Design options for sectoral carbon market mechanisms and their implications for the EU ETS

CLIMA.B.3/SER/2011/0029

Annexes

Client: European Commission - DG Climate Action

Rotterdam, 31 August 2012

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Hans Bolscher
Jeroen van der Laan
Jos Sijm
Stefan Bakker
Tom Mikunda
Timon Wehnert
Wolfgang Sterk
Jelmer Hoogzaad
Matthieu Wemaere
Darragh Conway

Rotterdam, 31 August 2012

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ECORYS Nederland BV
Watermanweg 44
3067 GG Rotterdam

P.O. Box 4175
3006 AD Rotterdam
The Netherlands

T +31 (0)10 453 88 00
F +31 (0)10 453 07 68
E netherlands@ecorys.com
Registration no. 24316726

W www.ecorys.nl

Table of Contents

1 Annex A: Full Assessment of Design Options

In this Annex we present the full assessment of the different options for key design elements and modalities for the New Market Mechanism. The next sections present the assessment for each of the individual design element.

As one of the first tasks in the study, the project team has identified and assessed options for key design elements and modalities for the New Market Mechanism (NMM). Based on this assessment, packages for design options to develop the NMM have been compiled and established (Annex B) that will be elaborated and specified in the case studies (Annex C).

Market-based mechanisms may be designed very differently. Key design features which are highly relevant in developing a new market mechanism have been elaborated in the Interim Report. After the Interim Meeting and discussion on the Interim Report, the project team has worked on regrouping of design elements and modalities (e.g. some are linked to each other and cannot be assessed without taking them together) and worked on a regrouping of the assessment criteria. The regrouping of design elements is presented below in Table 1.

Table 1 Regrouped design features for developing new market mechanisms

#	Design element	Other design element that is included
1	Crediting or trading	
2	Coverage of the mechanism	Sector/activity boundaries Types of GHGs to cover Upstream versus downstream coverage
3	Sector target or crediting threshold	Nature of target/threshold Method for setting target/threshold Interaction with other policies and measures
4	Operational/incentive framework	Operation/incentives at government/installation level Methodology for allocating trading units Currency used Temporal flexibility
5	Requirements for data collection and MRV	
6	Compliance framework and penalties	
7	Government institutions and accounting framework	National governance International governance
8	Ways of managing the transition from CDM to new market mechanisms	
9	Finance of the system	

For each of these design elements, different options have been identified and, subsequently, assessed by means of the following criteria:

Table 2 **Regrouped assessment criteria for evaluating design features for developing NMMs**

#	Assessment criteria
1	Environmental effectiveness
2	Environmental integrity/MRV robustness
3	Administrative feasibility, including transaction costs
4	Political feasibility
5	Economic efficiency
6	Private sector participation/potential to mobilize private capital
7	Potential impacts on competitiveness of EU enterprises
8	Preparedness for evolution towards EU ETS compatible cap-and-trade system
9	Low risk of perverse outcomes

- **Environmental effectiveness** – The extent to which the specific design feature(s) of the New Market Mechanism (NMM) contribute(s) to controlling or reducing GHG emissions on a global level, including the avoidance of carbon leakage outside the NMM system boundary.
- **Environmental integrity** – The extent to which the specific design feature(s) of the NMM affect(s) the guarantee that a claimed tonne of GHGs emitted or reduced is indeed a tonne of GHGs emitted or reduced ('a tonne is a tonne'), in particular by means of a robust measurement, reporting and verification (MRV) system.
- **Administrative feasibility** – The extent to which the specific design feature(s) of the NMM affect(s) the opportunity to meet the need for appropriate data, information and administrative capacity (staff, expertise, time, equipment) in order to implement the NMM in an adequate way, including the administrative costs involved.
- **Political feasibility** – The extent to which policy makers, officials, stakeholders and/or constituents are willing to accept and support the specific design feature(s) of the NMM.
- **Economic efficiency** – The extent to which the specific design feature(s) of the NMM contribute(s) to achieving the result of the NMM at the lowest social costs.
- **Private sector participation/potential to mobilize private capital** – The extent to which the specific design feature(s) of the NMM incentivise(s), mobilise(s) or enforce(s) private sector participation/capital investments into GHG mitigation measures.
- **Potential impacts on competitiveness of EU enterprises** – The extent to which the specific design feature(s) of the NMM affect(s) the competitiveness of EU-based enterprises compared to outside, non-EU based firms.
- **Preparedness for evolution towards EU ETS compatible cap-and-trade system** – The extent to which the specific design feature(s) of the NMM facilitate(s) the evolution or transition towards a cap-and-trade system that is compatible – and can be linked – to the EU ETS.
- **Low risk of perverse outcomes** – The extent to which the specific design feature(s) of the NMM avoid(s) the risk of providing incentives to policy makers and/or private participants to increase – rather than decrease – GHG emissions, e.g. by postponing or abandoning the implementation of intended policy measures that mitigate GHG emissions, or by switching to higher GHG-emitting activities.

The major reason for conducting this assessment is to provide policy makers a deeper insight into and a better overview of the different design options for the NMM. This will be helpful for policy makers to trade off the different pros and cons of these options and, hence, to make well-considered choices and decisions.

The following sections present the assessments of the different options for the 9 regrouped key design elements and modalities for the NMM listed in **Table 1**.

1.1 Design Element 1 – Crediting or Trading

Design options

Sectoral crediting would be based on an agreed emissions threshold or "no-lose target" at sectoral level. That is, countries would agree on a level of emissions for a sector. This threshold could be either in terms of absolute emissions or intensity-based, for example in terms of emissions per unit of GDP, emissions per unit of electricity generated, etc. The developing country could then undertake actions to reduce its emissions to the agreed level, either unilaterally or with some international support. If emissions were reduced below the target, the developing country would receive credits. If the target was not achieved, there would be no penalties.

By contrast, under **sectoral trading** the developing country would receive tradable units ex ante. If the country managed to reduce its emissions below its target, it would thereby achieve a surplus of trading units, which it could sell. If the country did not achieve its sectoral target, it would need to buy trading units to cover the shortfall.

It bears noting that the question of which approach is chosen only refers to whether units are issued ex-post or ex-ante and to whether the host country would need to offset excess emissions in case the target is missed. It does not relate to domestic implementation. In particular, sectoral trading does not automatically imply that there would be a sectoral cap-and-trade system, the host country government could also pursue other policies and measures to achieve the target. Options for domestic implementation are discussed in design element 4a.

1.1.1 Assessment of main design options

Environmental Effectiveness

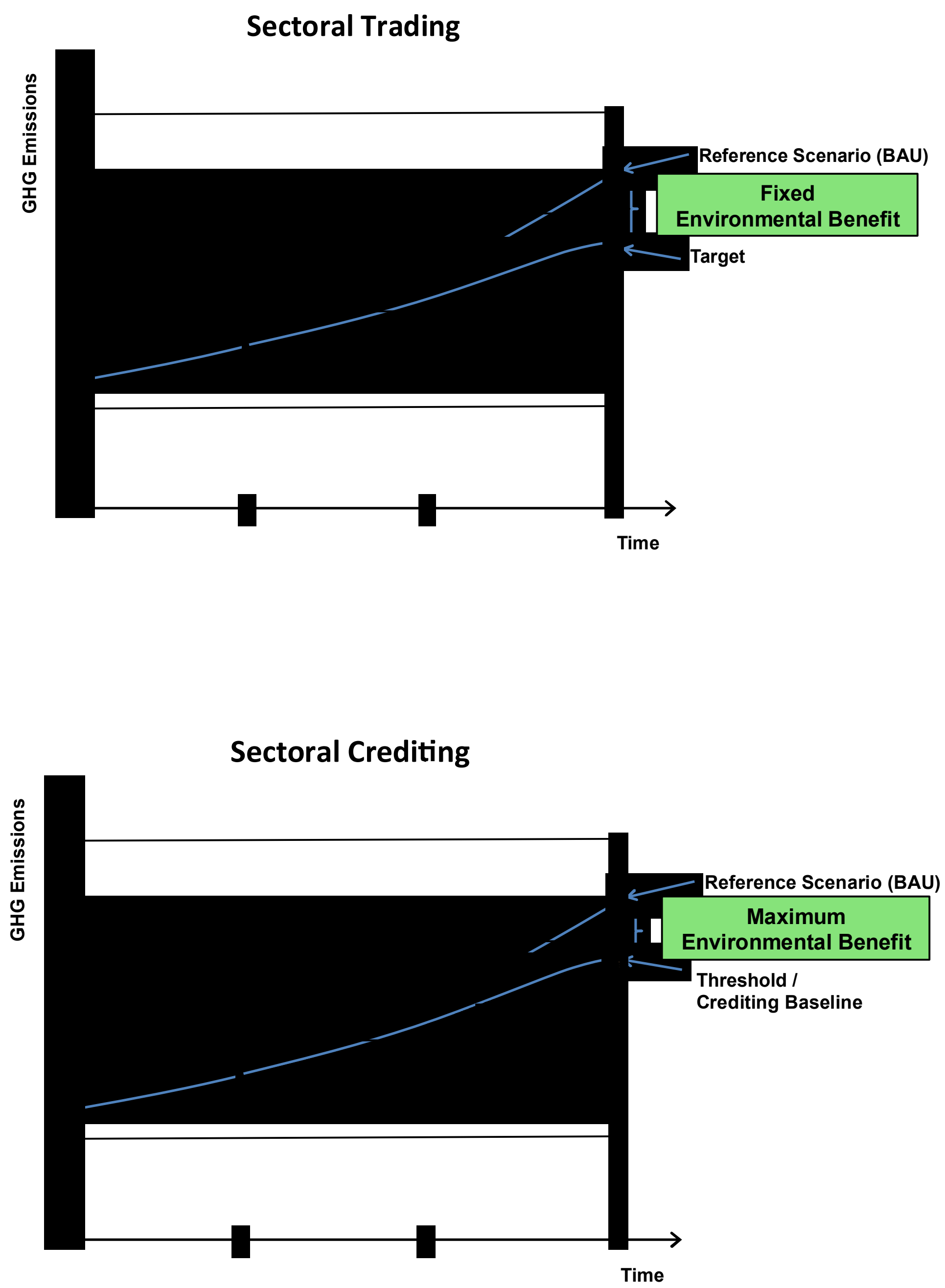
In both systems the benefit from an environmental perspective is the reduction of GHG emission equivalent to the delta between the reference (business as usual) and the emission level defined by the cap / the crediting threshold respectively (Figure 1). Any further emission reductions would be used to offset emissions in other sectors / countries by either selling credits or trading emission units. However, the environmental certainty would be higher under the trading approach because the host country would need to offset excess emissions, while the crediting approach implies a no-lose target. That is, the delta marks the maximum emission reduction – factually it could be smaller or even zero as there are no penalties.

In the crediting case an economic incentive to reduce emissions is created, by the option to sell surplus credits. The magnitude of the incentive however depends on the demand for credits, thus generally on international carbon pricing. Thus, if prices are low the environmental performance of the system diminishes. Or to put it differently: the scheme only works if a strong demand for credits exists, that is, if other countries commit to ambitious reduction targets (Ward et al. 2008). In the current market situation and based on the generally not very ambitious pledges made by Annex I countries under the Cancún Agreements, it is very likely that the existing Kyoto mechanisms will be able to satisfy any demand there may be for credits. The World Bank's latest State and Trends of the Carbon Market estimates that demand over the period 2013-2020 may lie in the range of 2,156 to 2,706 Gt CO_2-eq. while supply from CDM and JI may lie in the range of 2.3 to 4.8 billion credits. "One can conclude that the supply of existing current Kyoto mechanisms, i.e. CDM and JI, may be sufficient alone to serve global demand for international offsets over 2013-2020." (Kossoy and Guigon 2012: 107) CDC climat research have even estimated that the price of CDM and JI credits may fall to close to zero in 2013/14 already (Bellassen et al. 2012).

The environmental impact of both systems strongly depends on the level of ambition of the cap / crediting threshold. However, in crediting there is a trade-off: If the threshold is too ambitious, then the costs for credits become too high to be attractive. Thus, a crediting scheme only works if a buying system (other sectors or countries) exists, where mitigation costs are significantly higher.

However, beyond these economic considerations there are also political ones. Governments may also have inherent motivations to pursue emission reduction measures and may be more willing to set ambitious targets if these do not have penalties attached to them. In the run-up to Copenhagen, for example, representatives from South Korea argued that if their country was forced into binding

Figure 1 Environmental benefit in sectoral crediting and sectoral trading schemes



targets these would be much less ambitious than if targets remained voluntary. Another example is the developments in Brazil, China and Mexico, which are increasingly moving towards implementing emission trading systems even though they do not have internationally binding targets.

Environmental integrity/MRV robustness

The question of crediting or trading does not seem to have implications for how baselines are set and how emissions and reductions are MRVed. Both rely on the availability of data on sectoral GHG-emissions, be it on a sector level or on an emission source level, e.g. installations (Butzengeiger-Geyer et al. 2010: 11). That is, in both cases baselines and the achievement of the crediting threshold or trading target are assessed on the sectoral level, so the host country will in both cases have to produce a sectoral inventory.

Differences between trading and crediting could in theory relate to different frequencies for reporting, verification and compliance checks. Under the crediting approach host countries have an incentive to submit reports frequently in order to receive credits. Developing countries will in the future anyway have to produce inventories at least every two years: a full national communication every four years and biennial update reports in-between national communications. It might therefore be sensible to align the submission of implementation reports under the NMM with the submission of national communications and biennial reports. The implementation reports under a new market mechanism would of course need to be substantially more detailed than what is currently foreseen for national communications and biennial update reports. Nevertheless, aligning submission dates may allow for synergies and avoid duplication of work.

However, the ex ante issuance of units under the trading approach raises the problem that the host country might oversell, leaving it with too few units to cover its emissions. In this case buyer countries would use units to offset their emissions that actually do not correspond to real emission reductions. The Kyoto Protocol therefore includes a commitment period reserve to make sure that countries retain as many units as they need to fulfil their compliance obligations. In addition, there might be a case for requiring at least annual reports under the sectoral trading route to enhance confidence that the host country is not overselling. Implementation reports might therefore be aligned with national communications and biennial reports when these are due and be submitted as separate reports in the intermediate years.

Administrative feasibility, including transaction costs

The technical and administrative effort for implementation strongly depends on the details of the domestic implementation scheme, which is discussed in design element 4a. As noted above, there does not seem to be a marked difference between MRV requirements for sectoral crediting and sectoral trading. There might be a case for requiring more frequent reporting and verification under sectoral trading to minimise risks of over-selling, which would mean higher transaction costs.

Sectoral trading would also require higher efforts in case it is based on intensity targets because issuance would then require two phases: ex-ante issuance would have to take place on the basis of projected economic activity and would then need to be adjusted ex-post to the actual economic activity during the reporting period.

Political feasibility

The question of crediting or trading goes to the heart of the divide between industrialised and developing countries. While industrialised countries would like developing countries to accept binding targets, developing countries are afraid that these might become a “cap on growth”. Indeed, if – in a strict and reliable trading system - the cap is chosen to be too ambitious, the costs can potentially become very high. And under sectoral trading the country would have to achieve the target no matter how costly. Under sectoral crediting, the country would not be forced to reduce emissions. If the crediting threshold turned out to be too ambitious, the country could simply give up on trying to achieve it.

The major benefit of a sectoral trading mechanism is that it allows immediate access to the international carbon market. Due to the ex ante allocation of allowances trading can be conducted right from the beginning of the compliance period and not only ex post as in the case of today's CDM and the proposed sectoral crediting mechanism (Butzengeiger-Geyer et al., 2010: 34). However, it currently does not seem likely that this advantage would persuade many developing countries to choose trading rather than crediting.

Economic efficiency

The economic efficiency of a system mostly relates to how the system is implemented domestically, which is discussed in design element 4a. All other things being equal (e.g. stringency of the target and political backing), a binding target may provide higher certainty to market actors than a non-binding target, which would lead to higher investor confidence and thus a more efficient allocation of resources. However, it is doubtful whether all other things would remain equal, irrespective of whether the target was binding or not binding.

Private sector participation/potential to mobilize private capital

Setting a target or crediting threshold at sectoral level does not directly provide an incentive for the private sector. The issue of mobilizing private capital is mostly one of how the system is implemented domestically, which is discussed in design element 4a. Butzengeiger-Geyer et al. (2010: 48) expect that the host countries would implement stricter measures and/or provide stronger incentives under sectoral trading than under sectoral crediting because the targets under sectoral trading would be binding. On the one hand, as noted above, such an interpretation might be too one-dimensional as governments might also have inherent motivations to pursue emission reduction measures. On the other hand, as also discussed above, the mere act of adopting a binding target may send a strong signal to market participants which should lead to higher investor confidence.

Potential impacts on competitiveness of EU enterprises

Sectoral trading with its binding character includes rewards for reducing emissions and penalties for not reducing emissions. As noted above, it might therefore be expected that Non-Annex I countries would implement stricter measures and/or higher incentives for reducing emissions than under sectoral crediting. The impact on EU competitiveness would depend on which measures a host country implements. If the host country implemented measures such as emission standards or an emission tax, companies from the EU would have less of an incentive to shift their production to this country. By contrast, if the host country provided direct or indirect financial incentives for emission reductions such as subsidies, there might be an additional incentive for companies covered by the EU ETS to shift their production to this country (Butzengeiger-Geyer et al. 2010: 48)

Being a "no-lose" approach, sectoral crediting only includes rewards for reducing emissions but no penalties for not reducing emissions. Sectoral crediting can hence be likened to providing subsidies for emission reductions. In contrast to sectoral trading, where the impact on competitiveness depends on the national implementation, sectoral crediting might therefore pose a systematic incentive to shift production to the host countries.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

As a matter of general principle the binding character of sectoral trading provides for a stronger evolution towards an EU ETS-compatible system than the non-binding character of sectoral crediting. However, here as well much depends on the national implementation. A government might not be willing to assume a binding target internationally, but it might nevertheless choose to implement a mandatory national cap-and-trade system as means to fulfil the voluntary target it has taken internationally. As noted above, countries such as Brazil, China and Mexico are increasingly interested in emissions trading.

Low risk of perverse outcomes

The question of whether crediting or trading is chosen does not appear to involve risks of providing incentives to policy makers and/or private participants to increase rather than decrease GHG emissions.

1.1.2 Summary assessment

Table 3 Summary assessment of different options for design element 1

Options and issues	Pros	Cons
Sectoral crediting	Non-bindingness may lead to stronger targets Higher political feasibility No need for a commitment period reserve May require lower frequency of reporting and verification than sectoral trading	Non-binding target, thus lower environmental certainty Incentive to invest depends largely on carbon price: can only work if a buyer with significantly higher mitigation costs exists Ex-post access to credits Non-bindingness may lead to lower investor confidence and thus less efficient allocation of resources Provides only rewards and no penalties and may therefore lead to production shifts
Sectoral trading	Higher environmental certainty because of binding target Ex ante access to allowances Longer-term reliability for enterprises within sector Strong political signal that should lead to higher investor confidence and thus more efficient allocation of resources Mostly depends on national implementation, but in principle binding target provides for stronger evolution towards EU ETS-compatible system than no-lose target	Strong growth dynamic in developing countries makes target-setting technically and politically difficult High potential costs if target is too ambitious in relation to mitigation potential Need for a commitment period reserve May require higher frequency of reporting and verification than sectoral crediting

1.1.3 Need for international regulation

There does not seem to be a need to regulate whether countries should follow the crediting or the trading route. Depending on the details of implementation, which are discussed in the following sections, both approaches can in principle ensure environmental integrity and achieve substantial net emission reductions.

1.2 Design Element 2a – Sector boundaries

Design options

There are numerous design options that could be considered, dependent on the type of sector chosen and the country/region where the sectoral crediting scheme will take place. The main design options for defining a sector include:

- The entire sector (i.e. an entire industry sector, or power generation sector)
- A particularly technology or process within a sector (e.g. coal-fired power stations or blast furnaces within the iron and steel sector).
- Inclusion threshold (based on industrial output or power capacity for example)

It should be noted that these options are not mutually exclusive, for example you could combine a focus on a particular process within a sector, and include a minimum threshold.

1.2.1 Assessment of main design options

1. The entire sector

Schneider and Cames (2009) state that as a general rule, it could be argued that the coverage of entities in a sector should be as wide and include as many installations as possible. The reason stated is that it would facilitate "the determination of robust baselines since a larger coverage would level out exceptional emission profiles of some installations" (p.11). Having the entire sector included in may also improve the economic efficiency of the sectoral mechanism since a wider range of mitigation options with variable abatement costs will be available. In addition, covering the entire sector prevents possible intra-sectoral leakage.

However, there are also some challenging issues of including the entire sector. Firstly, it may be difficult to acquire data from all installations in a sector, especially small emissions sources (for example diesel-generators or CHP installations) which could be dispersed around the country. Schneider and Cames (2009) state that in order to reduce administrative and transactional costs, it may be prudent to exclude small installations with low emissions by establishing a de minimum threshold. The inability or difficulty in collecting data from small installations will make the development of robust baselines challenging.

With the power sector as an example, countries that have a large percentage of renewable energy sources, such as large-scale hydro, it may be an unattractive proposition to include the entire power generation sector as making reductions in emissions intensity may be more challenging than a country that relies more heavily on fossil fuels, even though abatement potential exists within parts of the energy mix.

2. A particularly technology or process within a sector

Here the sectoral crediting/trading scheme is restricted to particular technologies or processes within a sector. For example, a mechanism could focus on fossil-fuel power plants within the power generation sector, or blast furnaces within the iron and steel industry. Data collection of such large point sources is often well established, although not necessarily for emission data, and thus generating robust baselines should be achievable. Focusing on specific technologies could also facilitate the development of national policies and emissions mechanisms. For example, national policies such as emissions standards on coal-fired power plants could be enacted to ensure that all operators implement abatement options to achieve emissions reductions below the crediting baseline. Focusing on specific technologies can help to pinpoint areas of abatement potential, such as the use of residual heat or incremental energy efficiency improvements. The disadvantage of restricting the sectoral mechanism to certain technologies or processes, is that no incentives exists to take action outside the sectoral boundary. In addition, there may be a risk of intra-sectoral leakage.

3. Including a minimum threshold

This option has a de minimum threshold for inclusion in the sectoral mechanism. This threshold could be based on, for instance, annual industrial output or MW power generation capacity. A threshold can effectively restrict the coverage of the sectoral mechanism to larger installations which could reduce transaction costs. For example in the power generation sector, a de minimum threshold of 100MW would restrict inclusion to relatively large fossil fueled or nuclear power plants, large hydro, large wind farms and possibly solar power installations. This option retains the flexibility to move away from fossil-fueled power stations towards renewable forms of power generation. The issue of collecting data from numerous low capacity power generating installations is also removed. Of course a de minimum threshold excludes certain installations and thereby reduces the environmental impact of the mechanism.

Using a threshold approach is therefore a trade-off between environmental effectiveness and reducing transaction costs. Butzengeiger-Geyer et al. (2010) note that in China and India the industrial sectors usually consist of very efficient large installations on the one hand and large numbers of very inefficient small installations on the other hand. Effectively addressing emissions would mean to include these small installations in a sectoral scheme. However, this would cause high costs for monitoring and verification of emissions.

Environmental effectiveness

Of course the greater the scope of the sectoral crediting mechanism the more emissions could potentially be reduced through the various incentives and policies enacted and the lower the risk of intra-sectoral leakage.

Environmental integrity/MRV robustness

Narrowing the scope of the sector boundary could improve the level of data collection and improve MRV robustness, however only general conclusions can be drawn at this point.

Administrative feasibility (including transaction costs)

Generally speaking, the broader the scope of the mechanism, the greater the transactional costs can be expected to be. If covering a large sector such as the power sector, multiple policies may be required to achieve the desired emissions reduction, such as emissions taxes on power from fossil-fuels and incentives for renewable sources. Multiple policy development and monitoring may therefore have a higher administrative burden than certain governments can carry.

Political feasibility

Again it could be speculated that establishing the boundaries of inclusion could become a political debate, depending on how the mechanism is foreseen. Certain boundary selections could be seen as penalising or giving preferential treatment to certain parts of a sector. Setting boundaries and inclusion thresholds will therefore need to be a transparent process which engages industry stakeholders.

Economic efficiency

As mentioned above, minimising the transactional costs by focusing on the largest emitters could improve the economic efficiency in terms of $/ton GHG abated. On the other hand, a broader scope will lead to having a wider range of mitigation options with variable abatement costs available. As Butzengeiger-Geyer et al. (2010) note for China and India, small installations may be the most inefficient and hence have the lowest abatement costs. Policy-makers therefore need to find the right balance between minimising transaction costs and bringing in low-cost abatement potential.

Private sector participation/potential to mobilize private capital

Again, it can only be speculated that private sector participation and the ability to mobilize private capital will be determined by the foreseen risks and the expected returns on a project in terms of credits generated/retained. It could be logically understood that larger entities may find it easier to gain access to capital and management capacity compared to smaller emitters, which could cause problems in mechanisms with a broad sectoral scope.

Potential impacts on competitiveness of EU enterprises

In general, broader coverage would have a positive impact on the competitiveness of EU enterprises as more potential competitors would be subject to a carbon constraint.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

In general, coverage is not a matter of institutional compatibility, nor does it affect the environmental effectiveness of a linked trading scheme. A constellation where one or more gases or categories of sources are included in one scheme but not in the other first and foremost raises questions regarding competitiveness and gaining the necessary political support for linking under these circumstances. However, competitive disadvantages and possible discrimination due to diverging treatment of sectors in two trading regimes are not caused by linking and would also occur in its absence. The paper on market readiness by Aasrud et al. (2010) also has coverage as one of the items where harmonisation is not required.

Low risk of perverse outcomes

Placing mandatory measures on parts of the economy could always lead to adverse effects. For example, a not well thought threshold could shift production of electricity or goods to less efficient installations that fall outside of the sector boundary. Such adverse outcomes must be assessed in an impact assessment once specific policies and sectors have been chosen.

