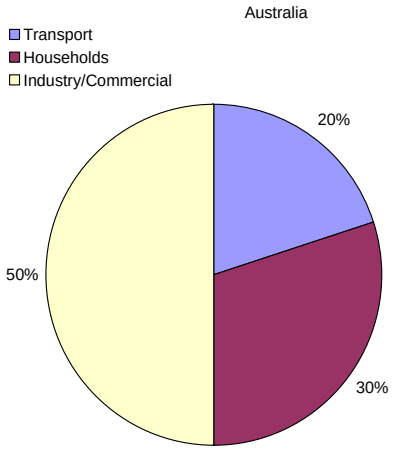
gradual shift to less energy intensive industries (e.g. services) may be viable and relatively inexpensive to implement. Furthermore, as Australia enjoys highly favourable conditions for the large-scale use of photovoltaics, the share of renewable energy in electricity generation promises potential increases. Finally, despite being at a very early stage, carbon capture and sequestration (CCS) might be a future possibility to reduce emissions.

***Mitigation options and Abatement Costs***

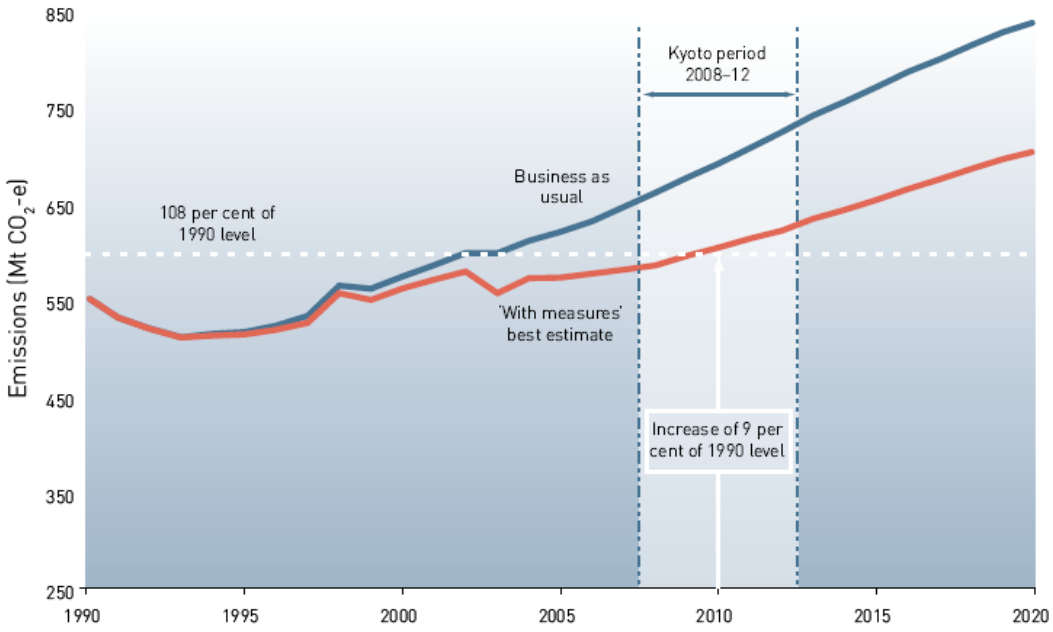
Taking into consideration the comparatively high emissions due to Australia's energy intensive industries as well as the high carbon content of primary energy carriers in conjunction with the availability of renewable energy options, we expect a rather generous supply of mitigation options that can be implemented at low costs. Under the assumption that the envisaged cap for 2012 will be maintained until 2020, the announced target translates into a moderate 19% reduction below the BAU case (own calculations, based on Australian Government, 2007). Therefore, we expect the abatement costs for Australia to be among the lowest of all countries under study.




*Energy Mix by fuel types*
*(source: Australian Government, 2004)*




*Energy Mix by sectors*
*(source: Australian Government, 2004)*




*Historical emissions projections 1990-2005*
*and forecasts for BAU and policy scenarios to 2020*
*(source: Australian Government, 2007)*

# List of Acronyms

| | |
|---|---|
| AAU | Assigned Amount Unit |
| AWG | Ad-hoc Working Group on further Commitments of Annex-I Parties under the Kyoto Protocol |
| BAU | Business as Usual |
| CDM | Clean Development Mechanism |
| CER | Certified Emission Reduction (credits issues under CDM) |
| CITL | Community Independent Transaction Log (registry in EU ETS) |
| EPA | United States Environmental Protection Agency |
| ERU | Emission Reduction Unit (credits issues under JI) |
| ETS | Emissions Trading System |
| EUA | European Union Allowance (allowance in EU ETS) |
| EU ETS | European Union Emissions Trading System |
| GHG | Greenhouse Gas |
| GWP | Global Warming Potential |
| ICAP | International Carbon Action Partnership |
| ITL | International Transaction LOG (registry for Kyoto trading, maintained by UNFCCC secretariat) |
| IPPC | Intergovernmental Panel on Climate Change |
| JI | Joint Implementation |
| LULUCF | Land Use, Land Use Change and Forestry |
| MAC | (California) Market Advisory Committee |
| MAC | Marginal Abatement Costs |
| MRV | Monitoring, Reporting and Verification (of emissions) |
| NAP | National Allocation Plan (in EU ETS) |
| NZ ETS | New Zealand Emissions Trading System |
| RGGI | Regional Greenhouse Gas Initiative |
| UNFCCC | United Nations Framework Convention on Climate Change |
| WCI | Western Climate Initiative |

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