1.2.2 Summary assessment

Table 4 Summary assessment of different options for design element 2a

Options and issues	Pros	Cons
Entire sector	Greater technical abatement potential. No risk of intra-sectoral leakage	High administrative costs
Particular process or technology	Allows for targeted policies and incentives Potentially reduced data requirements	The coverage is limited The focus could have political consequences due to unequal treatment (opposition by either those included or excluded) Data may be required at a more disaggregated level than normally reported
Inclusion threshold	Allows for targeted policies and incentives Reduced data requirements Potentially improved economic efficiency due to lower administration costs	Environmental effectiveness is reduced Inclusion threshold must be agreed A risk of carbon leakage to installations outside the inclusion threshold

1.2.3 *Need for international regulation*

The COP/UNFCCC modalities and procedures should specify which sectors – or broad range of activities – could be part of an NMM, but it does not have to define or specify the boundaries of these sectors or activities. The latter can be left to the proposal submitted by the host government. The COP/UNFCCC, however, should specify the rules and qualifications for defining the sector boundaries in this proposal.

1.3 Design Element 2b – Types of GHGs to cover

Design options

This design element includes the greenhouse gas(es) (GHGs) that will be covered within the sectoral mechanisms. The selection of the GHGs to cover is dependent on a number of factors, primarily the level of data availability, the sector to be involved, and the costs associated with the development of baselines and subsequent monitoring. From a non-sector specific viewpoint, four design options are proposed:

- Carbon dioxide (CO_2) only
- CO_2, methane (CH_4) and nitrous oxide (N_2O) only
- CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)
- Selective GHG coverage based on the characteristics of the sector

1.3.1 Assessment of main design options

1. CO_2 only

CO_2 is the most important greenhouse gas, and therefore has the greatest reduction potential. CO_2 is also the baseline unit to which the global warming potential of all other greenhouse gases are compared. UNFCCC Annex-I parties have the obligation to submit national inventories of emissions of the full range of direct GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) on an annual basis. Non-annex I countries have no fixed date for the submission of national inventories and the gas coverage is more limited: only CO_2, CH_4 and N_2O are required “as appropriate and to the extent possible” while coverage of HFCs, PFCs and SF_6 is only “encouraged as appropriate” (Decision 17/CP.8). Therefore broadly speaking the data availability for certain emissions in various sectors is often limited.

The advantage of restricting the GHG coverage in the sectoral mechanism to CO_2, is hence that existing national inventories for this gas are most likely to be the most comprehensive. CO_2 emissions can be quite easily calculated using established emission factors for a wide range of fossil fuels, power production and industrial processes. Furthermore, it is possible that certain countries have used more elaborate methods of assessing CO_2 emissions, potentially using more disaggregated data collected from source/technology specific emission factors, or actual measurements. Dependent on the level of data disaggregation required by the crediting scheme, this option is likely to entail the lowest costs for the development of robust baselines for a number of key sectors.

In most countries CO_2 is the primary greenhouse gas for large sectors such as power generation, industry and transport. However the environmental impact of including CO_2 only will of course not be as great as the option involving the wider range of GHGs. Although the other gases may be less abundant in the atmosphere, they do have higher global warming potential (GWPs) than CO_2. Although the present contribution of HFCs, PFCs and SF_6 to the radiative forcing effect of all anthropogenic greenhouse gases is small, because of their extremely long lifetimes, many of them will continue to accumulate in the atmosphere as long as emissions continue. Furthermore, CO_2 only may not be most suitable GHG to monitor for certain sectors including agriculture, transport or certain industrial sectors that are associated with high emissions of HFCs and PFCs.

2. CO_2, CH_4 and N_2O

The main sources of CH_4 are livestock production, rice cultivation, fossil fuel production, processing and transport, natural gas production, waste disposal and transport. Therefore it is beneficial to include CH_4 in countries which have large agricultural sectors. Although of generally less global and national importance to most countries, N_2O emissions are most significant in some countries with a substantial agricultural sector, biomass burning and animal manure management. N_2O is also released from transportation and the production of adipic and nitric acids.

The inclusion of CH_4 and N_2O will therefore be important in certain countries, and will also improve the environmental impact of the crediting mechanism. Although the administrative costs will be higher than assessing CO_2 alone, the national inventories of CH_4 and N_2O are likely to be well established. For example, of the 122 countries that have submitted 'national communications' to the UNFCCC estimating their GHG emissions, all of the Parties provided estimates of CO_2, CH_4 and N_2O. However, even though estimates have been made, this does not necessarily mean that the data in the national communications is sufficiently comprehensive and reliable to develop baselines for sectoral crediting/trading mechanisms. Nevertheless, default emission factors for all three gases are well established for an extensive range of fuels and processes and could be calculated.

3. CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)

HFCs, PFCs and SF_6 are fluorine-containing gases, often referred to as "F" gases. Such gases have very high global warming potentials compared to CO_2 as they have very long lifetimes in the atmosphere, however they make only a small contribution of global GHG emissions. HFCs, PFCs and SF_6 are mostly related to HCFC-22 production, semiconductor manufacture, aluminium production, magnesium production and electric transmission and distribution. The presence of certain industrial sectors outlined above, could warrant the inclusion of the F-gases in a sectoral crediting mechanism.

However the inclusion of the F-gases will cause significant administrative burden, and the development of robust baselines will require significant work in many cases. Of the 122 countries that have submitted 'national communications' to the UNFCCC, 15% of the parties included inventories for the F-gases, compared to 100% for CO_2, CH_4 and N_2O (UNFCCC, 2005). Of course not all of the 122 countries will have F-gases to report to the UNFCCC, however default emission factors are less well developed for process emitting F-gases, and existing data may be aggregated to a level that is insufficient to accurately monitor changes within an industrial sector.

On the other hand, in some developing countries experience has been gained over the past years with gathering data, setting baselines and MRV regarding industrial F-gases at the installation level due to implementing CDM projects mitigating these gases in these countries. This experience can be used and built on to gather data, set baselines and conduct MRV for these gases at the sectoral level.

4. Selective GHG coverage based on the characteristics of the sector

With this option the GHGs covered are based on the emissions profile of the sector in question. Naturally not all sectors will emit the entire range of the GHGs covered by the UNFCCC. For example in the aluminium producing sector, the gases to include would be CO_2 and perfluorocarbons. Or, as suggested above, in some countries the GHG coverage of a sectoral mechanism could be restricted to (one or two of) the industrial F-gases in some specific sectors for which reliable data can be obtained and MRVed at acceptable costs. By focusing on primary selected GHGs, the sectoral mechanism can contribute to some significant emissions reduction and crediting, while still meeting environmental integrity and administrative demands at acceptable costs.

Environmental effectiveness

The greater the number of greenhouse gases included in the sectoral mechanism the higher the environmental effectiveness can potentially be.

Environmental integrity/MRV robustness

Increasing the number of gases in the sectoral mechanism will place additional requirements on the MRV requirements, which could test the capacity of parties undertaking verification activities.

Administrative feasibility, including transaction costs

Generally speaking, the broader the scope of the mechanism, the greater the transactional costs can be expected to be.

Economic efficiency

Focusing on the primary GHGs of CO_2, CH_4, N_2O which are released abundantly and where data collection is comprehensive could improve the economic efficiency in terms of $/tonGHG abated.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

The EU ETS only covers industrial installations that emit CO_2, and N_2O is only reported in the production of nitric, adipic, glyoxal and glyoxylic acids. Perflourocarbons are included in the production of primary aluminium. The type of GHGs covered have limited bearing on the preparedness of the sectoral crediting mechanism to be compatible with the EU ETS compared to other design elements.

1.3.2 Summary assessment

Table 5 Summary assessment of different options for design element 2b

Options and issues	Pros	Cons
CO_2 only	National inventories of CO_2 emissions well advanced Appropriate for many sectors Potentially more disaggregated data available	CO_2 is not the most important GHG in certain sectors Reduced environmental impact
CO_2, CH_4, N_2O only	National inventories of these gases are established, or can be established using default emission factors. Inclusion of these gases covers the majority of potential sectors, including energy, agriculture and transport	Data may not be available in such an aggregated form as CO_2 for specific processes Increased administrative costs
CO_2, CH_4, N_2O, HFCs, PFCs, SF_6	Full coverage of all GHGs for maximum environmental impact	Data for HFCs, PFCs, SF6 is likely to be underdeveloped for many sectors Increased administrative costs Increased capacity building costs for data acquisition
Selective GHG coverage based on the characteristics of the sector	Easier to meet environmental integrity and administrative demands at acceptable costs	Scope or potential of environmental effectiveness will be reduced

1.3.3 Need for international regulation

In order to avoid conflict or confusion, the COP/UNFCCC should specify which greenhouse gases could be covered by an NMM, given the availability of necessary, reliable data. Subsequently, in each NMM proposal, the host government should specify which of these greenhouse gases are indeed included in the proposed NMM and how the necessary data requirements are met.

1.4 Design Element 2c – Upstream versus downstream coverage

Design options

The terms 'upstream' versus 'downstream' coverage refer to the point of application of the GHG emissions reduction target in the production and consumption chain of an economy. An upstream system focuses on any point prior to the direct emissions source, i.e. the entities accountable for meeting the GHG emission reduction target are, e.g., the importers, producers or other suppliers of fossil energy or, in the transport or household sector, the manufacturers of cars or other products using fossil fuel (EPA, 2003; Philibert and Reinaud, 2004).

By contrast, in a downstream approach, the system applies to the end-users of fossil fuel energy, i.e. the actual, direct emitters of CO_2, and other, direct sources of GHGs. In theory, a downstram system could even be focused on the end-users of products (including electricity) or indirect emission sources.

In addition to these two 'pure' systems, a third option is a hybrid approach in which some sectors or entities are covered upstream and other downstream. For example, the emerging system in California will be a mixed upstream-downstream system, which will initially cover large downstream emitters in the industry and electricity sectors and in 2015 will be extended to residential, commercial and industrial as well as transport fuel combustion, with the point of regulation being where the fuels enter commerce, for example the fuel distributors.

1.4.1 *Assessment of main design options*

Compared to the downstream approach, the upstream approach has two major advantages (CCAP, 1998; EPA, 2003; Philibert and Reinaud, 2004):

- ***Greater coverage***. In most countries, an upstream system could capture the highest percentage of actual emissions. Upstream can be particularly effective when emissions are closely related to the fuel characteristics or end-of-pipe controls are not readily available. In addition, an upstream approach may better address sectors in which there are numerous small energy users with direct emissions, such as in the transport or household sector.
- ***Better administrative feasibility***. An upstream system would include fewer regulated entities than a comprehensive downstream system, implying that the administrative or other transaction costs would be relatively lower. Essentially, an upstream system would provide a higher administrative feasibility and a simpler means of capturing the CO_2 emissions from the millions of small sources in the transport, commercial and residential sectors.

On the other hand, there are some potential drawbacks to an upstream approach (CCAP, 1998; EPA, 2003; Philibert and Reinaud, 2004):

- ***Lower effectiveness of price signals***. According to some analysts, a downstream approach provides a more direct signal to reduce emissions because the target is the emission source itself, while an upstream approach provides only a price signal to the final energy users by passing through the costs involved. For the final users, an upstream system is hence essentially equivalent to a carbon tax.
- ***No incentives for certain GHG abatement technologies***. Another possible disadvantage of an upstream system is that it would provide no incentives for direct emissions sources to develop and employ post-combustion CO_2 abatement technologies, such as CCS or CO_2 scrubbers, since this behavior would not be directly awarded. On the other hand, although it creates additional complexity, policy makers can create incentives for such technologies by awarding offset credits to downstream emission sources that reduce or sequester emissions (EPA, 2003).

The major advantage of a hybrid or mixed approach is that it may combine the best elements of both the upstream and downstream approaches. On the other hand, it may make the system more complex and lead to all kinds of double counting of GHG emission reductions.

Note however that it depends on the GHG whether an upstream or a downstream approach is more appropriate. Upstream approaches are only applicable where a clear functional relationship between fuel or resource input and GHG emission can be identified. This is the case for CO_2 but usually not for CH_4 and N_2O emissions from fuel combustion (Schneider and Cames, 2009). Moreover, the appropriateness of either an upstream or a downstream approach depends also on the sector considered. In general, an upstream approach is more appropriate for a sector covering a large number of small emitters, while a downstream approach is more appropriate for a sector covering a small number of large emitters.

Evaluating the options concerned – i.e. upstream, downstream or hybrid coverage – against the most relevant assessment criteria results in the findings below.

Environmental effectiveness
For a trading mechanism, the environmental effectiveness is most likely higher under an upstream/hybrid approach, but for a crediting instrument it is, on balance, hard to say. On the one hand, as the GHG coverage is usually larger in an upstream/hybrid system – compared to a downstream approach – the environmental effectiveness of a crediting/trading mechanism under such a system will generally be higher (assuming a similar mitigation rate under all coverage systems). On the other hand, under an upstream system, the signal to reduce emissions is less direct, while there is hardly or no incentive for certain mitigation technologies. For a trading mechanism with an absolute target, the latter argument is not relevant (as the size of the required emission reductions is determined by the cap), but for a crediting instrument an upstream system may result in less emission reductions.

Environmental integrity
On balance, hard to say. Under an upstream approach, the environmental integrity of a carbon market mechanism is most likely higher and more easy to meet as the number of participants to be covered is significantly lower and, hence, the data and MRV requirements are most likely easier to meet. On the other hand, under a downstream system, the data collection and MRV procedures and modalities can be more differentiated, specific and precise, resulting in a higher environmental integrity.

Administrative feasibility
As the number of regulation points is lower in an upstream system, its administrative feasibility is usually higher, i.e. its administrative demands are easier and cheaper to meet.

Political feasibility
On balance, hard to say. As noted, under an upstream approach, the number of directly regulated parties is relatively low and, hence, the number of parties facing the administrative demands and other costs of a NMM and, hence, potentially rejecting the implementation of such a NMM is also low. On the other hand, the political influence of these parties (e.g. oil companies) may be relatively large. However, under both an upstream and downstream system, the political feasibility of implementing a NMM depends largely on other design elements such as the costs and incentives of a NMM, whether the costs can be passed through, but also whether there are alternative, more or less attractive instruments to meet a mitigation target.

Economic efficiency

On balance, hard to say. As the GHG coverage of an upstream system is generally larger, the potential of cheap reduction options is usually higher. On the other hand, under such a system, there are less incentives for certain (end-of-pipe) abatement options that may be relatively cheap.

Private sector participation/potential to mobilize private capital

On balance, hard to say. The extent of private sector participation is likely to be higher under a downstream system as such a system provides (i) a more direct signal to reduce emissions to a larger number of participants, and (ii) an incentive to reduce emissions for a wider set of abatement options. On the other hand, under an upstream approach, participating parties – although smaller in number – are usually much larger having more easy access to larger amounts of private capital. These parties, however, are not the ones who would make the investments at the point of combustion.

Potential impacts on competitiveness of EU enterprises

Speculative/hard to say. Under both an upstream and downstream system, the potential impact on competitiveness of EU enterprises depends mainly on which parties will be regulated, whether they compete with EU enterprises domestically and/or abroad, and on the costs and benefits of a NMM including the extent to which these parties can pass on these costs.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

As the EU ETS is a downstream system, the preparedness for evolution towards an EU ETS compatible cap-and-trade system is most likely to be higher under a downstream approach for a NMM.

Low risk of perverse outcomes

Most likely, there is no significant difference in risks of perverse outcomes between upstream and downstream systems.

1.4.2 Summary assessment

Table 6 Summary assessment of different options for design element 2c

Options and issues	Pros	Cons
Upstream	Greater coverage; Higher administrative feasibility/lower administrative costs	Lower effectiveness of price signal (similar to a carbon tax); No incentives for certain (end-of-pipe) abatement options, e.g. CCS
Downstream	Higher effectiveness of direct incentives; Incentives for wider range of abatement options	Smaller coverage; Lower administrative feasibility/higher administrative costs
Hybrid	May combine the advantages of both upstream and down systems	Enhances complexity and risk of double counting of emission reductions

1.4.3 Need for international regulation

The option whether a sector will be covered either upstream or downstream can be left to the host government. As noted above, however, the COP/UNFCCC should set clear rules and qualifications for defining the coverage or sector boundary of a NMM initiative depending on the point of regulation that is chosen(see design element 2a).

1.5 Design element 3a – Nature of the sector target or crediting threshold

Design options

This design element refers to what type of target or threshold is set, e.g. absolute or intensity-based, whether they are static or dynamic, and on what basis (emissions or other) they are made. The latter is mostly dealt with in element 2a, here we assume emissions as the basis. The design options of this element depend to some extent on design elements 1 (crediting or trading), and 4a (operation/incentives at government/installation level), and may have implications for several others.[1] Three design options are:

- Absolute emission baselines: the crediting baseline or trading threshold is set at an absolute level of GHG emissions for the sector.
- Indexed baselines: the emission level is set at a function of one or several economic or physical variables, such as GDP, tonne of output etc. Sometimes also called 'intensity baselines', in case it is based on one index. For instance, the baseline for a specific year or period could be based on an emission factor per unit output, e.g. 0.5 $MtCO_2$ per MWh of electricity produced or 0.3 $MtCO_2$ per € 1 billion of output in a certain sector, and subsequently multiplying this factor by the level of sectoral output for that year or period.
- Technology diffusion baselines: the crediting threshold is defined at a certain level of technology diffusion, e.g. MW installed capacity, production or production share for renewable electricity. The definition of technology could be very specific or generic (Baron et al, 2009). This option may be less suitable for a trading scheme. Emissions to be credited may be calculated using an emission factor. Sometimes 'diffusion' is also called 'penetration'.

1.5.1 *Assessment of main design options*

Absolute baselines have a large uncertainty due to difficulty in predicting emission levels, and may also be politically unacceptable. However it's more simple to administer and covers all emission reduction efforts, and could be suitable for more complex sectors.

Indexed baselines on the other hand have the advantage of lower uncertainty in establishing the baseline levels and could be politically more acceptable. However establishing an acceptable indexed baseline may be very difficult in complex or diverse sectors. In addition, the amount of baseline emissions and allowances can only be determined ex-post, increasing uncertainty for operators and the carbon market, and constitute an incentive to increase output. There is also no incentive to reduce output, i.e. for demand side measures, which can be an important source for emission reductions. Finally measuring the index involves monitoring costs, and can be technically challenging (e.g. for vehicle kilometres).

For technology diffusion setting an appropriate baseline is also very difficult, and always involves a degree of arbitrariness; for technologies in an early stage of development it is probably impossible. In addition there are substantial challenges with regard to setting appropriate emission factors to calculate the emission savings. Another disadvantage is the relatively narrow scope. On the other hand, it could be interesting for countries interested in technology transfer and is relatively simple to administer (Schneider and Cames, 2009; Baron et al., 2009).

Environmental effectiveness

Whether an absolute baseline is likely to create larger emission reductions than an indexed baseline or vice versa, cannot be assessed up-front, as this depends on the stringency of the baseline. An indexed baseline, however, constitutes an incentive to increase production to get more

[1] Schneider and Cames (2009) and Baron et al. (2009) are the most important sources for this design element, although NERA (2011) broadly has a similar categorisation.

credits and, hence, may result in higher emissions than an absolute baseline. A technology diffusion mechanisms is likely to have a smaller scope than the other two options, therefore the environmental effectiveness will also be lower.

Environmental integrity/MRV robustness

On balance, hard to say for the first two options. On the one hand MRV of absolute emissions is less complicated than relative emissions based on an index as in the latter case also the index basis (e.g. tonne of product) needs to be measured. On the other hand there is a large risk of non-additional credits or over-allocation of allowances in case of absolute baselines. This risk could in principle be lower for indexed baselines, however due to the complexity of setting indexed baselines in practice there is still significant risk for reduced environmental integrity. For technology diffusion, setting a conservative baseline could even be more difficult, as is applying the appropriate emission factor, therefore in this case environmental effectives is likely to be lowest.

Administrative feasibility, including transaction costs

Due to the lower data needs for establishing baselines and corresponding MRV, technology diffusion baselines its administrative feasibility is highest. Second would be absolute emission baselines due to the more straightforward MRV compared to indexed baselines.

Political feasibility

Absolute emission caps in general are not perceived well as compared to indexed baselines. Technology diffusion often is more appealing and has the highest political feasibility.

Economic efficiency

Technology diffusion schemes have a relatively small scope and low flexibility with regard to cheaper and more expensive options. As this mechanism is likely not applicable to immature technologies, it is not likely to contribute significantly to long-term economic efficiency. Indexed baselines often exclude a number of mitigation options including demand side measures and very complex sectors (unless it covers the entire economy with GDP as index), therefore offer lower economic efficiency compared to absolute schemes, which provide the largest flexibility.

Private sector participation/potential to mobilize private capital

This is not likely to be very different for absolute and indexed baselines. For technology diffusion baselines private sector participation is likely to be lower, due to the smaller scope of emission sources and abatement options.

Potential impacts on competitiveness of EU enterprises

Speculative/hard to say. Under all three options, the potential impact on competitiveness of EU enterprises depends mainly on which parties will be regulated, whether they compete with EU enterprises domestically and/or abroad, and on the costs and benefits of a NMM including the extent to which these parties can pass on these costs.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

Absolute emission baselines are most in line with the ETS system, more than indexed baselines. Technology diffusion scores lowest in this criterion.

Low risk of perverse outcomes

With indexed baselines there is an incentive for emitters to increase output in order to gain more allowances, thereby providing the highest risk for perverse outcomes. All three options involve also a certain risk that climate-friendly technologies or policies are implemented after establishing the baselines in order to gain more credits.

1.5.2 Summary assessment

Table 7 Summary assessment of different options for design element 3a

Options and issues	Pros	Cons
Absolute emissions baseline	Allows crediting of all measures to reduce GHG emissions in the sector Easier to implement in sectors with diverse products and services or complex industries Simplicity	Higher uncertainty in establishing the threshold compared to indexed thresholds: risk of over- or under-crediting May be perceived as more stringent and thus politically less acceptable than indexed thresholds
Indexed baseline	Lower uncertainty in establishing the threshold compared to absolute emission threshold May be politically more acceptable than absolute emission targets	More difficult to apply in sectors with diverse products and services More complex to implement Some measures may be excluded from crediting Potentially incentive to increase outputs
Technology diffusion baseline	Focus on technology may be interesting for countries interested in promoting particular technologies	Focus and scope rather narrow Considerable uncertainty in establishing the threshold for a single technology

1.5.3 Need for international regulation

The COP/UNFCCC modalities and procedures should specify which types of baselines are allowed when proposing to implement an NMM, as well as rules and principles for their definition.

1.6 Design Element 3b – Technical method for setting the sectoral crediting threshold or carbon trading target

A major challenge in designing a sectoral carbon market mechanism is to the set the sectoral mitigation baseline, i.e. either the sectoral crediting threshold of a crediting mechanism or the carbon trading target in a trading mechanism, compared to the Business-As-Usual (BAU) baseline during the crediting/trading period of the mechanism. If, for instance, the crediting threshold is set too ambitious, the incentive or expected net return to host governments and/or private investors to participate in the mechanism will be too low. On the other hand, if the threshold is too lenient - or even higher than the BAU baseline - the incentive to participate will be high, but the market may be flooded by large amounts of cheap credits, depressing carbon prices, while even credits may be issued for no emission reductions at all, thereby harming the environmental integrity of the mechanism.

Setting the sectoral mitigation baseline ex-ante at an appropriate level, however, is a complex issue as future emissions levels are driven by many factors such as economic and technological developments, population growth, fuel prices, etc. Moreover, any GHG mitigation target is ultimately based on a political or social agreement between policy makers and stakeholders involved. Therefore, any setting of sectoral mitigation baselines based on projected emissions is characterised by a mixture of considerable uncertainties, methodological limitations, subjective judgements, stakeholders negotiations and political bargaining.

Design options

Sectoral mitigation baselines can be determined by means of different approaches (Schneider and Cames, 2009):

- ***Deviation from projected BAU emissions***. The mitigation baseline could be based on a politically agreed deviation from BAU emissions, expressed as a percentage deviation from BAU emissions (e.g. 20% below BAU emissions). This option requires projecting BAU emissions. It could be used for setting absolute and indexed baselines.
- ***Mitigation potential and costs***. The mitigation baseline could be based on the mitigation potential that should be achieved without using the crediting mechanism. The target could, for example, be set at the level of the no-regret potential in the sector or up to a certain cost level (e.g. 5 €/tCO_2). This option requires projecting BAU emissions and determining the mitigation potential and costs. It could be used for setting absolute and indexed baselines.
- ***Emission rate or benchmark.*** In some sectors, the mitigation baseline could be based on an emission rate or benchmark per output produced (e.g. 0.5 tCO_2 per kWh of power generated). In turn, this rate or benchmark could be based on a reference technology – for instance, a state-of-the-art technology or the commercially best available technology – or on a historical trend level, e.g. the average emission rate over a certain period corrected by a trend factor (i.e. an average reduction rate per annum). An emission rate or benchmark could particularly be used for setting indexed or relative mitigation baselines. In case of setting an absolute baseline, however, a projection of future output would be required in addition to the emission benchmark.
- ***Policy objectives scenario***. The mitigation baseline could be established based on policy objectives in the sector or country. For example, policy objectives for energy efficiency improvements or the penetration of renewable power generation could be used to derive the crediting baseline. Credits would then be issued for efforts that go beyond the established policy objectives. This option could be used for absolute and indexed baselines.
- ***Technology penetration scenario***. The mitigation baseline could be established based on a defined technology penetration scenario that goes beyond a BAU scenario. For example, a crediting baseline for the power sector could be derived based on a targeted portfolio of low-

carbon power plant technologies added to the grid. This option requires projecting BAU emissions. It could be used for absolute, indexed and technology penetration baselines.

1.6.1 Assessment of main design options

Some of the options mentioned above derive the mitigation baseline from a projection of sectoral BAU emissions in an absolute or relative sense. A disadvantage of this approach is that it involves the risk that the emissions projections be deliberately inflated to increase the credit revenue stream. Emissions projections rely on many assumptions which are uncertain and difficult to validate in an objective manner such as sectoral growth rates, future energy prices, etc. These assumptions could be made in ways that tend to overestimate the emissions development in the sector. And countries do have an incentive to inflate their baselines in order to weaken the level of mitigation efforts they have to make themselves and to increase the potential for generating credits and selling them to other countries.

On the other hand, there is the risk that the BAU baseline will be set too conservative. This will make it harder for the host country to reach and, hence, to accept an even more stringent mitigation baseline. Therefore, setting mitigation versus BAU baselines requires a set of reliable data and projection methodologies that are acceptable to all parties involved.

If the mitigation baseline is based on the potential and costs of sectoral GHG abatement options, the risk of a biased determination of the mitigation baseline is even greater (Schneider and Cames, 2009). In this case, it is not only necessary to project BAU emissions but also to estimate the potential and costs of a variety of sectoral abatement options. The estimation of mitigation potentials and costs poses similar challenges as the projection of emissions. Although this approach is conceptually sound, as the mitigation baseline is based on abatement potential and cost, the results depend heavily on the data and methodological assumptions used, including assumptions on deployment rates and future costs of new mitigation technologies.

Compared to using a deviation rate from projected BAU emissions, however, an advantage of using abatement potentials and costs to set the mitigation baseline is that it may have a more objective basis with less uncertainties on abatement potentials and costs and, therefore, less dependent on abatement uncertainties and subjective considerations.

The application of an *emission rate or benchmark* is particularly useful, or even necessary, when setting a relative or indexed baseline. Moreover, this approach appears notably attractive and feasible in homogeneous sectors with a limited number of clearly defined outputs, such as aluminium or cement. In addition, setting an emission benchmark on a reference technology or historical trend level seems to be relatively straightforward and rather objective, i.e. technology- and fact-based.

On the other hand, the benchmark approach has some limitations and other disadvantages. Actually, a benchmark has to be set for each type of activity, output or service. Many sectors, however, are characterised by a large variety of activities, outputs and services which are sometimes closely related or even co-produced. For these sectors, it may be rather cumbersome and administratively demanding to set a large number of benchmarks, which each covering only a limited amount of emissions. For instance, in the chemical and refinery sectors, one plant or production process often generates a variety of output products more or less simultaneously. In these cases, it is very hard and rather demanding to set a benchmark for each product separately.

Moreover, even if the product or activity is well defined, its rate of emissions may still vary widely depending on the type of technology or process used, the type of installation (e.g. new versus existing plants), or – in the transport sector – the type of vehicle and mode of transport used. This raises the question whether a single, uniform benchmark or a set of differentiated benchmarks should be used to set the baseline for a similar product or activity (Schmidt et al., 2006; CMIA, 2011).

In addition, setting a benchmark based on a current technology or historical trend level has its limitations as it does not necessarily reflect what is likely to be applicable in the future. Finally, in the case of setting an absolute emission baseline, the level of future output also has to be determined ex ante (in addition to the benchmark), which may be a cumbersome process for some specific products.

The use of ***policy objectives*** to derive sectoral mitigation baselines appears promising in sectors where such policy objectives have already been established in the past. For example, in countries where medium- or long-term policy objectives for energy efficiency, GHG mitigation or renewable energy have already been established in the past, these objectives could be used to set BAU and (more ambitious) mitigation baselines. However, the use of policy objectives may result in a so-called 'perverse incentive': if policy objectives are not yet adopted in a country or sector this approach could discourage countries to adopt ambitious policy objectives as adopting a less ambitious policy objective would provide higher revenues from the sale of carbon credits for the country. Similarly, one could argue that the use of policy objectives tends to punish early movers, i.e. countries that have adopted ambitious policy objectives already at an early stage, and to favour countries that have not yet adopted such objectives (Schneider and Cames, 2009).[2]

Using a ***technology penetration scenario*** to set a mitigation baseline has similar advantages and disadvantages as applying a policy objectives scenario discussed above. In addition, a technology penetration scenario has the advantage that it may be administratively/politically more feasible as it appeals to more concrete, direct technology innovation interests rather than to achieving mitigation targets in which developing and emerging countries are often less interested. On the other hand, a technology penetration scenario faces probably even higher difficulties in setting ambitious but realistic and mutually acceptable targets for individual technologies. In addition, it runs the risk of 'picking the winners' and neglecting more cost-effective technologies.

Different options to derive mitigation baselines could also be combined with the view to provide better safeguards that mitigation baselines are actually set reasonably below BAU emissions. To this end, it could be required that different criteria be met at the same time. For example, it could be politically agreed that the sectoral mitigation baselines should be at least X% below BAU emissions, that they should be set at least at an emissions level that reflects already adopted policy objectives, and that they should be set below the no-regret mitigation potential (Schneider and Cames, 2009).

Assessment of related design options

In addition to the approach used to set the mitigation baselines, there are at least two other, related design options that are briefly assessed below.[3]

Firstly, there is the question how and when the sectoral mitigation baseline will be set and agreed at the national and international policy level. Basically, there are two options:

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[2] This important issue is discussed in some more detail in the next design element (3c) on the interaction with other policies and measures.

[3] A third related design option refers to the length of the crediting/trading period and particularly to the question whether the mitigation baseline has to be renewed after each period. This issue is discussed separately as part of design element 4d on temporal flexibility and other timing issues.

- **High UNFCCC level, top-down process.** Commitments in terms of sectoral mitigation baselines could be negotiated as part of a new climate deal and could be included in an Annex to a new climate treaty.
- **Bottom-up process**. Developing countries could propose sectoral mitigation baselines in a bottom-up process. In this case, a new climate treaty would only specify the principles and institutional framework for processing sectoral mitigation baselines, and recognize the baselines approved at national level. Under this approach, sectoral mitigation baselines would be determined in a process following the new climate treaty (Schneider and Cames, 2009). For instance, a crediting threshold could be approved either by an international body such as the CDM Executive Board or by a more political level body than CDM EB.

The key advantage of the first option is that it ensures a common approach/agreement as well as an early adoption of sectoral mitigation baselines, and that it provides at an early stage certainty for Parties and the private sector which may facilitate an early implementation of GHG abatement measures.

On the other hand, agreeing on sectoral baselines which are meaningful and acceptable for both the UNFCCC and the host country involved may be a lengthy and cumbersome, technical process to collect necessary data, to prepare emission projections, to assess potential mitigation policies and measures and to review all information. Waiting on the outcomes of such a process, in particular for a large variety of countries and sectors, will most likely delay significantly the agreement and ratification of a new climate treaty.

A way forward could be an agreement in a climate treaty on key principles of a sectoral market mechanism, including principles for the ambition or environmental effectiveness of the mitigation baselines and on principles for the procedures and approaches to set and agree mitigation baselines. The actual determination of these baselines could then be delegated to a technical process conducted by (local/international) experts and, subsequently, approved by both the host government and the UNFCCC (Schneider and Cames, 2009).

A second issues concerns the question whether the sectoral mitigation baseline should be flat or sloping (i.e. either upward or downward) over the crediting/trading period as a whole (CMIA, 2011). The advantages of a sloping baseline are (i) that it may better reflect the actual trend in GHG emissions (either in an absolute or relative sense), (ii) that it may result in a more equal spread of mitigation efforts and generated credits over the crediting period, and, hence, (iii) that it may be more cost-effective, attractive and acceptable to host countries. On the other hand, it may be easier to set a flat baseline rather than to determine and agree on the right slope of a mitigation baseline.

Evaluating the options regarding the approaches for setting sectoral mitigation baselines against the assessment criteria results in the findings below.

Environmental effectiveness

The environmental effectiveness of a sectoral carbon market mechanism depends not so much on the specific (technical) approach to set the mitigation baseline but rather on the (political) agreement on the GHG abatement ambition of the mechanism. However, as some approaches are based on targets which are more appealing or better acceptable to host governments (e.g. targets in terms of emission benchmarks or technology penetration rates, rather than absolute mitigation targets), such approaches may result in accepting and achieving more ambitious emission reductions.

Environmental integrity
The environmental integrity of a sectoral carbon market mechanism depends not so much on the specific (technical) approach to set the mitigation baseline but rather on the robustness of the data and methodologies used to set and MRV the mitigation baseline. For some approaches, however, the environmental integrity may be harder to meet due to higher administrative demands (see discussion on next criterion). As discussed above, the risk of inflated baselines is probably highest under the approach based on mitigation potential and costs and lowest when based on an emission rate or benchmark.

Administrative feasibility
For some approaches, in particular those based on determining both BAU emissions as well as mitigation potentials and costs, the administrative demands are relatively high to set the mitigation baseline ex ante, but relatively low to determine and MRV reduced emissions ex post. For other approaches, notably those based on a specific policy objective or technology penetration scenario, the opposite applies (i.e. the administrative demands are relatively low to set the mitigation baseline ex ante, but relatively high to determine and MRV reduced emissions ex post). However, for the approach based on using emission benchmarks, both setting mitigation baselines ex ante and determining/MRVing reduced emissions ex post may be relatively low in some homogeneous, well-defined sectors but relatively high in more heterogeneous sectors with a large variety of products, technologies and installations.

Political feasibility
For host countries, the political feasibility of the methodological approaches discussed above is most likely ranked highest in the following order:

- ***Technology penetration scenario***, as policy makers in developing and emerging countries are usually most interested in reaching specific technology innovation targets.
- ***Policy objectives scenario**,* in particular if policy makers are interested in – or have already agreed to meeting energy efficiency or renewable energy targets.
- ***Emission rate or benchmark**,* as these relative emissions targets do not run the risk of limiting economic growth.
- ***Mitigation potentials and costs**,* as this approach is based on setting absolute emission targets but offers some certainty on controlling costs.
- **Deviation from projected BAU emissions**, as this approach is based on setting absolute emissions.

For buying/non-host countries, the political feasibility of the approaches mentioned depends on their perspective, i.e. whether they are mainly interested in enhancing the environmental effectiveness/integrity of the scheme or in buying as much credits as cheap as possible. It should be noted, however, that realizing one or the other of these perspectives depends less on the approach used but rather on the level of setting the crediting/trading baseline, the MRV system and the compliance regime.

Economic efficiency
This criterion is hardly or not relevant for the design option concerned.

Private sector participation/potential to mobilize private capital
This criterion is hardly or not relevant for the design option concerned as the private sector participation/potential to mobilize private capital depends less on how the sector mitigation baseline is set but rather on how the incentives to meet this baseline – and the resulting net revenues involved – are translated at the installation level (see design element 4a).

Potential impacts on competitiveness of EU enterprises

This criterion is hardly or not relevant for the design option concerned as the potential impacts on competitiveness of EU enterprises depends less on how the sector mitigation baseline is set but rather on how the incentives to meet this baseline – and the resulting net revenues involved – are translated at the installation level (see design element 4a).

Preparedness for evolution towards EU ETS compatible cap-and-trade system

As the EU ETS is a trading mechanism with an absolute emissions cap, this criterion ranks highest for the approaches discussed above in the following order:

- Approaches resulting in an absolute sectoral mitigation baseline ex ante, such as the approaches based on deviation from BAU emissions or based on reaching a certain mitigation potential below the BAU baseline.
- Approaches based on a relative mitigation target such as an emission rate or benchmark.
- Approaches based on either a technology penetration or non-ETS policy objectives scenario.

Low risk of perverse outcomes

The risk of perverse policy outcomes applies for all approaches outlined above, but is probably highest for approaches based on new, general GHG mitigation targets and lowest for approaches based on specific technology or energy policy targets, notably if the host government has already agreed on such targets or is highly interested in achieving such targets.

1.6.2 Summary assessment

Table 8 Summary assessment of different options for design element 3b

Options and issues	Pros	Cons
Approaches for baseline setting:		
Deviation from projected BAU emissions	Method of reducing projected GHG emissions by certain % is quite common in climate agreements	Setting BAU emissions is a complex issue with many uncertainties; Setting deviation rate depends on political agreement; Risks of biased baseline setting
Mitigation potential and costs	Conceptually sound, i.e. mitigation is based on abatement potential and cost	Uncertainties/risks of biased baseline setting are even higher due to added complexities of determining abatement potential and cost
Emission rate/benchmark	Useful/necessary when setting relative/indexed baselines; Attractive/feasible in homogeneous, well-defined sectors; Rather straightforward	Rather cumbersome and administratively demanding to set benchmarks for heterogeneous sectors with large number of outputs and/or large variety of production processes, technologies and installations
Policy objectives scenario	Promising in sectors where policy objectives have already been established in the past	May result in perverse policy incentive; May punish early movers and reward laggards
Technology penetration scenario	Promising in sectors where penetration rates have already been established in the past; Administratively/politically more	May result in perverse policy incentive; May punish early movers and reward laggards;

Options and issues	Pros	Cons
	feasible	Risk of 'picking the winners
Process:		
Top-down (high UNFCC level)	May ensure a common approach/agreement and early adoption of mitigation baselines, early certainty and an early implementation of mitigation measures	Agreeing on baselines may be a lengthy and cumbersome, technical process; Probably delays agreement and ratification of climate treaty
Bottom-up	Reflects better local circumstances and complexities of setting baselines across a large diversity of countries and sectors; Bottom-up information is often needed to set up meaningful baselines	May result in a cumbersome and biased process of baseline setting, including bottom-up, stakeholders interests; May result in a large variety of specific/detailed methodological approaches
Flat or sloping baselines:		
Flat baselines	May be easier to set and agree	May not adequately reflect actual trend in emissions; May result in unequal spread of mitigation efforts and generated credits over crediting period
Sloping baselines (i.e. upward or downward)	May better reflect actual trend in emissions; May result in more equal spread of mitigation efforts and generated credits over crediting period; May be more attractive/acceptable to host countries	May be harder to determine and agree on 'right' slope of mitigation baseline

1.6.3 Need for international regulation

The detailed specification of the exact method used for setting the baseline can be left to the NMM proposal submitted by the host government. The COP/UNFCCC, however, should specify which types of method are allowed and the basic rules for elaborating this method in the proposal, including the type of data to be provided, etc.

1.7 Design Element 3c – Interaction with other policies and measures

Carbon market mechanisms may interact with other policies and measures (PAMs), in particular with other measures reducing similar sectoral emissions, such as Nationally Appropriate Mitigation Actions (NAMAs), which may be supported or credited by foreign donors. This type of policy interactions may lead to double counting/crediting of emission reductions. It can be avoided by determining appropriate crediting baselines for each instrument which take due care of the emission reduction effect of other, interacting instruments.

In addition, carbon market mechanisms may interact with domestic PAMs to stimulate energy efficiency or renewable energy, or with other PAMs which reduce GHG emissions and which have or would have been adopted even without these mechanisms. As noted in the previous section on setting mitigation baselines, this type of policy interactions may lead to perverse incentives, i.e. if PAMs that favour the reduction of GHG emissions are included in the baseline of a crediting mechanism, this could constitute perverse incentives for governments not to adopt such policies and measures, as it would lower the potential for sectoral crediting. Such perverse incentives can be avoided by deciding that certain policies and measures that have been adopted after a certain date do not need to be taken into account when establishing the crediting baseline. However, this decision also bears the risk that the GHG reduction effects of some policies and measures are not included in the crediting baseline although they would have been implemented anyhow – i.e. even without the mechanism – thereby resulting in the generation of credits which cannot be really regarded as additional. Hence, there is a clear trade-off between the objective of avoiding perverse incentives regarding new policies and measures and the objective that only additional emission reductions should be credited (Schneider and Cames, 2009).

The CDM has had to deal with the same question (Castro et al., 2011). In order to prevent situations where developing countries hesitate to introduce climate-friendly policies in order not to render CDM projects non-additional, the CDM Executive Board has decided that the impacts of such policies can be excluded in establishing a baseline scenario if they have been implemented since the adoption of the Marrakesh Accords (11 November 2001) (EB 22, Annex 3). However, the result is that the more time progresses, the more unrealistic the baselines of projects become.

1.7.1 Assessment of main design options

Hence, there are basically two options regarding how to factor other policies and measures – including NAMAs – into the baseline:

- Factor all PAMs into the baseline, regardless when they have been agreed/implemented.
- Exclude PAMs after a certain date, e.g. when the UNFCCC adopts the modalities and procedures of the new market mechanisms.

Evaluating the options regarding the inclusion of interacting PAMs into the baseline against the assessment criteria results in the findings below.

Environmental effectiveness

Including all PAMs reduces the mitigation baseline of the sectoral carbon mechanism (and, hence, enhances its environmental effectiveness, notably in case of a trading mechanism), but increases the risk of perverse policy outcomes, I.e. delaying or not implementing certain GHG emissions, which may result in emissions above the no-lose mitigation baseline in case of a crediting mechanism. Therefore, environmental effectiveness is probably best served in case of excluding PAMs from a certain date.

Environmental integrity

Excluding PAMs from a certain date, however, runs the risk of reducing the environmental integrity of the mechanism over time as it may result in growing numbers of credited emission reductions which are not really additional. More generally, it is highly important to determine which policies are included in the baseline and what is a country's contribution on top of that as this highly affects the environmental integrity and effectiveness of the scheme.

Administrative feasibility

Hard to say, but most likely there is no major difference between the options concerned in terms of administrative feasibility.

Political feasibility

For host countries, the political feasibility of a mechanism is most likely higher if PAMs are excluded from a certain date.

Economic efficiency

Hard to say, but this criterion is likely to be better met when excluding PAMs from a certain date as it reduces the risk of perverse policy outcomes. On the other hand, you may get the same reduction being paid for twice, first from the domestic policy and second from the carbon market. E.g. first you get a feed-in tariff and then you get carbon credits on top even though the FIT may already be sufficient to make the project viable.

Private sector participation/potential to mobilize private capital

This criterion is likely better met when excluding PAMs from a certain date as (i) it reduces the risk of perverse policy outcomes, and (ii) it results in a higher amount of credits generated (although the impact of the latter depends on how crediting is translated in incentives at the private sector level).

Potential impacts on competitiveness of EU enterprises

Hard to say, but depending on how crediting is translated in incentives at the private sector level, the option of excluding PAMs from a certain date may result in higher crediting revenues for private firms and, hence, in improving their competitiveness compared to EU enterprises.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

Most likely this criterion is better met if all policies are included in the baseline.

Low risk of perverse outcomes

This criterion is best met when PAMs are excluded from a certain date.

1.7.2 Summary assessment

Table 9 Summary assessment of different options for design element 3b

Options and issues	Pros	Cons
Including all PAMs	Enhances the opportunity that credited emission reductions are really additional	High risk of perverse incentive/policy outcome
Excluding PAMs from a certain date	Avoids risk of perverse incentive/policy outcome	High risk that over time growing numbers of credited emission reductions are not really additional

1.7.3 Need for international regulation

The COP/UNFCCC should specify whether, when and which policies and measures should be included or excluded from the NMM baseline.

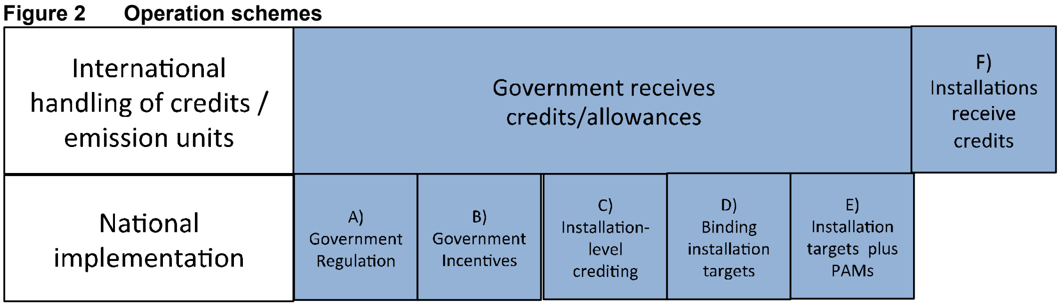
1.8 Design Element 4a – Operation/Incentives of the scheme at government/ installation level

Sectoral crediting and sectoral trading schemes can be operated at government level or at installation level. The following basic options can be conceived:

- The government receives credits/allowances and implements non-ETS policies and measures (PAMs) to reduce emissions. These may be either mandatory “sticks” or voluntary “carrots”.
- The government receives credits/allowances and defines individual targets for the installations within the sector. In a crediting system, if an installation beats its target, it receives credits from the government. If not, there are no penalties. In a trading system, however, an installation can sell its surplus of allowances if it beats its target (in case of free allocation) or it has to buy less allowances (in case of auctioning).
- The government receives credits/allowances and defines binding installation-level emission targets, possibly forming the basis for a national emission trading system.
- The government defines binding installation-level targets, possibly as basis for an ETS, and in addition implements further PAMs to promote emission reductions.
- IETA (2010) has also proposed that instead of going through governments sectoral crediting might be established with a direct relation between the installations and the international authority. In this version, installations would receive credits directly from the international authority if they beat their installation-level crediting thresholds.

These different options are illustrated in Figure 2. These are prototypical archetypes; in practice overlaps and combinations are likely.

Figure 2 Operation schemes



Design options

Options A) and B) Government receives credits/allowances and implements non-ETS policies and measures

The government, respectively a governmental or non-governmental coordinating entity, implements emission reduction plans or policies. Governments in general have a broad array of PAMs at their disposal which they can choose from, such as:

- General economic and fiscal PAMs such as energy/CO_2 taxation, abolishment of fossil fuel subsidies;
- Targeted economic and fiscal PAMs, such as subsidies for energy saving investments, feed-in tariffs for electricity from renewable energy sources or from cogeneration of heat and power, or certificate schemes for energy savings or electricity from renewable energy sources;
- Standards such as performance standards for industrial installations, building codes, or efficiency standards for electric appliances or vehicles
- Information, know-how transfer and education PAMs such as PR campaigns, energy analyses (audits), specialised consultancy, demonstration and training activities, energy labelling or driver training.
- Promotion of research and development of new technologies.

One crucial distinction is whether PAMs impose mandatory obligations or provide incentives for voluntary actions. The question of whether “sticks” or “carrots” are used has an impact on some of the assessment criteria, “sticks” and “carrots” are therefore treated as two separate options. However, in practice governments usually implement policy packages consisting of mandatory as well as voluntary policies.

Depending on whether sectoral crediting or trading is used, the government receives allowances ex ante or credits ex post. It is in the coordinating entity’s discretion how (if at all) to distribute the revenue within the sector. If revenue is to be distributed, it may be distributed directly, or it may be used to co-finance the policies and measures the government is implementing, such as renewables feed-in tariffs or other financial incentives. For example, the power sector is in many countries still publicly owned or very tightly regulated, so governments could directly implement measures to reduce emissions and use carbon revenues to finance these actions.

Option C) Government receives credits/allowances and defines installation-level crediting thresholds

In this approach, the government breaks the sectoral target down to the installation level. The process would be similar to an allocation in a cap-and-trade system, but instead of allowances each installation would be given an individual target based on the sectoral target. If an installation beats its individual target, it receives credits from the government.

Option D) Government receives credits/allowances and defines binding installation-level targets

This option is similar to Option C, but instead of non-binding targets the installations are assigned binding targets. These might form the basis for an emission trading system, but not necessarily. For example, South Korea is currently implementing a “Greenhouse Gas & Energy Target Management System”. In this system, the nationally-set target is broken down to the company level and individual targets for the country’s 470 largest emitters are imposed but the emitters are given only very limited options for emissions trading (Sterk and Mersmann 2011).

This option may hence be chosen for both sectoral crediting and sectoral trading. As the Korean example shows, even if the government’s target is not internationally binding it may still choose to make compliance with targets mandatory for the installations.

Option E) Government receives credits/allowances and defines installation-level targets as well as complementary policies and measures

This approach is a hybrid of the above options. The government would define voluntary or mandatory installation-level targets and also introduce other PAMs to promote emission reductions. This reflects the policy approach of for example the EU, which on the one hand has an ETS but on the other hand also has a broad range of sector- and technology-specific instruments.

Option F) Installations receive credits directly from international authority

For each covered installation a specific emission reduction objective is set (e.g. by benchmarking of similar installations). If the individual installation overachieves the reduction objective, then it is directly eligible for credits from the international credit-issuing agency.

1.8.1 Assessment of main design options

Environmental effectiveness

In a sectoral crediting scheme, the environmental effectiveness strongly depends on the operation of the scheme. In principle, breaking the sectoral crediting threshold down to the individual installations in the form of mandatory emission targets (Option D) would be the option that would give the certainty that the intended environmental effectiveness will be reached. If installations receive voluntary individual crediting thresholds (Options C and F), the environmental effect strongly depends on sector specifics and on the level of the carbon price, unless the scheme is backed by other policies (Option E).

If a government chooses to implement non-ETS policies and measures (Options A and B), the environmental effectiveness depends on the details of what actions are taken and how well they are implemented. As discussed in the previous section, a crucial factor is whether the international carbon price is high enough to constitute a strong incentive for the government to take action and/or a government has strong intrinsic motivations to pursue emission reduction policies.

In general, while many analysts consider that emissions trading has the highest environmental certainty, non-ETS policies and measures can also be very effective, as for example demonstrated by the rapid scale-up of renewables in Germany due to the renewables feed-in tariff. Some policies such as banning outdated technology can also achieve very considerable emission reductions at very low transaction costs (Schneider and Cames 2009: 50). Depending on the circumstances, non-ETS PAMs can in fact be even more environmentally effective than emissions trading. While the cap in an ETS guarantees a certain level of emission reductions, this is at the same time the maximum level of emission reductions. Any factor that serves to depress emissions, such as a recession or rising fuel prices, in an ETS only leads to freeing up allowances for later use.

In Options C and F it may occur that some installations are successful in reducing emissions while others are not. This could lead to the national crediting threshold not being achieved. Thus, the country as such would not be eligible for credits but individual installations would be. If installations that reduce emissions run the risk of not being rewarded because of the failures of others, the system would hardly provide an incentive to reduce emissions. The crediting of individual installations would therefore need to be decoupled from the performance of the sector as a whole. One option would be for the host country government to take on the risk and agree to provide credits to installations that reduce their own emissions, regardless of the overall sector performance. However, this does not reduce the risk, it merely shifts it from the installation owners to the host country government. Another option, which would probably be politically more acceptable to developing countries, would be to hold back a share of the credits issued to form a reserve. The government could also try to reduce the risk by implementing additional policies to reduce sectoral emissions (Option E). The most straightforward approach would be Option D, to make the installation-level targets mandatory with penalties attached. These could either be financial penalties, which could be used by the government to purchase trading units if needed, or obliging the companies themselves to purchase trading units for their excess emissions (Baron, et al., 2009; Helme et al., 2010; Marcu 2009, NERA 2011).

As NERA (2011: 31) notes, the exception to this problem is where a single player dominates a sector and can therefore influence the overall sector outcome materially. This is for example the case where the power sector is still state-owned. Companies like South Africa's Eskom would have the full carbon price incentive even in a fully voluntary crediting system.

Environmental integrity/MRV robustness

The question of whether to introduce PAMs, or issue credits or allowances has no relation to how sectoral baselines are set and how emissions are MRVed. The question of whether "a tonne is a tonne" therefore does not seem to be affected by which of the above approaches is chosen.

Administrative feasibility, including transaction costs

A centrally coordinated scheme (Options A and B) might be quite simple to implement, the technical and administrative effort is limited as policies can be chosen to fit to the countries' and sectors' framework conditions. As noted above, some policies such as banning outdated technology can achieve very considerable emission reductions at very low transaction costs. MRV requirements could also be kept quite simple. MRV could be done on the basis of the national inventory using statistical data such as fuel statistics.

If the crediting threshold is broken down to the installation level (Options C-F), emission accounting will also need to be done at the installation level, which would significantly increase the complexity and also lead-time for implementation. Butzengeiger-Geyer et al. (2010: 12) consider that national implementation even in the base case (Options A and B) is likely to take at least 3 years. If implementation is to be done on an installation basis, national implementation would in their view require an additional 1-2 years.

Political feasibility

Politically, Options A and B may appear as the most straightforward as emission targets are not broken down to the installation level. However, mandatory “sticks” (Option A) may engender substantial political resistance. Voluntary “carrots” (Option B) would probably not encounter much opposition by companies. However, the government would need to mobilise funding for the financial incentives it offers. The revenue from selling credits or allowances is supposed to exactly address this issue, but there would be uncertainty whether the carbon revenue would in fact match the necessary government spending.

To implement Option D, mandatory installation-level targets, quite strong political backing is needed. Furthermore, the administrative burden and transaction costs for participating actors are very high.

In Options C and F, the installation-level crediting, the technical and administrative efforts are also quite high. Politically we rate Option C and F very critical: the set-up is very beneficial for private sector actors as it implies no penalties and incentives are accessible on a voluntary basis. The flaw however is that factually the government has to hedge the risk of underperformance: if the countries’ crediting threshold is missed, the government has to cover the costs of the excess credits that were issued. We anticipate only few governments to be willing to do this, unless the threshold was so low that underperformance was highly unlikely. However, if this was the case, the environmental effect would also be very small.

Options C and F may also not be the option most favoured by buyer governments. As noted above with relation to environmental effectiveness, unless there was some form of insurance or backup, there would be little incentive for installations to reduce their emissions. Buyer countries could hence expect only few credits to result from such a system (NERA 2011).

Economic efficiency

Looking at the economic efficiency, the options C-F that include domestic trading or direct international crediting will in most cases perform very well on a short term basis (static efficiency), but will not be prone to promote long-term innovations unless this is stimulated by accompanying measures (Option E). If CO_2 pricing is the only instrument that employed, investment decisions tend to be based mostly on current technology prices. This disadvantages new technologies that are still at the beginning of their learning curve but may in the long run become the cheapest options. Taking the example of electricity generation, emissions trading incentivises efficiency improvements at power installations and may change the merit order of coal and gas but at current prices gives only limited incentives for renewable electricity generation (Weber and Hey 2012). At the same time, the dedicated support given by some countries through instruments such as renewables feed-in tariffs has led rapid technological learning and price decreases. For instance, the price of solar PV has dropped by 22% for each doubling of installed capacity and some analysts even estimate that solar PV may soon become the cheapest option to generate electricity (e.g. van der Leun 2011). If only emissions trading had been used without being complemented by technology-specific promotion policies, there would hardly have been any up-scaling of solar PV and hence hardly any technological learning. As exemplified by the CDM, which hardly has any solar energy projects.

Thus the dynamic efficiency of options C-F will be only average. A centrally coordinated scheme (Options A and B) can – if designed well – potentially foster dynamic efficiency better, but potentially at the cost of static economic efficiency. A hybrid of emissions trading and government policies (Option E) could potentially have the best mix of static and dynamic efficiency, depending on the details of the policy package.

Butzengeiger-Geyer et al. (2010: 44) argue that a sectoral mechanism is the more cost-effective, the more flexibility there is for the private sector to autonomously select measures to reduce its GHG-emissions. In Options A and B, this depends on the PAMs that are implemented by the government. Taxes leave high flexibility if designed in an output-oriented manner, efficiency standards can be designed in a way that provides flexibility but also in a way that offers little flexibility. Subsidies typically are technology-specific and hence offer little flexibility. Options C and F would provide maximum flexibility as installation-level targets would be voluntary. Option D would provide high flexibility if the installations could use emissions trading as a means to comply with their mandatory targets.

Private sector participation/potential to mobilize private capital

In Options A and B, governments would either force companies to invest through measures such as mandatory performance standards (Option A) or they would provide incentives to invest (Option B). Some incentive schemes such as renewables feed-in tariffs haven proven very effective at quickly scaling up private investments.

If a sectoral emission target is broken down to the installation level (Options C-F), installation owners have an incentive to reduce emissions as long as their abatement costs are lower than the price of carbon. As noted above, the balance between supply and demand on the carbon market is hence a crucial factor for the effectiveness of the system.

As noted above, in Options C and F the crediting of individual installations would need to be decoupled from the performance of the sector as a whole, otherwise there would hardly be an incentive to invest.

A cap-and-trade system at installation level as part of Option D would further simplify issues. As units are issued ex ante, they could be traded under standardised contracts. This would probably result in exchange-based trading, which would further facilitate operation of the mechanism. Entities could manage their allowances as assets and sell them whenever they liked, rather than having to wait for the ex-post assessment of their performance (Marcu 2009).

As noted above, the scope for private participation also depends on the sectoral characteristics. If the majority of installations are owned by public or governmental entities, the government does not have to create incentives but may implement emission reduction measures directly. This applies for example to the power sector in many developing countries, including large ones such as India, Indonesia or Mexico (Butzengeiger-Geyer et al. 2010: 123)

Some of the options have different impacts on domestic and foreign investors. If a government implements mandatory regulations (Option A) or installation-level emission targets (Option D), the role of foreign investors would be restricted to buying credits from the host country government. It also is unclear whether a domestic ETS based on binding installation-level targets would offer opportunities for the participation of foreign investors. As the trading units would only have value within the host country's domestic scheme, they would not have any direct value to outside investors. By contrast, if the government provides financial incentives (Option B) or internationally fungible credits are issued (Options C and F), there could be incentives for participation by foreign investors, depending on the design. The incentives created by a hybrid approach (Option E) would similarly depend on whether domestic or internationally fungible units are used and what PAMs are implemented (NERA 2011: 32f).

Potential impacts on competitiveness of EU enterprises

In Options A and B the covered sectors are not directly linked to the carbon market and the impact on competitiveness depends on what PAMs the host country introduces to achieve its target. If the country introduces financial incentives for investments in low-emission technologies (Option B), this will likely have a positive impact on this sector's international competitiveness and correspondingly a negative impact on the competitiveness of EU companies. Such incentives might also constitute an incentive for EU companies to shift production to the developing country.
If the host country introduces mandatory standards such as efficiency standards (Option A), this might force the covered companies to invest in the short term or at least faster than originally intended. This might lower companies' liquidity in the short term, but in the long term the company/sector will profit from its more efficient operations. If the host country introduces (or increases existing) energy or carbon taxes, this will increase the production costs of the covered companies. The impact on the sector's international competitiveness depends on the scope and level of the tax (Butzengeiger-Geyer et al. 2010: 43-45)

As discussed in the previous section, due to their voluntary "no-lose" character crediting approaches can be likened to subsidies. Options C and F would generate additional revenue for companies in developing countries and could hence be expected to have a negative impact on the competitiveness of EU companies. Option D would impose binding targets, the impact would depend on the sector's characteristics. If companies have cheap abatement potential at cost below the carbon price, they would still get a financial benefit and, hence, a competitive advantage from the system.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

In terms of evolution towards an EU ETS-compatible trading scheme, generally the introduction of sectoral crediting or trading is a first step, e.g. establishing national emission inventories etc. Options A and B, non ETS PAMs, bring no additional benefit in this respect. Breaking the sectoral target down to the installation level (Options C-F) would build up further capacities as installation-level data and accounting systems would be required. Option D would come quite close to the establishment of compatible trading schemes in this sector, depending on the details of the policy set-up of the trading system.

Low risk of perverse outcomes

The question which operation scheme is chosen relates to the implementation of a previously set target. It therefore does not appear to involve risks of providing incentives to policy makers and/or private participants to increase rather than decrease GHG emissions.

1.8.2 *Summary assessment*

Table 10 Summary assessment of different options for design element 4a

	Pros	Cons
A) Government regulation	Medium environmental certainty, depending on specific PAMs Potentially low administrative costs May foster high dynamic efficiency Low impact on EU competitiveness	Political resistance by companies to be expected Potentially low static efficiency No evolution towards cap-and-trade
B) Government incentives	Medium environmental certainty, depending on specific PAMs Potentially low administrative costs Probably no resistance by companies May foster high dynamic efficiency Incentives for domestic and foreign investors	Governments needs funding for incentives Potentially low static efficiency Negative impact on EU competitiveness No evolution towards cap-and-trade
C) Installation-level crediting	Potentially high static efficiency Incentives for domestic and foreign investors Medium evolution towards cap-and-trade	No environmental certainty No investor certainty, unless "insurance" provided or sector dominated by single player Insurance would need to be provided by government, probably not politically attractive Installation-level accounting involves high transaction costs Negative impact on EU competitiveness
D) Binding installation targets, possibly ETS	Very high environmental certainty Potentially high static efficiency if ETS used Low impact on EU competitiveness Strong evolution towards cap-and-trade	Installation-level accounting involves high transaction costs Political resistance by companies to be expected Little incentive for foreign investors
E) Installation targets plus PAMs	High environmental certainty Probably good for static and dynamic efficiency Low impact on EU competitiveness Strong evolution towards cap-and-trade	Installation-level accounting involves high transaction costs
F) Installations receive credits from international authority	Potentially high static efficiency Incentives for domestic and foreign investors Medium evolution towards cap-and-trade	No environmental certainty No investor certainty, unless "insurance" provided or sector dominated by single player Insurance would need to be provided by

	Pros	Cons
		government, probably not politically attractive Installation-level accounting involves high transaction costs Negative impact on EU competitiveness

1.8.3 Need for international regulation

While the different options have different impacts on the potential of achieving emission reductions, none seem to have an impact on the question of whether a tonne is a tonne. Environmental integrity does therefore not require an international regulation on what implementation scheme should be used. In addition, in contrast to the CDM the new market mechanism is supposed to be run by the host country government, and it is unlikely to be politically acceptable to adopt international rules that would limit domestic climate policy choices in this way.

1.9 Design Element 4b – Methodology for distributing trading units

Design options

In a cap-and-trade system, a highly controversial question is the choice of method according to which the allowances are allocated to the participants. There are two basic options, one option involving costs for installations (via auctioning or selling of trading units) or free distribution. Free distribution schemes can be based either on past GHG emissions ("grandfathering"), or on input (fuel use) or output (e.g. electricity production). In the latter two cases the GHG emission allowances would have to be calculated by use of a standard or benchmark for installation types or the whole sector (EPA 2003; Matthes et al. 2008). It is also possible to combine these two options and, e.g., hand out a specific amount of allowances for free and auction or sell the rest of the units. Also, governments may refrain from distributing all units available and put some units aside for new installations that will be covered under the cap-and-trade scheme or for incentivising predefined behaviour such as efforts in energy efficiency or renewable energy (EPA 2003).

1.9.1 Assessment of main design options

Environmental effectiveness

The way in which the allowances are allocated in a scheme affects the level and distribution of costs of a programme. However, they do not differ in their impact on the environment since this is determined by the amount that is allocated, not by the methodology for distributing this amount.

Environmental integrity/MRV robustness

The methodology for distributing trading units does not affect the environmental integrity/MRV robustness of a system.

Administrative feasibility, including transaction costs

Administratively, auctioning is the easiest of the options as all that is needed is an auctioning platform. Private actors such as stock exchanges can be expected to be eager to offer respective services.

In case of free distribution additional data needs to be gathered to serve as basis for the allocation. In case of grandfathering, historic emissions data from the covered installations has to be gathered. In case of benchmarking, additional effort has to be invested in order to compare installations and determine appropriate benchmarks. The experience from the EU's national allocation plans highlights the substantial effort that is required to implement free allocation.

Political feasibility

Politically, free distribution is substantially more feasible than auctioning. The EU and other countries have therefore used a phased approach, starting with mostly free distribution and increasing the share of auctioning over time. Among the options for free allocation, grandfathering is politically easier than benchmarking, as the latter option involves judgment of what is an appropriate benchmark.

Economic efficiency

The methodology used for distributing trading units has significant economic impacts on the installations covered by a system and the government. Trading units are a valuable commodity. In case of free allocation, the emission sources receive a transfer of wealth whereas the government receives money when trading units are auctioned. This money could either be distributed to households or, for example, be used to trigger transformational processes towards low-emission pathways in other parts of the economy.

Especially approaches based on historic activity have been widely criticized in the past, as they tend to privilege incumbent installations. Approaches to distribute allowances according to a standard not directly linked to historic emissions may alleviate this problem somewhat. Critics have also claimed that free allocation in the EU ETS has led to substantial windfall profits as companies were able to include the opportunity costs of allowances into their product prices (Neuhoff and Matthes 2008).

Auctioning off allowances, on the other hand, may often be more economically efficient, as it creates a source of income for the issuing government from the start, while at the same time creating a higher incentive to make use of existing resources, and circumventing controversies of free allocation methods.

Private sector participation/potential to mobilize private capital

As the carbon price signal is the same under all approaches, they should all constitute the same incentive for investments. However, as noted above auctioning mobilizes substantial new revenue for the government, which may be invested in further emission reduction efforts or other social goods.

Potential impacts on competitiveness of EU enterprises

After the initial allocation, the carbon price will be independent from the method of allocation but be determined by the supply and demand of allowances. Beyond an initial transfer of wealth in the case of free allocation, the method of initial transfer of allowances should therefore not affect the competitiveness of the companies. However, the subsequent allocation rules, which concern potential updating of the allocation in future trading periods, treatment of plant closure and treatment of new entrants, can lead to different distributional effects (Blyth and Bosi 2004: 25).

In the case of grandfathering, governments may in subsequent trading periods decide to allocate allowances based on the emissions from a new, up-dated base year in the first period. In this scenario, if allowance prices are likely to rise in later periods, companies may choose to avoid emission reductions in the initial phase and instead comply with their targets by purchasing allowances from the market since they can expect that high emissions in the first period will result in a more generous allocation of allowances in the second phase. Updating provisions may hence constitute an incentive to shift production in order to receive a more generous allocation (Choquette 2005: 9f).

Several approaches are conceivable regarding the issue of plant closure. If a plant shuts down during the first trading period and the base year for allocation is set prior to the beginning of the first period, the closed plant may still receive allowances in subsequent trading periods. If, however, the base year is shifted forward through updating, the closed plants will not be allocated any allowances for the second phase. A company may be tempted to cease production in a country that continues to allocate to closed plants and start up or expand production capacity in countries that will allocate allowances free of charge to new entrants (Blyth and Bosi 2004: 26).

Preparedness for evolution towards EU ETS compatible cap-and-trade system

As the EU is shifting towards increased auctioning there will be a preference for having other countries use auctioning as well. However, as the EU initially used mostly free distribution it could hardly object to other countries doing the same.

Low risk of perverse outcomes

As noted above, provisions for updating, plant closures and new entrants may constitute an incentive to shift production in order to maximize allocation.

1.9.2 Summary assessment

Table 11 Summary assessment of different options for design element 4b

	Pros	Cons
Auctioning	Easiest to administer Highest economic efficiency Substantial government revenue	Politically difficult
Grandfathering	Politically least difficult	High administrative costs Lowest economic efficiency Favours incumbents Windfall profits Rules on updating, new entrants and plant closure may have negative distributional effects
Benchmarking	Low political difficulty	Highest administrative costs Low economic efficiency Windfall profits Rules on updating, new entrants and plant closure may have negative distributional effects

1.9.3 Need for international regulation

The way in which the allowances are allocated affects the distribution of costs but not the environmental outcome as this is determined by the amount that is allocated, not by the methodology for distributing this amount. In addition, as is the case for design element 4a – Operation/Incentives of the scheme at government/installation level – while auctioning is clearly the most preferable option for a number of reasons, unless environmental integrity is at stake it will not be politically acceptable to prescribe what domestic implementation scheme host countries should pursue.

1.10 Design Element 4c – Currency

Design options

In a carbon market mechanism the most obvious unit of trading is 1 tonne CO_2-eq. However in addition to carbon-based mechanisms other types of market-based instrument may contribute to greenhouse gas emission reductions, such as renewable energy and energy efficiency market mechanisms, each with their own unit of trading or 'currency'.

Three options for such currencies are:

- Greenhouse gas emissions: 1 tonne of CO_2-eq., emission allowance or credit
- Unit of renewable energy (kWh, GJ) – tradable green certificates (TGC)
- Unit of energy savings (kWh, GJ) – tradable white certificates (TWC)

The first option refers to a carbon scheme, in which the crediting or trading unit are tonnes of CO2-equivalent, as currently used in the CDM (Certified Emission Reductions) and the EU ETS (European Union Allowances). The trading/crediting commodity in such schemes are sometimes also called 'black certificates'.

In a TGC scheme the unit traded is one kWh of renewable energy, which can be in the form of electricity, heat or transport fuels. A number of EU Member States for example, have set a target for the production of electricity from renewable sources, to be met by the electricity suppliers. The latter have to surrender green certificates proportional to their total production. These certificates can be generated by the suppliers themselves or acquired on the market. The two commodities, electricity and green certificates, are traded in two different markets (Harrison et al., 2005). The objective of a TGC scheme is to achieve the renewable energy target in the most cost-effective way, with a longer term objective to stimulate investments in renewables, thereby bringing down costs.

In a TWC scheme the unit is 'energy savings' for the end-user, e.g. in kWh or GJ electrical or thermal energy, per year or over the lifetime of a programme. In several countries TWC schemes are operational, including Italy, France, the UK, India and Australia, covering end-use sectors such as buildings, industry and in some cases transport. Energy suppliers such as electricity companies and gas suppliers, are bound by a national target for energy savings set by the government. Energy service companies (ESCOs) can implement energy saving projects (e.g. housing insulation) for which White Certificates are issued by the regulator, if this project is considered 'additional' (Sorrell et al., 2009). These certificates can be traded among energy suppliers to comply with the target. It is believed that TWC can address barriers faced by end-users towards energy efficiency, and that TWC allows for cost-effective achievement of energy efficiency targets (e.g. Harrison et al., 2005).

In this section we focus on the implications of the currency of the different market mechanisms, however to a large extent this design element cannot be seen independently from the other design elements of these mechanisms or the reasons for choosing specific design options. We assume that ultimately any currency has to be translated into GHG emission savings, as that is the overall policy objective.

1.10.1 Assessment of main design options

For all mechanisms, additionality of certificates needs to be ensured and for TWC and TGC they need to be converted into emission reductions. For energy saving projects and programmes it is rather challenging to establish additionality, i.e. that a certain activity has taken place due to the introduction of the scheme for all end-users involved. The number of free-riders can be substantial (Giraudet, 2011). The larger the programme the smaller this problem becomes, as a baseline can be set based on historical observations from a larger set of actors (Sorrell et al., 2009). The industry sector however may not have a large number of similar actors. In the transport sector TWC experiences are still rather limited. In renewable energy market mechanisms the additionality problem could be much smaller, as financial considerations are much more important, and as long as the share of renewables is set higher than the baseline.

In addition to additionality, the other issues for TGC and TWC are estimating the number of certificates, and after that converting certificates into tonnes of CO_2-eq reductions. For electricity and heat production from renewable sources, the number of certificates can be measured based on the kWh_e or GJ_{th} produced, as is standard practice. The conversion to CO_2-eq reduced can be done based on CDM baseline and monitoring methodologies, including biomass. For liquid biofuels the challenges are larger, and not fully resolved in the relevant EU Directives and in the CDM.

TWCs are generated based on a combination of three types of approaches:

- Deemed savings: each installed piece of more efficient equipment is expected to save a certain amount of energy, based on historical observations;
- Engineering approach, with detailed calculations in combination with some field observations;
- Energy monitoring plans.

In addition, the rebound effect (increases in energy use due to reduced end-user costs) is taken into account. This combination of approaches ensures a reasonable balance between costs and accuracy in energy efficiency estimates, however the uncertainty can still be significant. In order to convert the final energy savings into primary energy savings, (electrical or heat) efficiency factors can be used. Conversion from primary energy savings to carbon savings is based on emission factors for each primary energy source. The uncertainty in these calculations will be lower than those for estimating the energy savings. In order for green or white certificates to be converted into carbon units, it needs to be reported which project type they were generated by.

The clear advantage of using CO_2-eq as the currency in a scheme is the potential direct fungibility with other carbon schemes. For TGC and TWC, an additional step of converting renewable energy and energy efficiency into CO_2-eq is necessary. There are methodologies to do so, e.g. from the CDM and the IPCC guidelines for GHG inventories, and the technical challenges would be limited compared to ensuring additionality of schemes (as discussed above). However, even though the technical challenges may be relatively limited, agreeing on such approaches is likely to involve considerable policy debate, as shown by experience e.g. with IPCC guidelines and their adoption under the UNFCCC. In addition, in case a TGC or TWC schemes are used alongside a carbon market mechanism there is a risk of double counting of emission reductions. For example an energy efficiency programme could generate both white certificates as well as carbon credits.

In terms of political feasibility across host countries, however, the TGC and TWC schemes themselves may have significant advantages in: they both provide positive incentives into technologies that bring benefits to society at large: reduced energy consumption, new technologies, reduced air pollution. Potentially it can boost innovation in a country. These are important incentives to participate in (inter)national schemes (de Coninck, 2009). Mechanisms only focused on GHG emissions may lack such incentives. In addition, many countries already have support schemes for renewables and energy efficiency in place. If TGC or TWC instruments can build on these administrative feasibility is increased.

From the perspective of non-host countries, however, TGC and TWC schemes may be far less politically feasible, in particular due to the energy-emission conversion problems involved and the resulting risks for safeguarding the environmental effectiveness and integrity of the scheme.

Environmental effectiveness

The currency may have an impact on environmental effectiveness or the amount of emission reduced as conversion from units that are not expressed in CO_2 equivalents is not always that simple, i.e. it is possible to reduce energy use while emissions increase, e.g. when both reducing overall energy use and simultaneously switching to more carbon intensive fuels. The schemes themselves, depending on their design elements and their stringency, have different emission reduction potentials. TWC only focus on renewables, and TWC only on energy efficiency, while a carbon mechanism could cover both and therefore theoretically have a larger mitigation potential.

Environmental integrity/MRV robustness

For each of the three currencies there are challenges with regard to ensuring 'a tonne is a tonne'. For a carbon mechanism it needs to be ensured that the cap or crediting threshold is below the business-as-usual scenario (see design element 1), i.e. that emission reduction measures are taken because of the incentives given by the mechanism. The main issue is additionality of the schemes, particularly for TWC, but also for TGC and carbon credits. Secondly, estimating energy savings is challenging. Moreover, conversion into CO_2-eq for renewables and energy savings may sometimes be rather complicated and, hence, enhances the risks of violating the environmental effectiveness/integrity of the scheme.

Administrative feasibility (including transaction costs)

Given that converting renewable energy and energy savings is feasible with relatively little additional data gathering, the currency of the sectoral scheme is not of great relevance for this criterion.

For the overall schemes administrative requirements could be different. TGC are relatively low in data and administrative requirements, while TWCs are more data intensive. A carbon scheme would likely cover both areas. Another consideration is that for certain countries TGC and TWC schemes would build on existing policies and institutions to promote renewables and energy efficiency, therefore the administrative feasibility could be higher.

Political feasibility

The TGC and TWC schemes may have significant political advantages for host countries: they both provide positive incentives for specific technologies that bring benefits to society at large, thereby enhancing political feasibility across host countries as compared to carbon instruments.

As noted above, however, TGC and TWC schemes may be less political feasible for non-host countries due to the energy-emission conversion problems involved which may violate the environmental integrity of the scheme.

Economic efficiency

The currency of the schemes does not have a direct impact on the economic efficiency, as the transaction costs related to converting certificates into emission reductions are roughly similar.

Private sector participation/potential to mobilize private capital

The currency of the schemes does not have an impact on the private sector participation. TWC schemes however give strong incentives for the private sector to initiate and invest in energy saving projects. TGC schemes setting renewables obligations for energy suppliers also provides similar incentives to promote the supply of renewable energy.

Potential impacts on competitiveness of EU enterprises

The currency of the schemes does not have an impact on competitiveness.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

This is much better for tonnes of CO2-eq than for TGC and TWC.

Low risk of perverse outcomes

The currency of the schemes not likely to have an impact on perverse outcomes.

1.10.2 Summary assessment

Table 12 Summary assessment of different options for design element 4c

Options and issues	Pros	Cons
Tonnes of CO_2-eq	Direct link to climate policy objective Easy to understand Common metric with other schemes	Does not facilitate specific incentives for renewable energy and energy efficiency
Tradable green certificates	Facilitates schemes focused on renewable energy development (which provides positive incentives for technology development and deployment, and enhances political feasibility)	Indirect link with emission reductions: additional reporting and calculation requirement Potential for double counting
Tradable white certificates	Facilitates schemes focused on energy efficiency (thereby providing incentives for barrier removal and enhancing political feasibility)	Indirect link with emission reductions: additional reporting and calculation requirement Environmental integrity (ensuring additionality) Potential for double counting

1.10.3 Need for international regulation

The COP/UNFCCC should regulate clearly which types of sectoral NMM currency are allowed, as well as whether and how they can be converted to other currencies at the sectoral, national and international level.

1.11 Design Element 4d – Temporal flexibility and other timing issues

The main issues with regard to the temporal flexibility of new carbon market mechanism relate to (i) the length of the trading/crediting period, including the start and end of this period, (ii) the frequency and other timing modalities of issuing and surrendering emission allowances/credits, and (iii) the provisions or rules concerning the banking and borrowing of trading/crediting units across different commitment periods. These issues and some options involved are further discussed below.

1.11.1 Assessment of (timing)issues involved

Start and length of crediting/trading period

With regard to the length of the trading/crediting period, there is a fundamental trade-off which has to be addressed. From an investor's perspective it is important to have a long planning horizon. This is particularly true for investments with a long economic lifetime such as 10-20 years or even more. Short crediting periods would create regulatory or political uncertainty and thus increase the risks associated with long-term investments.

On the other hand, regulators often prefer shorter periods, specifically at the beginning of the implementation of a new instrument when experiences with the new mechanism are not yet available. Despite thorough impact analysis when designing the mechanism, the effects of the new mechanism might be different than expected. This could harm the credibility of the new mechanism. To reduce this risk, it is important that the regulators have an opportunity to adapt the new mechanism on the basis of the experiences made in the early stage. This requires shorter crediting periods or at least predetermined opportunities to adapt the mechanism, if necessary, in order to allow for some institutional learning. Moreover, shorter crediting periods may also be preferred in order to facilitate an early graduation to other mechanisms, such as, for example, emissions trading based on binding sectoral or national targets (Schneider and Cames, 2009).

The experience from the EU ETS highlights the relevance of being able to adjust a system. The first trading was substantially over-allocated, due to lack of reliable emission data and lack of political ambition, while the second trading period is again substantially over-allocated due to the impacts of the financial crisis. Other aspects such as the allocation methodology were also quickly revealed as needing substantial adjustment.

One option to balance these conflicting interests regarding the length of the crediting/trading period is to have a relatively short period during the initial or pilot phase of a new market mechanism and relatively longer periods after experiences with the mechanisms have been gained. For instance, in the EU ETS, the pilot or first trading period lasted only three years (2005-2007), the second phase took five years (2008-2012), while the third period will cover eight years (2013-2020). Experiences during the first/second periods have been used to adjust and improve the performance of the EU ETS during subsequent periods (Sijm, 2012).

Basically, there are two options for defining the start and length of a crediting/trading period: (i) the period could be directly harmonized with the duration of the commitment period of an agreement on GHG mitigation targets, instruments and/or measures, or (ii) the period could last a certain number of years conceivably with a renewal or update option like under the current CDM. Both options have advantages and disadvantages (Schneider and Cames, 2009):

- ***Harmonized with commitment period***. The advantage of this option is that it would avoid or at least limit the need for specific transitional arrangements when a country moves to another mechanism or new target in the subsequent commitment period. On the other hand, in some cases, this option could result in a cyclical pattern of GHG mitigation investments and carbon markets. If private investors receive incentives directly from the carbon market, they will be inclined to make investments at the beginning of the crediting/trading period in order to earn the total marginal return potentially available over the respective period. Investments implemented at a later stage of the crediting/trading period would earn only a share of this return and would face a risk of less attractive or no carbon revenues in the subsequent period. Hence, if the crediting/trading period of a carbon market mechanism is harmonized with the commitment period of a GHG mitigation agreement, investors could be inclined to focus their investments on the beginning of this period or postpone it to the start of the next period.

- ***Certain number of years***. If the crediting/trading period of a NMM always lasts a certain number of years regardless whether NMM agreements were established at the beginning or sometime during an ongoing commitment period, the above-mentioned risk of a cyclical investment pattern would be avoided as incentives to implement NMM agreements and resulting investments would be spread over the entire commitment period and not be concentrated at the beginning. On the other hand, a disadvantage of this option is that it might require a number of transitional arrangements when countries move to different GHG mitigation mechanism or targets. Moreover, another disadvantage is that the submission of proposals for implementing a NMM may be delayed if they can be submitted at any time during a commitment period.

A related issue is whether NMM agreements and, in particular, NMM trading/crediting periods can be renewed or not. A major advantage of allowing the option of renewing NMM agreements is that crediting/trading baseline targets can be adjusted after a relatively short crediting/trading period (say, e.g., 5-7 years) while still offering investors some certainty that carbon revenues will be earned over a longer time frame (e.g., three subsequent periods lasting 15-21 years).

On the other hand, adjusting baseline targets may be rather complicated and enhance uncertainty about carbon markets and emission reductions in subsequent crediting/trading periods. Moreover, the existence of a renewal *option* could rather constitute an *entitlement* for renewal of the NMM agreement, resulting in only weak adjustments of the baseline targets. Finally, if countries prefer to continue their agreement on (weak) sectoral crediting targets, a renewal option could rather impede the transition to more ambitious, integrated mitigation approaches (Schneider and Cames, 2009).

Following current practices in the CDM, countries willing to accept a NMM agreement could be offered the option of either a fixed, relatively long crediting/trading period, without the possibility to adjust the baseline within the trading/crediting period, or a certain number of renewable, relatively short crediting/trading periods, with the baseline being revised a the time of renewing the crediting/trading period. Moreover, the length of the crediting/trading period could be varied according to the sector or type of activities concerned. For instance, regular CDM projects have either a fixed crediting period of 10 years or three renewable crediting periods of 7 years each, i.e. 3x7 = 21 years in total, with the opportunity to revise the baseline when the crediting period is renewed. CDM projects in the land use, land-use change and forestry (LULUCF) sectors, however, have a fixed crediting period of 30 years or a renewable crediting period of 3x20 years (Aasrud et al., 2009). Similar period options could be offered in the field of NMM agreements, varying by the sector or type of activities involved.

Frequency and other timing modalities of issuing emission allowances/credits

Under a trading mechanism (assuming a legally binding cap in absolute terms), allowances would be issues ex ante, either on an annual or multi-annual basis for the trading or commitment period concerned. Similarly, compliance – i.e. surrendering allowances based on verified emissions – could also be established on an annual of multi-annual basis.

A ‘no-lose’ crediting mechanism allows for multiple options in how and when to generate/issue credits. Three options include (see Aasrud et al., 2009, including some simple quantitative and graphical illustrations):

1. ***Aggregate-no-lose***. Performance against the baseline is evaluated over the whole crediting period, implying that the net generation/issuance of credits depends on balancing surpluses of credits (i.e. annual emissions below baseline) in some years against deficits of credits (i.e. annual emissions above baseline) in other years. This option is beneficial from an environmental point of view but less attractive to host (credit-selling) countries as, compared to the options discussed below, the number of offset credits generated and issued will be lower and, hence, emissions in credit-buying countries will also be lower (while aggregated emissions in the host country remains the same over the crediting period). For host countries this option also has the disadvantage that the overall, net balance of credits generated – and available to be sold and to finance NMM activities – can only be determined for certain by the end of the crediting period, thereby enhancing the ‘finance gap’ between the moment when the costs of the NMM activities are made and the moment when the credit revenues become available.
2. ***Year*-by-*year no-lose***. Annual emissions below baseline lead to the generation and issuance of credits, while annual emissions above baseline are ignored. This is an attractive option for host countries but less beneficial from an environmental perspective as the number of offset credits generated and sold will be higher and, hence, emissions in credit-selling countries will also be higher (compared to the previous option). For host countries, this option has the additional advantage that credits in surplus years (i.e. annual emissions below baseline) can be issued and sold as soon as the annual surplus has been verified as they do not have to be balanced against potential deficits of credits over subsequent years in the remaining crediting period.
3. ***No-lose until crediting starts***. This is an intermediate position between the two options outlined above in the sense that crediting will only start from the year in which annual emissions are below baseline, but will be aggregated together with the performance over the next years of the crediting period. This implies that annual emissions above baseline before this starting year will be ignored, but after this year will be included in order to determine the net amount of credits generated and issued over the period as a whole.

Banking and borrowing

In order to enhance the compliance flexibility and, hence, the price stability and economic efficiency of meeting GHG mitigation commitments across different crediting/trading periods, two major temporal flexibility options concern the banking and/or borrowing of crediting/trading units.

Banking refers to the option of saving carbon trading/crediting units during the present period and using them during a next period. This option will be used if it is expected that future carbon prices will be higher than present prices. The major advantages of banking are that it enhances both price stability and cost-effectiveness, that it allows firms to smooth their emissions profile through the business cycle, and that if offers an incentive for early action to reduce emissions. Given these advantages, the option of banking is often included in emissions trading/crediting schemes, in particular for long-term pollutants such as CO_2 emissions, which are not characterised by adverse temporal ‘hot spot’ effects.

Borrowing refers to the option of using carbon trading/crediting units during the present period and realising the required emission reductions in a next period. This option will be used if it is expected that future carbon prices will be lower than present prices. Similar to banking, the major advantages of borrowing are that it enhances both price stability and cost-effectiveness, and that it allows firms to smooth their emissions profile through the business cycle.

On the other hand, however, borrowing gives rise to two concerns (Philibert and Reinaud, 2004; Sterk and Mersmann, 2011). Firstly, it delays emission reductions and, hence, entails the risk that mitigation measures may not be taken in future periods, for instance either due to lack of enforcement or if a company goes bankrupt. Secondly, after using all their trading/crediting units (including the amount of borrowing allowed), firms may argue that they are not able to meet their future compliance commitments – or only at prohibitive costs – and, hence, need softer targets. Due to these two concerns, borrowing is usually seen negatively from the environmental point of view and, hence, often not allowed.

Evaluating the options regarding the timing issues discussed above against the assessment criteria results in the findings below.

1.11.2 Assessment of main design options

Environmental effectiveness

The environmental effectiveness of a sectoral carbon market mechanism is likely to be highest or can be safeguarded best (i) when the mitigation baseline is set for, and regularly renewed after, relatively short crediting/trading periods, (ii) with aggregate no-lose crediting, and (iii) when borrowing is not allowed.

Environmental integrity

The timing issues discussed above may affect the environmental integrity of a sectoral carbon market mechanism. For example, if there are long crediting periods for mitigation options with short payback periods, there is a high risk of emission reductions not being additional towards the end of the crediting period. In addition, borrowing enhances the risks of compliance failure thereby reducing the integrity of the mechanism.

Administrative feasibility

The administrative demands of a mechanism are higher, i.e. its administrative feasibility is lower, if (i) crediting/trading periods are fixed for a certain number of years and not harmonized with commitment periods (i.e. requiring transitional arrangements), (ii) relatively short periods which are regularly renewed, and (iii) allowing both banking and borrowing.

Political feasibility

This criterion depends on the timing issue and perspective of the parties involved. While investors generally prefer long, fixed crediting/trading periods (including borrowing), regulators usually prefer relatively short periods which can be regularly renewed and adjusted (excluding borrowing). On the other hand, both investors and regulators/policy makers probably prefer 'year-by-year no-lose' crediting and the inclusion of banking.

Economic efficiency

This criterion is most likely served best in case of (i) long, fixed crediting/trading periods over a certain number of years (not necessarily harmonized with commitment periods), and (ii) allowing both banking and borrowing.

Private sector participation/potential to mobilize private capital

This criterion is most likely served best in case of (i) long, fixed crediting/trading periods over a certain number of years (not necessarily harmonized with commitment periods), (ii) allowing both banking and borrowing, and (iii) 'year-by-year no-lose' crediting (depending on how crediting is translated into incentives to private investors).

Potential impacts on competitiveness of EU enterprises

In general, hard to say, but most likely this criterion depends hardly or not on the timing issues discussed above.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

This criterion is met best if crediting/trading periods of sectoral carbon market mechanisms are harmonized with both UNFCCC commitment periods and EU ETS trading periods, and if these mechanisms allow banking but not borrowing.

Low risk of perverse outcomes

Most likely, the risks of perverse outcomes are lower in case of relatively short crediting/trading periods which are renewed regularly, i.e. adjustments can be made earlier and more regular in order to avoid or reduce perverse results.

1.11.3 Summary assessment

Table 13 Summary assessment of different options for design element 4d

Options and issues	Pros	Cons
Length of crediting/trading period:		
Short (1-2 years)	Creates opportunities to adapt NMMs based on experiences in early stages	Creates regulatory uncertainty for long-term investments
Long (more than 7-10 years0	Provides regulatory certainty for long-term investments	Lacks opportunities to adapt NMMs
Start/end of crediting/trading period:		
Harmonized with commitment period	Avoids the necessity of transitional arrangements when country moves to different mechanism	May result in cyclical patterns of GHG mitigation investments and carbon markets
Certain number of years	Avoids cyclical patterns of carbon markets and investments as investments can be implemented each year without affecting overall crediting.	May require transitional arrangements
Renewal of crediting/trading period:		
No, i.e. one fixed, relatively long period	High investment certainty over long period. Opportunity to move to more integrated, ambitious mitigation approach in next period	No opportunity to adjust baseline targets during long period
Yes, i.e. a restricted number of renewed, relatively short baseline periods	Baseline target can be adjusted after short period while still offering some long-term investment certainty	Adjusting baseline targets may be complicated and enhances uncertainty on carbon revenues in future periods. In addition, it may result in weak adjustments and/or impede transition to more ambitious mitigation approaches
Timing of 'no-lose' crediting:		
Aggregate no-lose	Environmentally beneficial (i.e. less credits for buying countries while similar emissions by selling countries over aggregate period)	Possibly less credits for both selling and buying countries. Net balance of credits can only be verified/issued after crediting

Options and issues	Pros	Cons
		period, thereby enhancing the 'finance gap' between the cost of NMM activities and resulting carbon revenues
Year-by-year no-lose	Possible more credits issued. Number of credits can be verified/issued after each year, thereby reducing 'finance gap'	Environmentally less beneficial
No-lose until crediting starts	Intermediate position (i.e. between two options outlined above)	Intermediate position (i.e. between two options outlined above)
Compliance flexibility		
Banking	Enhances carbon price stability and economic efficiency of GHG mitigation; Allows firms to smooth emission profile through business cycle; Offers incentive for early action to reduce emissions	Over-allocated surplus of allowances/credits in one period may be transferred to other period
Borrowing	Enhances carbon price stability and economic efficiency of GHG mitigation; Allows firms to smooth emission profile through business cycle	Delays emissions reductions and, hence, entails the risk that future mitigation actions may not be taken or future targets may be weakened

1.11.4 Need for international regulation

The COP/UNFCCC should clearly regulate:

- The length of the crediting/trading period;
- The start/end of the crediting/trading period, i.e. whether this period will last a certain number of years or is harmonised with other, UNFCCC commitment periods;
- Whether and how crediting/trading period can be renewed;
- How and when credits/allowances will be generated/issued;
- Whether banking/borrowing of allowances/credits is allowed.

1.12 Design Element 5 – Requirements for data collection and MRV

This ‘design element’ or aspect of NMMs refers to which data need to be collected, how often, what an accepted level of uncertainty / conservativeness is, how often reporting is to take place etc. It includes both ex-ante analysis (i.e. for establishing the baseline and target) and ex-post monitoring (i.e. MRV of emissions and reductions after implementation of policies). The former has an interaction with other design elements, e.g. ‘technical method for setting target or threshold’ and ‘crediting or trading’, ‘nature of target’ and ‘sector boundaries’. In Bosi and Ellis (2005) ‘data requirements’ is an evaluation criterion rather than a design element.

1.12.1 Assessment of main design options

The MRV system depends on a number of general issues (outlined below) and the choice for region, type and sector for the market-based mechanism: for instance, a building sector crediting scheme could be based on a benchmark based on energy use per m^2, while a cap and trade mechanism for industry may be based on absolute emissions below base year emissions for each individual installation. Therefore the details of the different options for the system cannot be dealt with here, and we will only outline the general issues. This is based on Castro et al. (2011) unless mentioned otherwise.

Purpose of MRV*:* in general, an MRV system can provide trust that mitigation actions are taken, support is provided and used, emissions reduced and provide incentives to take actions (Fransen, 2009). For market-based mechanisms where emissions are traded, environmental integrity is one of the most important criteria (‘a tonne is a tonne’), and MRV can provide this credibility.

Principles*: p*rinciples and criteria that an MRV system should meet could be:

- Completeness: coverage of all emission sources and greenhouse gases
- Accuracy: low uncertainty and no systematic under or overestimation
- Conservativeness: in case of uncertainty it is better to underestimate emission reductions
- Materiality: only MRV those elements which significantly influence emission reduction outcome
- Consistency: data should be comparable over time and methodologies only updated if this improves accuracy, completeness or conservativeness
- Cost effectiveness: MRV should not lead to unreasonable high cost, and be balanced against accuracy
- Adjustability: methodology can be improved over time
- Transparency: possibility to check all data and calculations by third parties, and secondly maximise publicly available data

An MRV system is designed based on an optimisation between several of those principles, such as accuracy and cost effectiveness. These principles will play out differently in different contexts and scopes (such as sectors and countries). Often it will be needed to include flexibility in the system through the use of different measurement ‘tiers’ for different emitters. In addition the requirements can be made more stringent over time, while drawing lessons from learning-by-doing (e.g. by a phased approach). In this regard, lessons can be learnt from the CDM and the EU ETS. In addition to lessons learnt, it may be useful to take into account existing carbon credit mechanisms’ MRV system, as this could improve fungibility of the different types of credits.

Confidentiality of data could also be an issue: some required data may not be usually disclosed by commercial parties (e.g. plant operators) due to competitiveness concerns, or private persons (e.g. socio-economic data). In these cases confidentiality may need to be ensured. However publicly available data could increase transparency of the system and therefore needs to be maximised.

Finally, several authors (e.g. Fujiwara et al., 2010) highlight the current lack of data and institutional capacity in many developing countries to implement a market-based mechanism. Capacity building would be necessary to enhance data availability, consistency and institutional framework.

1.12.2 Need for international regulation

The COP/UNFCCC should clearly set international standards for the collection and MRV of emission and other NMM data to ensure the environmental integrity and robustness of a NMM scheme.

1.13 Design Element 6 – Compliance framework and penalties

Assumptions and Clarifications

As it is assumed that as a "sectoral crediting" mechanism will involve "no-lose" baseline targets which do not incur penalties where they are not met, this design element applies primarily to "sectoral trading" or related mechanisms.

Compliance may apply not only to failure to meet a defined target, but also to failure to comply with accounting rules, as both are likely to be considered obligations of participating Parties. In certain circumstances this could also extend compliance frameworks to "sectoral crediting" mechanisms. Compliance exists at national and international level. At international level, the actions of states are regulated (whether bilaterally or multilaterally), while it is primarily at national level that the actions of individuals (including business entities) are regulated. Scope for international supervision of compliance at installation level is thus limited, though indirect supervision may arise in cases where, for example, developed countries require a certain stringency of domestic compliance frameworks in exchange for full fungibility of credits in emissions trading schemes. For this reason, this design element focuses on compliance at the international level.

The options presented below are not mutually exclusive. In particular, several elements contained in options (i) and (ii) are easily interchangeable, and the most favourable option may ultimately draw elements from both, and potentially combine them with other design options. In addition, the preferred option will largely depend on other design elements.

Design options

1. ***Kyoto-based approach*:** Under the Kyoto Protocol compliance is managed by a Compliance Committee with two branches: a facilitative branch (FB) and an enforcement branch (EB). The FB is tasked with providing financial and technical assistance to parties struggling to meet commitments (usually before the party is in fact in non-compliance), while the EB is tasked with applying standardized (punitive) consequences to parties which, it finds, have failed to meet their commitments. Members of both serve in their personal capacities. Proceedings can be triggered in a number of ways, including by any party or automatically where a Kyoto Protocol mandated expert review team finds a question of implementation in the course of their regular reviews of each party's progress. Consequences are automatically applied upon finding on non-compliance and vary depending on the non-compliance, ranging from suspension of eligibility to participate in flexible mechanisms, to punitive deductions of credits from future allocations. The role of the CMP is limited, though it retains the right to hear appeals based on due process and provide guidance on general matters to the Compliance Committee.
2. ***Montreal-based approach*:** Under the Montreal Protocol on Substances that Deplete the Ozone Layer the meeting of the parties (MOP) plays a stronger role in managing compliance. As under Kyoto, proceedings can be triggered by any party or by the Secretariat, which has a similar role to the Kyoto expert review teams in examining parties' submissions. Also like Kyoto, an administrative body, the Implementation Committee (IC), is tasked with investigating and reporting on instances of possible non-compliance. Unlike Kyoto, however, the IC is only empowered to investigate compliance, seek an amicable solution and make recommendations. Substantive decisions on providing assistance or imposing punitive consequences lie with the MOP. Potential consequences are defined, and include provision of assistance, issuing cautions and suspension of treaty privileges. The consequences therefore allow for a dual facilitation and enforcement approach to be employed by the IC and the MOP. Unlike under the Kyoto model, the MOP retains flexibility, however, regarding its application of the consequences.
3. ***Arbitration*:** Arbitration consists of the submission to an independent judicial body of a dispute to be decided based on principles of law. In this way, it closely resembles a court of law. In

contrast with regular courts, however, Parties are free to shape the form and effect of the arbitral proceedings to a large degree. Thus, parties may choose, amongst other things, the number of arbitrators, the rules of procedure (including rules on evidence), the penalties/consequences available and the applicable law. While it is open for Parties to agree to these rules on a case-by-case basis, in multi-lateral environmental agreements Parties will usually agree in advance to ensure continuity. The applicable law may be public or private and domestic or international, depending on the jurisdiction chosen, the parties involved, and the nature of the dispute. Arbitration may be provided for in bilateral or multilateral treaties or in contracts between states, international entities, private individuals or all. Consequences of a decision will depend on the applicable law and the prior agreement of the parties, and may include damages, costs and specific performance. Decisions of arbitral tribunals are usually binding between the parties to the arbitration. Some arbitral decisions are publicly available. Others remain confidential, depending on what is agreed between the parties to the arbitration.

1.13.1 Assessment of main design options

Environmental effectiveness

Both the Kyoto and Montreal models take a dual approach, including both facilitation ("carrots") and enforcement ("sticks"), recognizing the often complex and varied reasons for non-compliance, while arbitration most often focuses on enforcement only. The Montreal model has arguably been more successful in operationalizing the facilitation function due to its flexibility with respect to process and application of consequences. On the other hand, the certainty of the Kyoto model arguably provides a greater deterrence effect. In consequence, an approach that provides greater flexibility to incorporate facilitation measures while as a last resort ensuring certain enforcement measures, if facilitation does not prove effective, may be a worthy compromise. The type of facilitative support available should be tailored to other design elements. Thus, where governments are to pass on binding targets to installations, facilitation could focus on helping participating governments to build strong national systems for enforcing those obligations.

The Kyoto and Montreal models also take a pro-active approach to compliance, which is likely to be more environmentally effective. Arbitral tribunals generally focus on retroactive remedies, though injunctions (rulings of an arbitral tribunal where certain actions are stopped before they do expected and irreversible harm) can be obtained in limited circumstances. A pro-active approach is supported by facilitation, but also by regular and early opportunities for enforcement proceedings to be instituted. Under Kyoto, proceedings regarding compliance with reporting/inventory obligations can begin every year, while proceedings regarding not complying with emission targets can only take place two years after the end of the commitment period. Setting targets on, say, a year-by-year basis and providing the means for proceedings to be initiated shortly after the end of the year (i.e. requiring prompt reporting and review) will prevent parties from deferring compliance for long periods.

A further advantage of the Kyoto model (and slightly less so the Montreal model) lies in the (quasi-) automatic trigger mechanism. Under the Kyoto model review teams automatically trigger non-compliance proceedings when they find evidence of such non-compliance. Under the Montreal model the Secretariat may do so, but is not obliged to. Arbitration, on the other hand, relies entirely on Parties to trigger, which many will not do unless they have an individual interest at stake. This would work best if arbitration was not 'just' between state parties but if an entity responsible for compliance would be one of the parties to institute arbitral proceedings.

In both arbitral tribunal and compliance mechanisms, Parties may choose the penalties or consequences available. While it is open to Parties to provide for financial penalties for non-compliance in compliance procedures, Parties to Kyoto and Montreal were reluctant to do so. On the other hand, the suspension of trading under both mechanisms has proven quite effective where a Party gains substantial economic benefits from such trade. Penalties under a sectoral trading mechanism could thus include suspension of the right to buy or sell credits internationally, though the inclusion of financial penalties may also be appropriate in cases where Parties do not have much to lose through suspension from trading.

Environmental integrity/MRV robustness
A comprehensive compliance framework that incorporates compliance not only with achieving certain targets but also with accounting and reporting obligations is crucial to ensuring environmental integrity. Of the three models, the Kyoto model embodies the most sophisticated assessment of such obligations. Expert review teams conduct annual assessment of Parties' methodologies and data usage against the standards adopted by the CMP. Where discrepancies are found, a "question of implementation" is raised, triggering the enforcement function of the compliance committee. If the enforcement branch decides that the Party is not in compliance, the Party is automatically suspended from using the flexible mechanisms and is required to develop an action plan to overcome the deficiencies. When suspended, Parties typically work to overcome the accounting issues identified based on the plan and engage in an iterative process with the review teams and enforcement branch in which the plan and progress in meeting its goals are discussed and reviewed. When a Party considers the deficiencies have been sufficiently overcome, it will request its eligibility to use the mechanisms to be reinstated. If the expert team agrees that the issues have been sufficiently overcome, the Party's eligibility will generally be reinstated by the enforcement branch.

In practice, this trigger has been employed quite frequently and has proven relatively successful in bringing Parties back into compliance with their monitoring and reporting obligations. The development and review of an action plan together with regular progress reports keeps Parties engaged and contributes to a shared understanding of what is required for compliance. The ability of Parties to be reinstated as soon as deficiencies are deemed to be overcome, meanwhile, offers an incentive to return to compliance as soon as possible, particularly where there is a strong economic interest in using the flexible mechanisms. On the other hand, the strict division of the facilitative and enforcement functions has been criticised for failing to assist Parties whose non-compliance is based on inadequate resources to return to compliance sooner.

The Montreal model takes a less structured, more responsive approach to compliance with monitoring and reporting obligations. The implementation committee has worked with the secretariat to encourage Parties to improve and enhance their data, and has been important in making access to funding conditional upon compliance with reporting obligations. Together with helping to direct funding under the Protocol towards improved data collection and reporting, this has proved effective in improving compliance with reporting obligations.

Due to its *ex post* focus and lack of facilitation arbitration appears the least suited to ensuring compliance with monitoring and reporting obligations. As returning to compliance with such obligations should be encouraged as soon as possible, lengthy proceeding would unnecessarily delay the process of rectifying issues, while the adversarial process and absence of facilitation risks a disproportionate focus on deficiencies rather than improvements.

An approach that combines the successful elements of the Kyoto and Montreal models may thus likely be the most effective. This could incorporate periodic reviews of data and methodologies, expedited compliance procedures and a targeted combination of facilitation, enforcement, and Party engagement, potentially including providing conditional funding, in bringing Parties back to compliance.

Administrative feasibility (including transaction costs)

Institutionalised compliance procedures such as those under Kyoto and Montreal require the establishment of dedicated compliance bodies and infrastructures, whereas Arbitration is usually ad-hoc and outside the framework of the treaty regime. In addition to the compliance panel itself, compliance procedures require support from secretariats and, in the Kyoto model, expert review teams. This makes compliance procedures administratively somewhat cumbersome to establish, and with moderate running costs (the Kyoto systems costs in the region of USD 1 million per year). On the other hand, once infrastructure is in place the process can quickly be streamlined. Compared with arbitral proceedings with rules similar to regular courts, this makes compliance mechanisms substantially faster, though arbitration may also involve streamlined, expedited proceedings, Again compared with arbitration with formal rules, the costs for Parties will usually be lower in compliance mechanisms absent the need for formal legal representation, though arbitral proceedings can also be made less formal and not require representation.

While costs of keeping up a system like the Kyoto and Montreal ones are generally borne by all parties, costs of arbitration are generally borne by only the parties to the specific conflict where arbitration is applied. The fact that *all* parties bear the cost of a Kyoto / Montreal compliance system allows for spreading some of these costs and also for allowing more affluent parties to bear greater costs. With arbitration this is less evident.

Political feasibility

The three options are likely to see different levels of support from different Parties, and thus political feasibility will largely depend on the dynamics of negotiations and interplay with other design elements. From a host country perspective, the Montreal model may be most acceptable due to the important role of the MOP in making final determinations of non-compliance. For buyer countries with an interest in strong compliance, however, the ability of host countries to block action against themselves may be unacceptable, even if this not considered likely to be used in practice.

The Kyoto model has largely come to be accepted as legitimate by Parties. However, it has so far only applied to developed countries, and some developing countries may be reluctant to subject themselves to the authority of an independent body with the power to impose punitive consequences.

Providing for voluntary arbitration proceedings is commonly accepted by Parties as an option. Compulsory arbitration, on the other hand, has rarely been accepted by Parties to a multilateral environmental agreement,[4] and clauses allowing Parties to voluntarily accept arbitration over their compliance have not been widely used.

As noted, financial penalties have so far not been accepted by parties under environmental agreements. Trade restrictions directly related to the treaty, such as suspension from participation in carbon trading mechanism have become relatively common and acceptable. Conditioning financial support on compliance has been accepted in other regimes, but can also meet with resistance from Parties. The latter is more likely to be acceptable where the financial support in question is closely related to the compliance issue at hand.

Economic efficiency

Not relevant to this design element.

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4 The only notable instances of this are under the United Nations Convention on the Law of the Sea (which is partially an environmental agreement) and the North American Agreement on Environmental Cooperation.

Private sector participation/potential to mobilize private capital

The compliance procedure models (Kyoto/Montreal) do not provide for direct private sector participation. At the national level, private sector entities will often be involved in data gathering and reporting, and Parties may choose to create compliance systems at national level to ensure compliance at international level. Private entities will also often be affected by the suspension of eligibility from trading, which may provide an incentive to comply. Facilitative support may include improving national monitoring, reporting and compliance frameworks, leading to more effective compliance at private entity level. Lastly, a strong compliance framework can increase the perceived integrity of the NMM, which may reduce reputational risks and increase private sector participation.

Arbitration can involve public or private entities, though in the case of multilateral environmental agreements will in most cases only involve State Parties, with little opportunity for private entity involvement.

Potential impacts on competitiveness of EU enterprises

Not relevant to this design element.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

A comprehensive system that includes procedures for ensuring compliance with monitoring and reporting obligations will contribute towards ensuring that robust national monitoring frameworks are in place. This goal can also be contributed to by proper integration of the facilitation function and working closely with Parties to ensure accurate data reporting. Support to Parties in ensuring installation-level compliance can also may also contribute to ensuring a robust national framework that can later evolve towards a cap-and-trade system.

Low risk of perverse outcomes

Under the Montreal model host country Parties can in theory block any measures being taken against them in the MOP. This creates the risk that Parties may utilise the economic benefits of crediting and then later increase emissions and block any enforcement action. In practice, this has not happened due to the strong role of the implementation committee in adopting decisions and the engagement of Parties at an early stage.

As a consequence for non-compliance, suspension from trading may lead to private entities removing investments, though where eligibility is expected to be quickly reinstated this is not likely to be an issue.

Arbitration proceedings may reduce the risk of countries simply deciding not to comply at all by reserving the possibility of strong and binding penalties being imposed for failure to meet obligations. This will only be effective where arbitration is compulsory, binding and other Parties have an interest in initiating proceedings.

1.13.2 Summary assessment

Table 14 Summary assessment of different options for design element 6

Options and issues	Pros	Cons
Kyoto-based approach	Apolitical; Automatic trigger; Comprehensive (includes MRV obligations); Relatively stringent penalties; Facilitation and enforcement combined.	Inflexible; Strict division of facilitation and enforcement functions; Penalties contingent on overall desire to comply.
Montreal-based approach	Flexible and responsive, with scope for innovation; Quasi-automatic trigger; Combines facilitation and enforcement; Comprehensive; Links compliance to finance; Politically acceptable to host countries	Risk of host countries blocking or mitigating action against them; Lack of certainty; Penalties, while effective quite specific to context of Montreal Protocol
Arbitration	Binding; Stronger consequences; Apolitical; Can incorporate some flexibility	Reliant on Party trigger; Usually bilateral; Generally ex-post; Absence of facilitation; Lengthy; Costly

1.13.3 Need for international regulation

Compliance of individuals or installations with targets set by the host country should take place at domestic level. Compliance of the host country with relevant rules, in contrast, should take place at UNFCCC level, and should thus be the subject of international regulation.

Where sectoral trading is included as an option within the mechanism the COP should adopt an appropriate compliance framework to ensure compliance with adopted targets. In the case of both sectoral crediting and trading, a compliance framework should also be considered to address cases of information discrepancies or improper credit issuance.

1.14 Design Element 7a – National governance institutions and accounting framework

Design options

Both crediting and trading schemes need institutionalised oversight in order to work as intended. The following functions would need to be fulfilled (Aasrud et al. 2010; Schneider and Cames 2009):

- Development of the scheme and international submission: Substantial work will need to be done to develop a sectoral scheme, including collection of sector-specific data, identification of mitigation potential and costs, development and planning of policies, measures and mechanisms to provide incentives for the sector to reduce emissions, and an evaluation of the potential emission reductions from these instruments. Based on this work, a template for proposing the SCM needs to be filled in and submitted to the international regulatory body for review and approval;
- Trading regulation: The scheme needs to be strongly integrated with the country's legal framework. Independent of the responsibility to regulate the scheme, clear accounting and tax rules need to be laid down by the government in order to ensure clarity for investors and international trust in the robustness of the country's scheme;
- Issuance of trading units: If credits or allowances are to be issued to individual installations, a national registry including a transaction log is needed to record the emissions liabilities and to keep track of the transaction among participants. If only the government receives credits or allowances, this function could also be fulfilled by an international registry system
- Verification of GHG amounts and system performance: In order to ensure credibility of the credits generated, these must be validated either by an internal or external auditing. In the case of external auditing, responsibility for accreditation of third party verifiers must be given to the institution in charge;
- Stakeholder involvement: The entity responsible for the functioning of the scheme needs to consult with the relevant stakeholders in order to gain support, and to build knowledge and institutional capacity to facilitate the implementation of the scheme.

These functions could be fulfilled by a centralised agency, or distributed across different organisations both with and outside the government. For illustrative purposes, we assume that the system's governing functions will be fulfilled by a single agency instead of a variety of institutions. In any case, even if several institutions are involved one of them should have the competence to coordinate all activities. In general, three options for governing institutions can be identified:

1. ***Governmental***: Governance of the scheme may take place within the relevant ministry;
2. ***Independent***: An independent agency beyond governmental control, similar to a central bank, may be tasked to govern the sectoral mechanism;
3. ***Self-regulation***: The actors within the sector themselves are responsible for governing the system.

In addition, Schneider and Cames (2009: 49) suggest that whatever option is chosen, a steering committee should be established to supervise the work of the coordinating agency. This steering committee might include representatives from government, industry, and civil society. Also, even if Options 2 or 3 were chosen, a proposed scheme would still require government approval before being submitted to the international regulatory body for approval.

1.14.1 Assessment of main design options

Environmental effectiveness

Host country governments as well as companies have an incentive to keep their targets as lenient as possible in order to maximize the amount of credits they may receive. While one could assume that government management would still be superior to sectoral self-management, the experience from the EU ETS has shown that member state governments tend to support the interests of their national companies. Intervention by the European Commission has therefore frequently been necessary to achieve environmental effectiveness, for example when the Commission had to substantially cut the allocations proposed by member states for the second trading period. An independent agency beyond governmental control therefore is the best guarantee for environmental effectiveness.

Environmental integrity/MRV robustness

Host country governments as well as companies have an incentive to inflate their baselines in order to maximize the amount of credits they may receive. For the same reason they also have an incentive to not do robust monitoring. Several countries (Greece, Bulgaria, Romania, the Ukraine and Lithuania) have in the past been temporarily barred from using the Kyoto mechanisms due to the low quality of their emissions accounting. An independent agency beyond governmental control therefore is the best guarantee for environmental integrity.

Administrative feasibility (including transaction costs)

Creating a new independent entity would entail the highest transaction costs. If management of the scheme was done by an existing government institution or private sector association, transaction costs would probably be substantially lower.

Political feasibility

Establishing a sectoral mechanism can be expected to have substantial economic impacts on the affected sectors. Host country governments will therefore probably not be willing to give the management of the mechanism to an entity that is beyond their control. Even in the EU, which has a long history of supranational management by the Commission, implementation of the EU ETS was in the beginning mostly left to the EU member states.

Insofar as buyer governments want to ensure the environmental integrity of credits they buy, they would probably have a preference for an independent entity but could hardly object to management by the government. They would probably not accept management by an unsupervised private sector organization.

Economic efficiency

Management by the government or a private sector association would tend to be influenced by political or profit-seeking motivations. Decisions that are based on such motivations would probably usually not be the most economically efficient ones. A completely independent entity would probably be the least susceptible to such motivations and would hence probably provide for the most economically efficient management.

Private sector participation/potential to mobilize private capital

Self-management by the affected actors would on the surface seem to be the best choice to ensure private sector participation. However, such a self-managing body could be captured by the most powerful companies, which would probably lead to unattractive framework conditions for less powerful companies. Governments are also in principle susceptible to capture by powerful economic interests, though to a lesser extent. A fully independent entity would probably offer the best prospect for a level playing field for all actors.

Potential impacts on competitiveness of EU enterprises

The higher the environmental ambition and integrity of a scheme, and the lower the amount of subsidies to reach the environmental ambition, the lower the risk of competitive distortions. As discussed, an independent entity would hence be the best choice for preventing competitive distortions. Governments may be motivated to manipulate a scheme to favour their national producers and companies themselves even more so.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

The EU would probably have a preference for an independent entity but could hardly object to management by the government. They EU would probably not accept management by an unsupervised private sector organization.

Low risk of perverse outcomes

If other design features such as the rules for setting baselines involve risks of perverse outcomes, self-management by the affected actors would tend to maximise these risks as companies would have an incentive to use all possibilities to maximise the amount of credits they get. There may also be some risk in government management, for example if future baselines are influenced by current emissions.

1.14.2 Summary assessment

Governance by an entity that is independent of government would offer the best environmental and economic prospects. However, it does not seem likely that host country governments will be willing to give the management of a sectoral scheme to an entity beyond their control. Self-management is not recommendable for both environmental and economic efficiency reasons.

Table 15 Summary assessment of different options for design element 7a

Options and issues	Pros	Cons
Governmental oversight	Medium transaction costs No political barriers Medium risk of capture by powerful interests Compatible with EU ETS	Risk of baseline inflation, weak targets, and weak monitoring Political motivations may impact economic efficiency Risk of competitive distortions Some risk of perverse outcomes
Independent governance	Highest potential for environmental effectiveness and integrity Lowest risk of capture by powerful interests Lowest risk that political motivations may impact economic efficiency Lowest risk of competitive distortions Compatible with EU ETS Low risk of perverse outcomes	Highest transaction costs High political barriers
Self-regulation	Low or medium transaction costs	High risk of baseline inflation, weak targets, and weak monitoring High political barriers High risk of capture by powerful interests Profit motivations very likely to trump economic efficiency High risk of competitive distortions Not compatible with EU ETS High risk of perverse outcomes

1.14.3 Need for international regulation

As management of sectoral crediting and sectoral trading including baseline setting and MRV is supposed to be done mostly at the national level, robust national governance is crucial to maintain environmental integrity. An agency that is independent from the host country government clearly offers the best prospects for maintaining environmental integrity. However, setting international rules for national governing agencies will potentially come into conflict with the sensibilities of host countries regarding their national sovereignty. From the environmental perspective it would nevertheless be recommendable to set criteria for institutions that (i) ban self-regulation and other forms of political influence by the regulated entities on the regulator, (ii) allow government regulation (but perhaps under certain conditions) and (iii) express a preference for independent agencies.

1.15 Design Element 7b – International governance institutions and accounting framework

The interests of host countries and the international community can be polar opposites. While some countries may have strong intrinsic motivations to pursue emission reductions, it can generally be assumed that host countries (also) have an interest in generating as many credits as possible. By contrast, the international community has an interest in ambitious targets and rigorous monitoring. International governance is therefore necessary to supervise the implementation of the NMM and safeguard the environmental integrity the climate regime.

The basic international procedures that are needed seem fairly straightforward. They would be essentially the same for sectoral crediting and sectoral trading and involve the following steps (Sterk 2010):

1. The respective developing country would propose a sectoral crediting threshold or target. The proposal would need to be accompanied by a projection of BAU emissions in the sector.
2. This proposal would need to be assessed and approved by an international body.
3. Once approved, the developing country would need to initiate actions to reduce emissions in the sector and to maintain a sectoral emissions inventory.
4. The inventory would need to be submitted for international assessment at regular intervals, e.g. annually. As the crediting would relate to total sectoral emissions, the individual mitigation actions would not need to be submitted for international assessment, in contrast to the CDM.
5. The last step is the main difference between sectoral crediting and trading. In the case of sectoral crediting, the developing country receives emission credits if sectoral emissions are below the crediting threshold. If emissions are above the threshold, there are no consequences. In the case of sectoral trading the developing country would need to make up for any emissions shortfall by buying additional trading units or else face consequences that would need to be defined.

On this basis, the following questions need to be answered to fully flesh out the international governance framework:

- Who is competent to submit proposals? This question is addressed as a separate design element.
- What are the requirements for submitting proposals? This includes requirements for the definition of sectoral boundaries, baselines and target-setting, which are addressed as separate design elements.
- What is the process for approval and issuance? This question has several sub-questions:
  - Who is competent to assess and approve proposals and issuance of credits?
  - How should the regulatory body be structured?
  - How should the assessment process be organised?
- What are the requirements for MRV? This question is addressed as a separate design element.
- What are the consequences in case of non-achievement of targets? This question is addressed as a separate design element.

On this basis, this section will discuss the questions around the **approval and issuance process**.

1.15.1 Assessment of main design options – Competence for Approval

According to the decision taken in Durban, governance of the new mechanism is under the authority of the COP. The COP needs to establish a framework of rules and should review the rules periodically. However, the day-to-day work will need to be done by a dedicated regulatory body that can draw on the necessary technical expertise. The question is who should be competent for the final approval of a national proposal, in particular approval of the sectoral crediting threshold or target:

- The competence of the **CDM Executive Board** may be extended to cover approval of proposals under the NMM. The Board would take all decisions on its own based on COP guidance, similar to the process for registering CDM projects;
- Approval may be done by a ***new supervisory body*** on its own, similar to how the CDM Executive Board registers projects;
- Sectoral proposals could be approved by the ***COP*** on the basis of the assessment by the regulatory body (which may be the CDM Executive Board or a new body);
- Approval may also be granted at **national level** subject to the respect of all participation requirements and modalities for setting baselines and targets, with only a technical review undertaken at international level by some sort of International Expert Team designated by the COP.

Technically, the first two options are basically the same and will therefore be discussed as one option "approval by the regulatory body on its own", which leaves three options: approval by the regulatory body on its own, approval by the COP, and approval at national level subject to respect of participation requirements..

Environmental effectiveness

Decision-making by the COP body would be more politicized than decision-making by the regulatory body. Having decisions taken by the regulatory body on its own might therefore provide for higher environmental effectiveness. On the other hand, as the question of ambition is political rather than technical, the regulatory body may be reluctant to take a strong stand against a sovereign country on this issue. The third option, approval at national level with only a technical review at international level, implies that the countries' proposed level of ambition will be accepted without discussion. This option can be expected to lead to the lowest level of ambition compared to the other two options.

Environmental integrity/MRV robustness

The details of a country's baseline-setting and MRV system would in any case not be assessed by the COP. Options 2 and 3 probably make no difference in this respect.

Administrative feasibility, including transaction costs

In all three options there would be a technical assessment by technical experts, so the related administrative costs should be the same. The third option does not have a regulatory body, so it would probably have the lowest administrative costs. Decision-making in the first option would be slow as the COP meets only once a year.

Political feasibility

Target-setting is a highly political process, targets are usually set at the highest political level in a country. One may therefore question whether Parties will be willing to leave the final judgement whether a target is appropriate or not to a technical body. In addition, Parties may not be willing to establish a fully independent technical body. On the other hand, having the COP decide may lead to "hostage taking", that is, Parties may make approval on the target subject to agreement on other issues (de Sépibus and Tuerk 2011). Option 3 would fully depoliticize the process as only the technical robustness but not the level of ambition would be assessed. Developing countries would probably prefer this option but it may not be acceptable for industrialized countries.

Economic efficiency

The approval process would relate to environmental effectiveness and integrity, not the way economic incentives are structured within the host country.

Private sector participation/potential to mobilize private capital

As the approval process takes place between the host country government and the international institutions, there should be no impact on private sector participation.

Potential impacts on competitiveness of EU enterprises

If one of the options would provide for higher environmental ambition, this option would also be beneficial for the competitiveness of EU enterprises. However, as discussed above environmental arguments can be found for both of the first two options. Option three, a purely technical assessment without discussion of the level of ambition, would probably lead to the weakest environmental outcome and hence lowest additional costs for the installations in the sectoral scheme.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

The question of who decides on targets/crediting thresholds does not seem to affect EU ETS compatibility. It can be assumed that the rules for the new mechanism will stipulate that targets/crediting thresholds should at least not be weaker than business as usual, which would be assessed under all three options.

Low risk of perverse outcomes

All three options would include a technical assessment of the robustness of baselines and MRV provisions. Therefore, none of the options seem to entail a risk of perverse outcomes.

1.15.2 Summary assessment – Competence for Approval

Table 16 Summary assessment of different options

Options and issues	Pros	Cons
Approval by regulatory body on its own	Depoliticises process, which may lead to higher environmental ambition Faster decisions	Can a technical body tell a government whether its target is robust enough? Parties may not be willing to establish fully independent technical body.
Approval by COP based on assessment by new regulatory body	Higher political legitimacy, setting targets or thresholds a very political question	Politics may trump objective facts Potential for "hostage taking" Slower decisions, only possible once a year
National approval with merely technical assessment internationally	Lowest administrative costs Fully depoliticizes process, probably preferred option for developing countries	Probably weakest environmental outcome Having no international discussion of ambition may not be acceptable for industrialized countries

1.15.3 Need for international regulation

The COP will need to agree rules on who is competent to approve proposals.

1.15.4 Assessment of main design options - Composition of International Regulatory Body

If a new regulatory body is established, options are for example:

- The new body could be structured similarly to the CDM Executive Board, that is, composed of political candidates that are nominated by the UNFCCC's regional groups and basically serve as volunteers

- Alternatively, one might envisage a full-time professional body

Environmental effectiveness

Even though members of the CDM Executive Board are supposed to serve in their personal capacity, the discussions in the Board frequently take place along the lines of national interests. If certain decisions would negatively impact certain project types, Board members from countries which have a high potential for projects of this type frequently advocate for those options that would lead to the highest volume of credit generation. In addition, Board members are often political appointees rather than technical experts. A full-time professional body could be composed of experts and would probably depoliticize the process, which would probably lead to higher environmental effectiveness. This assumes however, that decisions on targets are left to the regulatory body. If final approval of targets lies with the COP as discussed above, the setup of the regulatory body may have little impact on environmental effectiveness.

Environmental integrity/MRV robustness

The controversies in the CDM Executive Board usually relate to the stringency of baselines, that is, environmental effectiveness. Where methodologies are shown to lead to erroneous accounting of emissions, the Board usually quickly finds a consensus to correct the mistakes. Both options should therefore work equally well for environmental integrity.

Administrative feasibility (including transaction costs)

Just as the CDM Executive Board does, even a body that is composed of politically appointed “volunteers” would need full-time professional staff to support its work. The administrative costs of both options should therefore be similar. However, a body like the CDM Executive Board could only meet several times a year, a full-time professional body could therefore take decisions faster.

Political feasibility

Parties will probably want to have a body similar to the CDM Executive Board to facilitate continuous political oversight. This probably applies equally to developing and industrialised countries. Developing countries will want to be able to influence decisions that affect them and industrialised countries will want to see first-hand whether the credits that are generated meet their standards.

Economic efficiency

As the details of national implementation and in particular how incentives are passed on to private companies would probably not be regulated at the international level, probably none of the options would have much impact on economic efficiency.

Private sector participation/potential to mobilize private capital

As the details of national implementation and in particular how incentives are passed on to private companies would probably not be regulated at the international level, probably none of the options would have much impact on private sector participation.

Potential impacts on competitiveness of EU enterprises

If a professional body was empowered to decide on targets and courageous enough to confront host countries where necessary, the resulting environmental ambition would have a positive impact on the competitiveness of EU enterprises.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

If one of the options had a systematic bias against environmental integrity, this would negatively impact EU ETS compatibility. However, this does not seem to be the case.

Low risk of perverse outcomes

None of the options seem to entail a risk of perverse outcomes.

1.15.5 Summary assessment - Composition of International Regulatory Body

A full-time professional body would probably lead to more objective and faster decision-making and would hence probably be best for maintaining environmental integrity, one of the priority criteria. However, both developing and industrialised countries will probably want to have political oversight through a body like the CDM Executive Board.

Table 17 Summary assessment of different options

Options and issues	Pros	Cons
CDM EB model	Established model Higher political acceptability	EB discussions often very politicised, many members represent country positions even though should serve in personal capacity EB members often political appointees rather than experts Slower decisions
Full-time professional body	Probably more apolitical Members can be experts Faster decisions	Probably less politically feasible

1.15.6 Need for international regulation

The COP will need to agree on the establishment of an appropriate regulatory body and, depending on which model is chosen, possibly also on the selection of members.

1.15.7 Assessment of main design options – Organisation of Assessment Process

Two basic options are conceivable for the assessment of sectoral proposals:

- The CDM model, that is, assessment by private auditing companies. With this model, either the regulatory body or the host country government would hire private auditing companies to assess the initial proposal and the regular implementation reports by the host countries. The regulatory body would need to develop an accreditation standard, accreditation procedures and procedures for the assessment process, such as qualification requirements, requirements for how to conduct desk on on-site reviews etc.
- The Annex I inventory review model under the Kyoto Protocol, that is, an assessment by independent experts that is coordinated by the UNFCCC Secretariat. Under the Kyoto Protocol, expert review teams (ERT) check Parties' initial reports and annual inventories to make sure they are complete, accurate and conform to the guidelines adopted by the CMP. Successful review of the initial report is precondition for being issued with AAUs and eligibility to participate in the flexible mechanisms. The annual inventory review is generally conducted as a desk review but there is at least one in-country visit for each Party during the commitment period. If the ERT finds any problems, it may recommend adjusting the data. If there is no agreement between the Party and the ERT, the Compliance Committee will intervene. In addition to recommending adjustments, the ERT may raise any apparent implementation problems with the Compliance Committee, triggering the compliance procedure as discussed in the previous section.

Environmental effectiveness and integrity

The CDM has shown that external validators are confronted with substantial information asymmetries when checking the claims made by project participants. This problem relates to both options.

However, there is also strong criticism that the DOEs are selected and paid for by the project participants, which leads to an inherent conflict of interest. A similar situation with respect to credit rating agencies is usually cited as one factor that contributed to the financial crisis (de Sépibus and Tuerk 2011).

It also should be noted that the CDM Executive Board has deemed it necessary to complement the work of the DOEs by two further layers of scrutiny, scrutiny by the Secretariat and scrutiny by a review and issuance team (RIT), which is a team of external experts that assist the Board in assessing projects. The RIT is in general terms comparable to the roster of experts which the Secretariat draws on for the in-depth reviews of Annex I inventories.

Administrative feasibility (including transaction costs)

Reviewing data for an entire sector will in any case incur substantial administrative costs. It can be assumed that using for-profit auditing companies would entail substantially higher costs than using the Annex I inventory review model. Both the Annex I inventory reviews and validations and verifications under the CDM are constantly hampered by lack of inventory reviewers/lack of sufficient staff in DOEs. A theoretical solution may be to have the UNFCCC Secretariat do all the reviews by itself and endow it with sufficient staff for this purpose, but that may not be politically feasible.

Political feasibility

Both options are based on already established models. However, it can be observed that CDM host countries frequently object to having DOEs verify data that is provided by the host country government, for example grid emission factors. Scrutiny by a body that has been established by the Parties themselves may therefore be more politically acceptable.

Economic efficiency

As the details of national implementation and in particular how incentives are passed on to private companies would probably not be regulated at the international level, probably none of the options would have much impact on economic efficiency.

Private sector participation/potential to mobilize private capital

As the details of national implementation and in particular how incentives are passed on to private companies would probably not be regulated at the international level, probably none of the options would have much impact on private sector participation.

Potential impacts on competitiveness of EU enterprises

It has been argued above that using the Annex I inventory review model may lead to higher environmental effectiveness and integrity. More environmental stringency implies higher costs or at least less revenues for the installations in the sector, which would have a positive impact on the competitiveness of EU enterprises.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

It has been argued above that using the Annex I inventory review model may lead to higher environmental effectiveness and integrity. This option might therefore be more compatible to the EU ETS as there might be less risk of impairing its integrity.

Low risk of perverse outcomes

None of the options seem to entail a risk of perverse outcomes.

1.15.8 Summary assessment –Organisation of Assessment Process

Table 18 Summary assessment of different options

Options and issues	Pros	Cons
CDM EB model	Established model	Potential for conflicts of interest Higher administrative costs
Annex I inventory review model	Less potential for conflicts of interest Lower administrative costs Established model Possibly higher political acceptability	

1.15.9 Need for international regulation

The COP will need to agree rules for how to assess host countries' reports.

1.16 Design Element 8 – Ways of managing the transition from CDM to new market mechanisms

Design options

Introducing a sectoral scheme in a sector where CDM projects are taking place raises the question of the relationship between these two mechanisms. A sectoral scheme should ideally cover all installations in a sector in order to prevent intrasectoral leakage, which would mean that CDM projects that take place in the sector would also be covered. The main issue is to prevent that emission reductions are counted twice, under the CDM and the sectoral scheme. There are two possible types of overlaps:

- Direct overlaps, for example if a sectoral scheme covers fossil-based power plants and there are CDM projects at some power plants, for example for fuel switch or supply-side efficiency improvements.
- Indirect overlaps, for example if a sectoral scheme covers fossil-based power plants and there are CDM projects that promote demand-side energy efficiency.

Ideally, the same rules should apply to all CDM projects that directly or indirectly affect the performance of a sectoral scheme. Available options are (see also Aasrud et al. 2009; Butzengeiger-Geyer and Michaelowa 2009; Schneider and Cames 2009):

1. ***Option 1 – Carve out CDM projects from the sectoral boundary***
    a. Option 1.1 Exclude existing CDM projects from coverage of the sectoral scheme but do not allow new projects in the sector
    b. Option 1.2 Exclude existing CDM projects from coverage of the sectoral scheme and allow new projects in the sector, which would then also be excluded from the coverage of the sectoral scheme
2. ***Option 2 – Phase-out CDM in sector***
    a. Option 2.1 Do not allow new projects but continue crediting of existing ones and deduct CERs from sectoral performance
    b. Option 2.2 Stop crediting of existing projects after their current crediting period and deduct CERs from sectoral performance
    c. Option 2.3 Stop crediting of existing projects immediately
3. ***Option 3 – Continue existing and allow new CDM projects and deduct CERs from sectoral performance***
4. ***Option 4 –Existing CDM projects are integrated into the sectoral scheme.***
    The specifics would probably be very case-specific. For example, if industrial installations are credited based on a certain benchmark, the CDM benchmark might be adapted to the benchmark used in the sectoral scheme. Another thinkable example is that if a policy-based scheme in the electricity sector includes a renewables feed-in tariff, the FIT may be extended to existing CDM projects in lieu of getting CERs. Sub-options are
    a. Option 4.1 Integrate existing projects immediately.
    b. Option 4.2 Integrate existing projects after their current crediting period.

It should be noted that the impact also goes in the other direction. If a sectoral scheme reduces the carbon intensity of a country's power mix, that should in principle also affect the baselines of projects in other sectors such as demand-side efficiency projects. So far, the CDM's rules stipulate that new policies need not be taken into account when defining the baseline and demonstrating additionality.

1.16.1 Assessment of main design options

Environmental effectiveness

All options where two crediting systems exist in parallel in the same sector may lead to shifting of production between the systems in order to maximize the amount of credits received, that is, intra-sectoral leakage. Options 2 and 4, which lead to phasing out the CDM immediately or after a certain period of time, are hence generally the most favourable from the environmental perspective.

Option 1.1 would probably not entail further risks in addition to the basic leakage risk. Option 1.2 and Option 3 would lead to "system shopping", as investors could choose between the CDM and the sectoral scheme. One decision factor would be which system would award them more credits, which implies more credits for the same emission reduction and hence a lower net environmental effectiveness at global level.

Stopping crediting of on-going CDM projects immediately or after a certain amount of time (Option 2) would have a positive environmental impact if the projects nevertheless continued operation. But this would not be the case for all projects and would involve substantial political and legal problems, as discussed below.

The environmental performance of Option 4 would depend on the relative stringency of the sectoral baseline compared to the CDM baseline. If the sectoral baseline is more stringent than the CDM baseline, Option 4 would in principle be beneficial for the environment. Aasrud et al. (2009) note that if CDM project participants are forced to adapt their baselines to the sectoral baseline, they would probably lobby to keep the sectoral baseline as close to the CDM baseline as possible, so this option might in their view lead to lower environmental effectiveness. However, industry lobbying to keep baselines as lenient as possible can probably be expected in any case.

Environmental integrity/MRV robustness

Options 2-4 should all be able to safeguard that there will be no double counting of emission reductions. However, option 1 would not be able to avoid double counting in case of indirect overlaps. For example, if a sectoral scheme covers the power sector, it is easily possible to exclude certain fossil fuel plants from the sectoral coverage (direct overlap). But renewable electricity or demand-side efficiency projects (indirect overlap) would in any case impact emissions from fossil-based power plants and should therefore be accounted for using one of the options 2-4.

Administrative feasibility (including transaction costs)

Excluding existing CDM projects from the sectoral boundary (Option 1) and immediately stopping existing projects (Option 2.3) should be easy to administer.

In Options 2.1, 2.2 and 3 there is an overlap between the CDM and the sectoral scheme. The options imply that the volume of issued CERs is monitored and deducted from the sectoral performance. However, it should be easy to automatically track and deduct the CERs in the ITL. These options should therefore also not involve high transaction costs.

The feasibility of Option 4 would depend on the specific case. Switching from the CDM to a policy-based incentive such as an FIT may even lead to lower transaction costs because the GHG accounting would then be done at the sectoral level rather than for each project. As for adapting the baselines of CDM projects to the sectoral baseline, projects' baselines anyway need to be reviewed at the end of a crediting period, so there should be no additional administrative effort. However, in general the feasibility of integrating existing CDM projects into a new sectoral scheme would need to be assessed for each CDM project type, which is beyond the scope of this study.

Political feasibility

Immediately stopping on-going CDM projects is probably not a feasible option as it would cause severe conflict with the project participants, who have spent a lot of prior investment and energy on the registration process and the project itself (Puhl et al. 2011).

On the other hand, host country governments may prefer a sectoral mechanism to the CDM for several reasons (Aasrud et al. 2009):

- A sectoral mechanism would probably generate more credits and hence more revenue;
- Depending on the national implementation scheme (see design element 4a), this revenue may accrue to the host country government rather than project participants;
- Higher volumes and standardization at sectoral level will probably man lower transaction costs per tonne than in the CDM;
- All relevant technologies may be employed in a sectoral scheme;
- Sectoral mechanisms open up the possibility for strategic government cooperation between the host country and industrialised countries.

In addition, Butzengeiger-Geyer and Michaelowa (2009: 4f) point out that it is in the interest of the host country to:

- Be able to reliably estimate and plan the emission reductions that will result from the measures it plans to use to implement the sectoral mechanism;
- Financially benefit from the sectoral mechanism by receiving credits that it can sell.

The impacts of continuing the CDM depend on the effectiveness of the implementing measures chosen by the government under a sectoral scheme and the degree of CER taxation done by the host country (if any). If the government's measures include financial outlays and CERs are taxed, the government would benefit from continuing CDM projects as long as the tax revenues per CER are higher than the government's financial outlays per tonne of CO_2-eq. reduced under the sectoral mechanism. As most developing countries do not tax CERs, this situation is unlikely. The host country would therefore benefit from CDM phase-out. The relative benefit for the government also depends on the timing of revenue accrual. If trading units from a sectoral mechanism can be sold ex ante, as is intended under the sectoral trading proposal, whereas CER tax revenue only accrues ex-post, the sectoral mechanism would be more attractive for the host country government (Butzengeiger-Geyer and Michaelowa 2009: 4f).

All in all, there are very strong reasons for host country governments to favour phase-out of the CDM, once they have decided to engage in a sectoral mechanism (which is a strong caveat). The interests of host country governments are therefore the opposite of CDM project participants' interests. Options 2.2 or 4.2 seem to strike a reasonable balance between these competing interests.

The preferences of industrialized countries probably differ. Some are not strongly engaged in the CDM and some have a strong interest in sectoral mechanisms. However, countries that have strongly invested in CDM projects will probably want to receive credits from these projects for as long as possible.

Economic efficiency

Does the CDM or a sectoral scheme provide for greater economic efficiency? The CDM gives direct incentives to investors. Whether the same would also be true for sectoral mechanisms very much depends on the implementation scheme, as discussed in design element 4a.

Private sector participation/potential to mobilize private capital

As noted above, immediately stopping on-going CDM projects would lead to severe conflicts with the project participants and probably also cause long-term distrust in the stability of regulatory decisions and carbon market incentives. While less severe, Option 2.2 would probably have similar results. Current CDM regulations unambiguously give project participants the option to choose multiple crediting periods, with a clear indication that the renewal of the crediting period after 7 years will only involve the updating of certain data. Stopping projects after the first crediting period might also be seen as giving an unfair advantage to project participants who opted for a single 10-year crediting period. Options 1, 2.1 and 3 are hence most in the interest of private investors (Butzengeiger-Geyer and Michaelowa 2009: 4).

In Options 1, 3 and 4 the question is whether the participants in new investments would find the CDM or the sectoral scheme more attractive. As the CERs that are issued to CDM projects would be deducted from the credits that are issued to the government, the government would probably have an interest to not let CDM projects claim the incentives it is offering to achieve the sectoral target. If project participants are given a choice of using either the CDM or the sectoral scheme, their choice will depend on the relative advantages of both options. A key factor will be the revenue that can be expected from the two options. Another factor is the timing of revenue accrual and risks involved. CERs are only issued ex-post and while forward sales are possible they usually involve a substantial discount. If the sectoral scheme involves up-front subsidies paid by the government, these may be more attractive to investors even if the revenue is somewhat lower than what may be got from the CDM. If the government only uses “sticks” rather than “carrots” (see design element 4a), investors will choose the CDM in Options 1 and 3, unless the CDM rules are changed to make projects non-eligible that do not conform to new regulations (Butzengeiger-Geyer and Michaelowa 2009: 7).

Potential impacts on competitiveness of EU enterprises

If emission reductions were double counted, the respective participants would receive windfall profits. As double counting of indirect overlaps may occur in Option 1, there might be impacts on competitiveness depending on who receives the double reward. In addition, all options that are more attractive to companies than others imply a comparatively higher positive impact on their competitiveness. This applies in particular, Option 1.2 and Option 3, which would allow “system shopping”. If in Option 4 the sectoral scheme gives higher benefits to companies than the CDM, this would probably also imply some positive impact on their competitiveness.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

All options that prevent double counting should in principle be compatible with the EU ETS.

Low risk of perverse outcomes

None of the options appears to involve risks of providing incentives to policy makers and/or private participants to increase rather than decrease GHG emissions. However, as noted above Option 1.2 and Option 3 would allow “system shopping” to maximise generation of credits.

1.16.2 Summary assessment

Most of the options would effectively address the risks of double counting and intra-sectoral leakage. Phasing out the CDM immediately would be the most effective option from the environmental perspective. However, the interests of the various stakeholders strongly differ. Project participants have a strong interest – and probably also a sound legal title – to gain the reward for the effort they have invested. In addition, dismantling the CDM may damage the confidence of the private sector in the carbon market’s ability to create value for the long term.

By contrast, host country governments could reap more benefits from sectoral schemes than from the CDM. Industrialized countries probably have different levels of attachment to the CDM. Options 2.2 or 4.2 may strike a reasonable balance between these competing interests. Option 2.2. is administratively much more straightforward than Option 4.2.

Table 19 Summary assessment of different options for design element 8

1.1 Carve out CDM projects from sector and no new projects	Easy to administer Acceptable to project participants	Potential for some intra-sectoral leakage Does not address double counting from indirect overlaps Not compatible with EU ETS
1.2 Carve out CDM projects from sector and allow new projects	Easy to administer Acceptable to project participants	Strong risk of “system shopping” and intra-sectoral leakage Does not address double counting from indirect overlaps CDM dynamics may complicate host country government’s mitigation planning Not compatible with EU ETS
2.1 Phase-out CDM - no new projects but crediting of existing ones	Addresses double counting Easy to administer Acceptable to project participants Generally compatible with ETS	Potential for some intra-sectoral leakage
2.2 Phase-out CDM - no more crediting after current crediting period	Addresses double counting Positive environmental impact if projects continue operation Easy to administer May be acceptable to project participants Generally compatible with ETS	Potential for some intra-sectoral leakage
2.3 Phase-out CDM - immediate stop of crediting	Addresses double counting Positive environmental impact if projects continue operation Easy to administer Compatible with EU ETS	Not acceptable to project participants
3 Continue existing and allow new CDM projects, but deduct CERs from sectoral performance	Addresses double counting Acceptable to project participants Easy to administer	Strong risk of “system shopping” and intra-sectoral leakage CDM dynamics may complicate host country government’s mitigation planning Not compatible with EU ETS
4.1 Integrate existing projects into sectoral scheme immediately	Addresses double counting No intra-sectoral leakage Positive environmental impact if sectoral baseline more stringent than CDM Administrative feasibility depends on specific case Acceptability depends on relative benefits of both schemes for	Administrative feasibility depends on specific case Acceptability depends on relative benefits of both schemes for project participants

	project participants Compatible with EU ETS	
4.2 Integrate existing projects into sectoral scheme after their current crediting period	Addresses double counting Minimises intra-sectoral leakage Positive environmental impact if sectoral baseline more stringent than CDM Administrative feasibility depends on specific case Acceptability depends on relative benefits of both schemes for project participants In line with CDM rules for updating baselines Generally compatible with ETS	Administrative feasibility depends on specific case Acceptability depends on relative benefits of both schemes for project participants

1.16.3 Need for international regulation

Doubling counting between the CDM and new mechanisms would strongly undermine the environmental integrity of the carbon market. There is therefore a strong need for clear rules and standards to prevent double counting.

1.17 Design Element 9 – Financing of the mechanism

Design options

Multiple sources of financing will be required for the various aspects of the sectoral market mechanism. Financing will be required for:

- The upfront costs of capacity building and establishment of the sectoral crediting mechanism;
- The costs of operating the system;
- The costs of mitigation activities within the host country.

Assessments for the design options have been made for the capacity building and establishment of the sectoral market mechanism and the mitigation activities within the host country. It is assumed that the costs of operating the system will be met by a commission on the generated credits or tradable units.

1.17.1 Assessment of main design options - Financing of sectoral crediting mechanism

Dependent on the level of data availability of the sector to be included, funds may be required for extensive data collection and for the establishment of robust baselines. Specialist consultants may be required to support industry and the national government in capacity building activities such as completing emissions inventories, selecting feasible baselines, agreeing targets and monitoring, reporting and verifying emissions over time. The upfront financing of the sectoral crediting mechanism could be a barrier to participation in certain less developed countries. A number of basic design options are proposed:

- Financing from host nation
- Financing from donor countries
- Financing from multilateral donors

Financing from host nation

With this design option, the host nation would cover the costs related to the establishment of the sectoral crediting mechanism. This could be a combination of public funding and funding from the stakeholders of the sector involved. This option may prove to be more economically efficient than an upfront lump-sum being provided by external donors. As the expenditure must take place in the host country, the national governments are best placed in terms of accounting for the money spent.

The potential disadvantage of this option is that the financial resources required may form a barrier to participation by the national government and private sector stakeholders. Moreover, a lack of funds may mean that certain activities are completed insufficiently or not to suitable standards to ensure the integrity of the mechanism.

Financing from donor countries

Here the establishment of the crediting mechanism would be borne by (Annex 1) donor countries. The costs could be met by overseas development funding, or as part of a future agreement for the off take of sectoral reduction credits generated, to be used for emission offsetting purposes. This option may overcome any financial barriers for participation by the host country. However, there may be additional transactional costs and issues related to accountancy and auditing of investments made.

Financing from multilateral donors

Examples of funding from multilateral donors include the World bank and the Global Environmental Facility. The World Bank operates the Partnership for Market Readiness, which is a grant-based, capacity building trust fund that provides funding and technical assistance in areas such as emissions monitoring, verification and reporting, and in the development of regulatory frameworks for market-based instruments.

The GEF is the largest global funder of projects to protect the environment. Projects to prevent climate change are eligible for funding from the GEF. The GEF is the operating entity of the financial mechanism of the UNFCCC, and provides financial assistance in accordance with guidance of the Conference of the Parties (COP) to non-Annex I Parties through its implementing agencies UNDP, UNEP and the World Bank. For example, $405,000 is made available for non-Annex 1 to complete national communications of their communications for submission to the UNFCCC (UNFCCC, 2011).

Again, the availability of external funding can overcome the barriers to participation. However, accountancy and auditing of expenditures will be required.

1.17.2 Summary assessment – Financing of sectoral crediting mechanism

Table 20 Summary assessment of different options

Options and issues	Pros	Cons
Financing from host nation	This could improve the economic efficiency of the overall system, rather than lump-sum external financing Removes the need for high transactional costs for accounting measures	Limited funds could prove to be a barrier leading to reduced environmental integrity.
Financing from donor countries	Funding could improve the attractiveness to the mechanism for certain countries with limited budget	Issues of accountancy and economic efficiency
Financing from multilateral donors	Funding could improve the attractiveness to the mechanism for certain countries with limited budget Ample experience with financing and implementing capacity building in developing countries	Issues of accountancy and economic efficiency

The costs of operating the system

The costs of operating the system are assumed to be relatively small compared to the costs of the actual abatement options. At the international level, assuming the sectoral crediting/trading mechanism will be controlled by an Executive Board within the UNFCCC (similar to the arrangement within the Clean Development Mechanism), the costs will be covered by a small share of the proceeds (SoP) of the credits or certified emissions reductions that are generated by the sector. This SoP for NMM credits may be more or less similar to the level of the SoP for CDM credits (i.e. US$ 0.10-0.20 per tonne of CO_2 equivalent reduced) . The exact level of the NMM SoP, however, is hard to determine at this stage as it will depend on the future climate regime, in particular the annual amount of NMM credits demanded and supplied, and the specific international governance structure of the NMM and the resulting costs of this structure in particular. Most likely, the best opportunity for raising this SoP is when the credits are issued to the host country or parties concerned.

Any operative costs by the host government could be covered via national accounts, or alternatively the national government could also cover their costs through a domestic SoP of the certified emission reductions generated by the private companies within the mechanism, assuming a crediting mechanism. Assuming a trading mechanism whereby the tradable allowances are provided to the host country ex-ante, the government could covers its costs by auctioning a small number of the allowances on the carbon market to raise funds.

1.17.3 Assessment of main design options – Mitigation activities within the host country sector

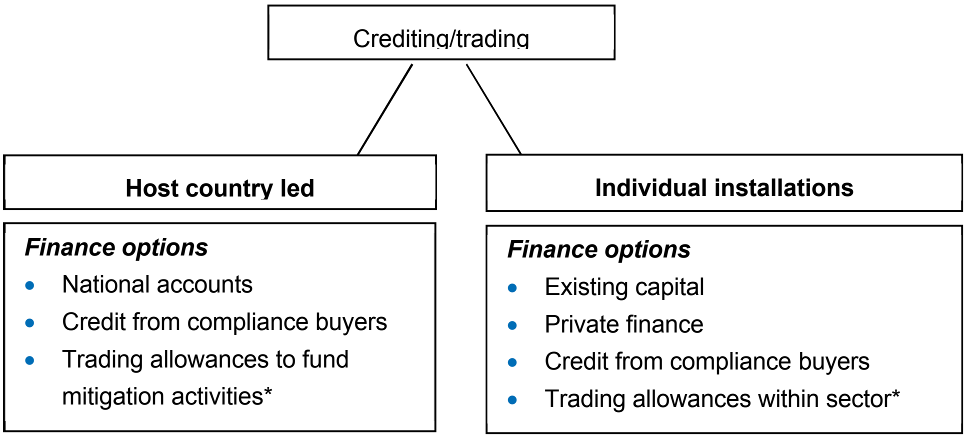
The way that the mitigation activities will be financed by the host country sector will clearly depend on how the sectoral crediting/trading mechanism is structured. However, regardless whether a system acts as a emissions trading or a emissions crediting mechanism, it is assumed that in order to finance abatement measures, capital will need to be raised by either host governments or sector stakeholders via Annex 1 credit purchase agreements and private entities. An exception of course would be a government or sector stakeholder that has the capital to individually implement abatement technologies. As stated in Dransfield et al., (2011), a financing gap exists whereby investments are needed at the start of the crediting period to bring the emissions down, whereas the credits are only generated after the emissions reductions are verified.

The financing routes for a crediting mechanism depends on the role of the government and entities within the system. If the government is in control of the mechanism and the credits generated, financing will be required for operating incentive schemes, for example a feed-in tariff or a technology subsidy. To cover the costs of enacting policies and measures the host country government could attempt to establish agreements with potential emissions credit consumers using emission reduction purchase agreements (ERPA), whereby a contractual agreement would be settled between the buyer and seller prior to the commencement of the crediting period. Often, upfront payments for credits may be made which lever capital for the host government to implement the necessary changes. However, the agreed price will be most likely less than the spot price for emissions credits.

If the emphasis is placed on private entities to reduce their emissions, potentially through a technology mandate, access to finance will depend on their own financial standing and/or the ability of the project to deliver non-carbon related revenues, such as energy savings or product improvements. It is expected that single installations within a crediting mechanism would find it very difficult to get financing based on the expected credits to be generated, because of the risk of the entire sector underperforming (IETA, 2010; see also design element 4a – Operation/incentives of the scheme at government/installation level).

In a trading system, whereby tradable allowances corresponding to the agreed target are provided to the host country at the start of the timeframe, an amount of allowances could be sold to fund upfront investment. However, this method of capital accrual places significant risk on the host, because if targets are not met then the excess emission requirements must be purchased from the market to avoid any eventual penalties. It is more likely that the host country government would try to avoid risk by establishing long-term sale agreements with compliance buyers and market intermediaries (IETA, 2010).

Figure 3 Financing routes for crediting and trading



* Sectoral trading only
* Assuming domestic installation-based sectoral crediting

However as with all investments, one of the key challenges in raising capital from compliance buyers and private market entities is risk. According to IETA (2010) buyers of credits generated from sectoral crediting mechanisms face three types of risk:

- ***Implementation risk –*** Risk that the coordinating entity(ies) fail to adequately enforce the required abatement objectives in the sector;
- ***Default risk –*** Risk that after issuance, the coordinating entity(ies) fails to honor the contracts that it has entered;
- ***Performance risk –*** Risk that although policies have been enacted and enforced, they fail to incentivize the necessary changes and the emission reduction goals are not met.

There are of course other risks to the investor that go beyond the delivery risks associated with the sectoral crediting/trading mechanism (see Morel and Delbosc, 2012, for a summary). There are methods to reduce these risks for private investors. Morel and Delbosc (2012) highlight two possible methods to encourage private investments for financing climate actions in developing countries:

- ***Climate bonds –*** Multilateral development banks, such as the World Bank, can use public funds to guarantee private investment through the issuance of climate or green bonds. These bonds are considered to be relatively safe and issue fixed rates or rates that are indexed to the LIBOR.[5] For example, the 'Green bonds' issued by the World Bank carry the same AAA rating at the World Bank itself.The Asian Development Bank also issues bonds for clean energy projects.
- ***Export credit agencies –*** An export crediting agency or investment insurance agency is a private or quasi-governmental institution that acts as an intermediary between national governments and exporters. Credit insurance guarantees creditors that they will be reimbursed by underwriting business activity. Export crediting agencies are frequently involved in project finance in developing countries. It may also be possible to develop an insurance packages specifically covering the risks of climate projects such as a sectoral crediting mechanism. Private insurers have emerged in the CDM market to cover the specific risks of certain projects, including guarantees on the sale of emission allowances.

5 The London Interbank Offered Rate, or LIBOR is the average interest rate that leading banks in London charge when lending to other banks.

1.17.4 Summary assessment – Mitigation activities within the host country sector

Table 21 Summary assessment of different options

Options and issues	Pros	Cons
Finance options		
Host government (budget) accounts	No external financing necessary	Potential underinvestment Barrier to participation Risk borne by host government
Credit from compliance buyers	Access to capital for mitigation measures No/minimal impact on national accounts	Credits may be sold at below market value Guarantee from host government or third-party may be required
Private finance (installation level)	Access to capital	Requires mandatory emission standards upon which to assess expected returns Risks too high in voluntary sectoral crediting mechanism due to the risks of the sector underperforming, unless combined with non-carbon benefit Guarantee from host government or third-party may be required
Trading allowances (government)	Access to capital for mitigation measures	Government carries the risk of non-compliance Risk of fluctuating carbon market
Trading allowances (domestic trading – installation level)	Access to capital for mitigation measures	Requires certainty on expected emissions
Risk management		
Climate bonds	Public funds can be used to unlock private investment for abatement measures which would otherwise not happen Can be used to reduce the interest rates of the investment and thus reduce whole project costs	Projects would need to be compliant both with the requirements of the UNFCCC and with the climate bond issuer which may lead to additional start-up costs
Export credit agencies	Can provide insurance on certain projects where the private insurance is unable to do so under acceptable conditions Insurance packages can be tailored to the specific risks of climate related projects	Export crediting agencies could encourage purchases from a particular country which may have political consequences.

1.17.5 Need for international regulation

The finance of the NMM system can be left largely to the host government and/or parties concerned (including donor organisations). This applies in particular to the financing of (i) the upfront costs of capacity building and establishment of the sectoral NMM, (ii) the national or domestic costs of operating the system, and (iii) the costs of the NMM mitigation activities within the host country. The only issue which should be regulated by the COP/UNFCCC concerns the financing of the international costs of operating the NMM system, in particular of the authority responsible for the international governance of the scheme.

2 Annex B: Full Assessment of Design Proposals for the New Market Mechanism

In this Annex we present our proposals for the design of the New Market Mechanism, based on the assessment of elements and modalities. The following sections present in-depth analyses for each of our design proposals.

Annex A has delivered a list of possible options for the design elements and modalities of a new market mechanism, including an assessment of their respective strengths and weaknesses. This Annex combines and elaborates these design elements and modalities towards three distinct, but coherent, proposals for the New Market Mechanism (NMM). For each design element and modality identified and assessed, one of the available options is selected and combined into full-fledged proposals for the NMM. It is important that the three proposals are substantially distinct from each other, but at the same time the three proposals should be workable and realistic.

The selection and combination of design options has been made on the basis of optimisation criteria. The optimisation criteria are the same as the assessment criteria in Annex A, but with different weights attached to them. The ranking of criteria was determined cooperatively by the European Commission and the consortium and is listed in Table 22.

Table 22 Regrouped assessment criteria for optimising and evaluating design proposals for NMMs

Top Priority
Environmental effectiveness and integrity
Preparedness for evolution towards EU ETS compatible cap-and-trade system
Economic efficiency
Further Criteria
Political Feasibility
Private sector participation/potential to mobilize private capital
Potential impacts on competitiveness of EU enterprises
Low risk of perverse outcomes
Administrative feasibility, including transaction costs

In addition, the design proposals are to take into account country- and sector-level considerations. Some proposals are more suitable for some countries and sectors than for others. For example, the transport sector poses challenges that are substantially different from other sectors. As the transport sector is composed of very many small and mobile emission sources, the transaction costs of addressing each individual vehicle in a downstream system would probably be prohibitive. Addressing transport would therefore probably require an upstream or government-run system.

The team has developed the following three proposals:

Proposal 1: Government Crediting System

This proposal aims at facilitating participation of countries that do not have the technical capacity to implement an installation-level system and to facilitate participation of sectors where installation-level emission accounting would involve very high transaction costs, such as the transport sector. Accounting for emissions is therefore proposed to take place at an aggregated level rather than source-based. In this system, the host country government adopts a sectoral crediting threshold and implements policies and measures to reduce emissions, which could in principle address all available emission reduction options. All emission reduction credits accrue to the host country government which can use them to (co-)finance policy implementation.

Proposal 2: Tradable Intensity Standard

As opposed to Proposal 1, in this system, the sectoral crediting threshold would be devolved to the individual emission sources. That is, each emission source in the sector would be assigned an individual crediting threshold and would receive credits if it reduced emissions below the threshold. An installation-based sectoral crediting system has the problem that the reductions at one installation may be offset by emission increases at another installation. If the issuance of credits to one installation depends on the overall sectoral performance, there would therefore hardly be an incentive to invest. We therefore propose that the host country government should make the installation-level targets mandatory. If the targets are intensity-based, as is proposed here, such a system is often referred to as a "tradable intensity standard".

Proposal 3: Installation-Based Emission Trading System

In this system, the host country government would introduce a domestic (sectoral) cap-and-trade system for a specific sectors and allow for "trading" under the emission cap of the sector.

The following sections elaborate the three proposals in more detail. During the elaboration process it became apparent that the three priority criteria – environmental effectiveness and integrity, preparedness for evolution towards EU ETS compatible cap-and-trade system and economic efficiency – point in very similar directions for many of the design elements. The below table summarises the design choices and highlights similarities and differences between the three proposals. The following description of Proposal 1 will go into all the details while the descriptions of Proposals 2 and 3 will mostly focus on the differences.

Table 23 Overview of Selected Design Elements for the Design Proposals

#	Design element	Proposal 1	Proposal 2	Proposal 3
1	**Crediting or trading**	Crediting	Crediting	Trading
2				
	a) Sector/activity boundaries	Entire sector	All emitters above certain threshold	All emitters above certain threshold
	b) Types of GHGs to cover	$CO_2$and other GHG gases, depending on data availability and quality	CO_2 and other GHG gases depending on data availability and quality	CO_2 and other GHG gases depending on data availability and quality
	c) Upstream versus downstream coverage	Not applicable	Upstream or downstream, depending on sector	Upstream or downstream, depending on sector
3				
	a) Nature of target/threshold	Indexed targets	Indexed targets	Indexed targets
	b) Method for setting target/threshold	Deviation from BAU or benchmarking	Deviation from BAU or benchmarking	Deviation from BAU or benchmarking
	c) Interaction with other policies and measures	Inclusion up to cut-off date	Inclusion up to cut-off date	Inclusion up to cut-off date
4				
	a) Operation/incentives at government/installation level	Government level	Mandatory at installation level	Mandatory at installation level
	b) Methodology for distributing credits	Not applicable	Benchmarking if possible	Preferably auctioning, otherwise benchmarking if possible
	c) Temporal flexibility	One or two short crediting periods in the beginning, especially up to 2020, longer ones thereafter Year-on-year no-lose	One or two short crediting periods in the beginning, especially up to 2020, longer ones thereafter Year-by-year no-lose	One or two short trading periods in the beginning, especially up to 2020, longer ones thereafter Annual compliance
5	**Requirements for data collection, monitoring and reporting**	Regular MRV, details depend on sector	Regular MRV, details depend on sector	Regular MRV, details depend on sector
6				
	a) National governance	Independent body or government agency	Independent body or government agency	Independent body or government agency
	b) International approval of national schemes	Approval by technical body on its own	Approval by technical body on its own	Approval by technical body on its own

#	Design element	Proposal 1	Proposal 2	Proposal 3
	c) Composition of international regulatory body	Full-time professionals	Full-time professionals	Full-time professionals
	d) Registry	National or international	National, possibly use of international registry as interim step	National, possibly use of international registry as interim step
7	**Compliance framework and penalties**	Kyoto-like accounting system with increased facilitation	Kyoto-like accounting system with increased facilitation	Kyoto-like accounting system with increased facilitation and penalties for non-compliance with targets
8	**Ways of managing the transition from CDM to new market mechanisms**	Phase out CDM projects after their current crediting period, deduct CDM credits from sectoral performance	Phase out CDM projects after their current crediting period, deduct CDM credits from sectoral performance	Phase out CDM projects after their current crediting period, deduct CDM credits from sectoral performance
9	**Finance of the system**	Start-up support from industrialized countries, on-going implementation costs covered from carbon revenue Finance international infrastructure through fees and share of proceeds	Start-up support from industrialized countries, on-going implementation costs covered from share of credits or fees Finance international infrastructure through fees and share of proceeds	Start-up support from industrialized countries, on-going implementation costs covered from share of credits or fees Finance international infrastructure through fees and share of proceeds

2.1 Proposal 1: Government Crediting System

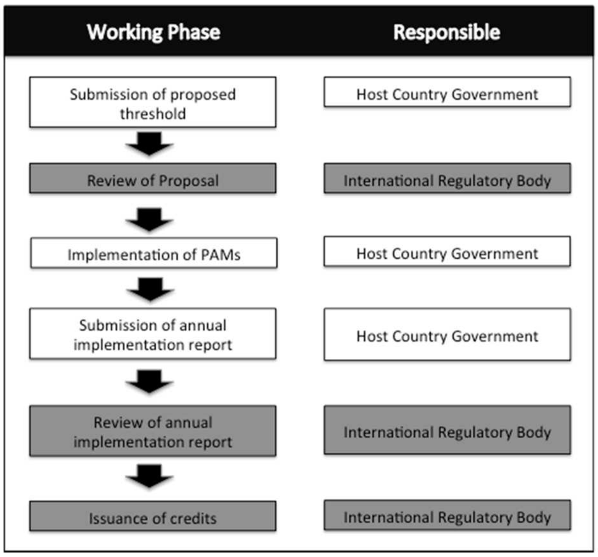
2.1.1 Basic Design, Rationale and Mechanism Cycle

Installation-level emissions accounting requires strong technical capacity in the host country and involves substantial transaction costs. In sectors such as transport, which are composed of very many very small emission sources, the transaction costs of accounting for each source individually would probably be prohibitive.

We therefore propose a government-level system that facilitates participation of such sectors and of countries that do not have the technical capacity to implement an installation-level system. Accounting for emissions is proposed to take place at an aggregate level, for example on the basis of national fuel statistics, rather than at the installation level. Being based on aggregate data, the system could cover all emissions from the sector.

No carbon units are issued to individual emitters. Instead, the host country government implements policies and measures to reduce emissions, which could in principle address all available emission reduction options. All emission reduction credits accrue to the host country government which can use them to (co-)finance policy implementation.

The basic steps of the mechanism's cycle are as follows:



- The host country government submits a proposed crediting threshold to the international regulatory body. This proposals needs to include at least a definition of the system boundary, a baseline projection, the proposed target and modalities for MRV. One may or may not require further elements, such as details on which measures the government intends to take to reduce emissions. However, some countries might view this as an infringement of their sovereignty.
- An international team of experts conducts a technical assessment of the proposal. On this basis, the international regulatory body reviews the proposal and approves it, requests changes or rejects it.
- Once the proposal has been approved, the host country government implements policies and measures, monitors sectoral emissions and submits regular, e.g. annual, implementation reports.
- The international body reviews the implementation report and approves it, requests changes or rejects it.
- If the report is approved and emissions are below the target, the host country government receives credits. If emissions are above the target, there are no further consequences.

The table below summarises the specific choices that were made for each individual design element. Next we discuss each individual design element in more detail and elaborate why which respective option was chosen in order to maximise the design towards the three priority criteria: environmental effectiveness and integrity, preparedness for evolution towards an EU ETS compatible cap-and-trade system and economic efficiency.

Table 24 Proposal 1: Government Crediting System

#	Design element	Selection
1	**Crediting or trading**	Crediting is much more acceptable to most developing countries
2	**Coverage of the mechanism**	
	a) Sector/activity boundaries	Entire sector, as accounting is done at aggregate level the question of inclusion thresholds does not apply.
	b) Types of GHGs to cover	Potentially all GHGs, depending data availability. Broad coverage enhances environmental effectiveness and economic efficiency if reliable MRV is ensured.
	c) Upstream versus downstream coverage	Not applicable as no credits are issued to individual emitters.
3	**Sector target or crediting threshold**	
	a) Nature of target/threshold	Indexed targets to minimize potential for over-crediting.
	b) Method for setting target/threshold	Benchmarks appear as most objective option if necessary data can be compiled at reasonable cost. If not, use of BAU projections appears to be the next best option.
	c) Interaction with other policies and measures	Inclusion up to cut-off date. Point of the mechanism is to incentivise host country government to take new mitigation actions.
4	**Operational/incentive framework**	
	a) Operation/incentives at government/installation level	Government level to minimise transaction costs and allow coverage of sectors composed of many small sources.
	b) Methodology for distributing credits	Not applicable as no credits are issued to individual emitters.
	c) Temporal flexibility	One or two short crediting periods in the beginning, especially up to 2020, to allow quick changes to scheme if problems occur; longer ones thereafter if robustness of scheme has been proven Year-on-year no-lose to create proper incentives
5	**Requirements for data collection, monitoring and reporting**	Regular reporting, details depend on sector
6	**Governance**	
	a) National governance	Independent agency to minimize political or business interference
	b) International approval of national schemes	Approval by technical body on its own without COP involvement to allow quick decisions and minimize politicization of process
	c) Composition of international regulatory body	Full-time professionals to minimize politicization of process
	d) Registry	National or international
7	**Compliance framework and penalties**	Kyoto-like with increased facilitation
8	**Ways of managing the transition from CDM to new market mechanisms**	Phase out CDM projects after their current crediting period to minimise potential for double counting and inter-sectoral lekage, meanwhile deduct CDM credits from sectoral performance
9	**Finance of the system**	Start-up support from industrialized countries, ongoing implementation costs covered from carbon revenue Finance international infrastructure through fees and share of proceeds

2.1.2 *Detailed Choice of Design Elements to Maximise Towards Priority Criteria*

Crediting or trading

A system might either take a crediting approach with ex-post issuance of emission credits or a "trading" approach with ex ante issuance of trading units. Crediting would be based on an agreed emissions threshold or "no-lose target" at sectoral level. If emissions are reduced below the target, the developing country would receive credits. If the target is not achieved, there would be no further consequences. Under a trading approach, the developing country would receive tradable units ex ante. If the country manages to reduce its emissions below its target, it would thereby achieve a surplus of trading units, which it could sell. If the country does not achieve its sectoral target, it would need to buy trading units to cover the shortfall.

Note: This issue has no bearing on how the system is implemented domestically, which is covered further below. In particular, "sectoral trading" does not necessarily imply a domestic cap-and-trade emission trading system. We propose to use sectoral crediting.

Arguments can be found for both sectoral crediting and trading. On the one hand, a "trading" target that is set below business as usual requires a certain emission reduction from the host country. If it does not meet the target, it would need to buy units to cover the shortfall. By contrast, crediting only works to reduce emissions if there is sufficient demand in the market. In the current situation (first half of 2012) with rather weak emission reduction pledges by Annex I countries there is not a lot of demand. On the other hand, countries appear to have inherent motivations to pursue emission reductions, not only the motivation to generate credits, as exemplified by countries like Brazil, China and Mexico, which are increasingly moving towards implementing emission trading systems even though they do not have internationally binding targets. Mexico has recently even adopted a climate law that sets domestically binding emission targets through to 2050, making it the second such country worldwide after the UK.

While in principle binding targets contribute more to evolving towards an EU ETS-compatible cap-and-trade system, voluntary crediting systems also entail such an evolution as they also require strong MRV.

The economic efficiency of a system mostly depends on how the system is implemented domestically. All other things being equal (e.g. stringency of the target and political backing), a binding target may provide higher certainty to market actors than a non-binding target, which would lead to higher investor confidence and thus a more efficient allocation of resources. However, it is doubtful whether all other things would remain equal, irrespective of whether the target was binding or not binding.

On balance, it hardly seems possible to determine whether sectoral crediting or sectoral trading would be a better option to achieve the three priority criteria. Sectoral trading guarantees a certain environmental outcome but if there are penalties, countries may choose a less ambitious target than if there are no penalties. "Trading" targets entail a stronger evolution towards a cap-and-trade system, but "no-lose" targets also require strong MRV. The impact on economic efficiency depends on many other factors and may be negligible.

While this is not a priority criterion, from the perspective of developing countries the political feasibility of crediting can be assumed to be much higher than the feasibility of "trading". We therefore select sectoral crediting as the preferred option.

Coverage of the mechanism

a) Sector/activity boundaries

In Annex A we have identified three options for the sectoral coverage: covering an entire sector, covering all installations above a certain *de minimis* threshold, or covering only certain technologies or processes. The government crediting system proposed in this section envisages coverage of the entire sector based on aggregate data for the following reasons.

Annex A has argued that coverage should in principle be as wide as possible. It facilitates baseline determination since exceptional emission profiles of some installations would be levelled out and there would be no risk of intra-sectoral leakage. Having the entire sector included may also improve the economic efficiency of the sectoral mechanism since a wider range of mitigation options with variable abatement costs would be available. The government-level system therefore maximises environmental effectiveness and economic efficiency.

As regards evolution towards an EU ETS compatible cap-and-trade system, it has been argued in Chapter 2 that differing sectoral coverage is not a matter of institutional compatibility, nor does it affect the environmental effectiveness of linking trading schemes. A constellation where one or more gases or categories of sources are included in one scheme but not in the other, affects competitiveness and makes it hard to gain political support for linking. However, competitive disadvantages and possible discrimination due to diverging treatment of sectors in two trading regimes will be caused by the mere existence of the two systems, irrespective of whether they are linked or not.

b) Types of GHGs to cover

Annex A determined the following options for GHG coverage:

- Carbon dioxide (CO_2) only
- CO_2, methane (CH_4) and nitrous oxide (N_2O) only
- CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6)
- Selective GHG coverage based on the characteristics of the sector

We propose to initially focus on CO_2 and include other gases only if reliable data is available, possibly at a later date.

As discussed in Annex A, the greater the number of greenhouse gases included in the sectoral mechanism the higher the environmental effectiveness can potentially be. In addition, broad coverage may enhance economic efficiency as more and more diverse abatement options become available. However, depending on the gas and the sector, non-CO_2 gases may be more difficult to MRV than CO_2.

Tying GHG coverage to data availability and quality is therefore a pragmatic approach. Addressing only some GHGs also does not pose problems for the evolution towards an EU ETS-compatible cap-and-trade system.

c) Upstream versus downstream coverage

Not applicable as only the host country government receives emission credits.

Sector target or crediting threshold

a) Nature of target/threshold

Annex A identified three design options for the nature of the sector target or crediting threshold:

- Absolute emission baselines: the crediting baseline or trading threshold is set at an absolute level of GHG emissions for the sector.
- Indexed baselines: the emission level is set at a function of one or several economic or physical variables, such as GDP, tonne of output etc. Sometimes also called ‘intensity baselines’, in case it is based on one index.
- Technology diffusion baselines: the crediting threshold is defined at a certain level of technology diffusion, e.g. MW installed capacity, production or production share for renewable electricity.

The definition of technology could be very specific or generic. Emissions to be credited may be calculated using an emission factor.

The proposed government crediting system is based on indexed baselines for the following reasons. In Annex A, technology-based baselines have been argued to be the weakest option. Setting an appropriate baseline is very difficult for technology diffusion and always involves a degree of arbitrariness; for technologies in an early stage of development it is probably impossible. In addition there are substantial challenges with regard to setting appropriate emission factors to calculate the emission savings.

As discussed in Annex A, absolute and indexed baselines both have their pros and cons in terms of environmental impact. Indexed baselines on the one hand constitute an incentive to increase economic activity in order to generate more credits and hence are likely to lead to higher absolute emissions. On the other hand they pose a lower risk of over-crediting exactly because emission drivers are factored into the baseline.

A further argument for absolute baselines is that they provide for stronger evolution towards an EU ETS-compatible cap-and-trade system, as the EU ETS is based on absolute targets.

Based on the above considerations there is no clear-cut argument for either absolute or indexed baselines. We consider that the risk of over-crediting is the most important risk. As discussed in Annex A, there are many examples where actual economic activity has diverged substantially from what has been projected, including in the current trading phase of the EU ETS. We therefore recommend the use of indexed baselines.

b) Method for setting target/threshold

According to the decisions taken in Cancún and Durban, the new market mechanism should achieve a net decrease of global GHG emissions. The crediting threshold would therefore need to be set below the baseline. Annex A identified five different options for setting targets:

- ***Deviation from projected BAU emissions***. The mitigation baseline could be based on a politically agreed deviation from BAU emissions, expressed as a percentage deviation from BAU emissions (e.g. 20% below BAU emissions). This option requires projecting BAU emissions. It could be used for setting absolute and indexed baselines.
- ***Mitigation potential and costs***. The mitigation baseline could be based on the mitigation potential that should be achieved without using the crediting mechanism. The target could, for example, be set at the level of the no-regret potential in the sector or up to a certain cost level (e.g. 5 €/tCO_2). This option requires projecting BAU emissions and determining the mitigation potential and costs. It could be used for setting absolute and indexed baselines.
- ***Emission rate or benchmark.*** In some sectors, the mitigation baseline could be based on an emission rate or benchmark per output produced (e.g. 0.5 tCO_2 per kWh of power generated). In turn, this rate or benchmark could be based on a reference technology – for instance, a state-of-the-art technology or the commercially best available technology – or on a historical trend level, e.g. the average emission rate over a certain period corrected by a trend factor (i.e. an average reduction rate per annum). An emission rate or benchmark could particularly be used for setting indexed or relative mitigation baselines. In case of setting an absolute baseline, however, a projection of future output would be required in addition to the emission benchmark.
- ***Policy objectives scenario***. The mitigation baseline could be established based on policy objectives in the sector or country. For example, policy objectives for energy efficiency improvements or the penetration of renewable power generation could be used to derive the crediting baseline. Credits would then be issued for efforts that go beyond the established policy objectives. This option could be used for absolute and indexed baselines.

- ***Technology penetration scenario***. The mitigation baseline could be established based on a defined technology penetration scenario that goes beyond a BAU scenario. For example, a crediting baseline for the power sector could be derived based on a targeted portfolio of low-carbon power plant technologies added to the grid. This option requires projecting BAU emissions. It could be used for absolute, indexed and technology penetration baselines.

As assessed in Task 2, setting targets in terms of deviation from BAU or emission benchmarks seem to be the least problematic options. While posing risks of biased baseline setting, the other options have even higher risks and may even result in perverse policy incentives and punish early movers.

The disadvantage of using a projection of sectoral BAU emissions is that it involves the risk that the emissions projections may be deliberately inflated to increase the credit revenue stream. Emissions projections rely on many assumptions which are uncertain and difficult to validate in an objective manner such as sectoral growth rates, future energy prices, etc.

If the mitigation baseline is based on the potential and costs of sectoral GHG abatement options, the risk of a biased determination of the mitigation baseline is even greater. In this case, it is not only necessary to project BAU emissions but also to estimate the potential and costs of a variety of sectoral abatement options. Although this approach is conceptually sound, the results depend heavily on the data and methodological assumptions used, including assumptions on deployment rates and future costs of new mitigation technologies.

The use of policy objectives may result in perverse incentives: if policy objectives are not yet adopted in a country or sector this approach could discourage countries to adopt ambitious policy objectives, as adopting a less ambitious policy objective would provide higher revenues from the sale of carbon credits for the country. Similarly, one could argue that the use of policy objectives tends to punish early movers, i.e. countries that have adopted ambitious policy objectives already at an early stage, and to favour countries that have not yet adopted such objectives.

Using a technology penetration scenario to set a mitigation baseline has similar advantages and disadvantages as applying a policy objectives scenario. In addition, the challenge of setting ambitious but realistic and mutually acceptable targets may be even higher for individual technologies than for policies, while it runs the risk of ‘picking the winners’ and neglecting more cost-effective technologies.

By contrast, the application of an emission rate or benchmark appears notably attractive and feasible in homogeneous sectors with a limited number of clearly defined outputs, such as aluminium or cement. In addition, setting an emission benchmark on a reference technology or historical trend level seems be relatively straightforward and rather objective, i.e. technology- and fact-based. On the other hand, in heterogeneous sectors a benchmark has to be set for each type of activity, output or service. Many sectors, however, are characterised by a large variety of activities, outputs and services which are sometimes closely related or even co-produced. For these sectors, it may be rather cumbersome and administratively demanding to set a large number of benchmarks, which each covering only a limited amount of emissions. Moreover, even if the product or activity is well defined, its rate of emissions may still vary widely depending on the type of technology or process used, the type of installation (e.g. new versus existing plants), or – in the transport sector – the type of vehicle and mode of transport used.

Setting baselines is always a counterfactual exercise subject to substantial uncertainties, there is therefore no “first-best” solution. The use of benchmarks appears as the most objective option if the necessary data can be compiled at reasonable cost. If not, the use of BAU projections appears to be the next best option.

c) Interaction with other policies and measures

Chapter 2 identified two options regarding how to factor other policies and measures – including NAMAs – into the baseline:

- Factor all PAMs into the baseline, regardless when they have been agreed or implemented.
- Exclude PAMs after a certain date, e.g. when the UNFCCC adopts the modalities and procedures of the new market mechanisms.

As it would be up to the host country government to reduce sectoral emissions through policies and measures, the point of the mechanism would be to incentivise the government to introduce new climate-friendly policies and co-finance these policies. Existing policies up to a certain date should therefore be included in the baseline but new policies are to be seen as the "investments" that are to be rewarded with carbon revenue.

If industrialized countries want the developing country to make a higher effort from its own resources than is reflected by current policies, this demand may be difficult to resolve at the level of individual policies. It may be rather more straightforward to tackle this issue directly when setting the target or crediting threshold.

Operational/incentive framework

a) Operation/incentives at government/installation level

Chapter 2 identified the following options for domestic implementation of a sectoral scheme:

- The government receives credits/allowances and implements policies and measures (PAMs) to reduce emissions. These may be either mandatory "sticks" or voluntary "carrots".
- The government receives credits/allowances and defines individual targets for the installations within the sector. If an installation beats its target, it receives credits from the government. If not, there are no penalties.
- The government receives credits/allowances and defines binding installation-level emission targets, possibly forming the basis for a national emission trading system.
- The government defines binding installation-level targets, possibly as basis for an ETS, and in addition implements further PAMs to promote emission reductions.
- Instead of going through governments, sectoral crediting might also be established with a direct relation between the installations and the international authority. In this version, installations would receive credits directly from the international authority if they beat their installation-level crediting thresholds.

The proposed government crediting system envisages to account for emissions at an aggregate level. This could be implemented through a system based on government PAMs (the first of the above option). Alternatively, for the electricity, heat or transport sectors there could be an upstream emission trading system where targets are set for individual distributors of fossil fuels and these would receive trading units correspondingly. We propose a system based on PAMs.

Having an upstream emission trading system has the difficulty that there are only a few market participants: fossil fuel vendors. Domestic market liquidity would hence be low and in addition these actors only have limited options to reduce emissions; most options are located at the point of combustion or energy use. Therefore, a crediting system with non-binding targets would probably produce hardly any emission reductions as the credits would be issued to the fuel distributors, not the ones who would need to make the investments. The only direct option for fossil fuel vendors to influence downstream emissions is through fuel prices and it seems doubtful whether the prospect of receiving emission credits would be an incentive for fuel vendors to raise their prices, in particular in a competitive market.

If binding targets were imposed on fossil fuel vendors the environmental outcome would be fixed as they would be forced to raise fuel prices as much as necessary to achieve their targets. However, while this could be an effective and efficient approach for electricity generation, this may not be the case for transport and energy efficiency in buildings. Transport emissions are strongly determined by the density of settlements and what infrastructure is put in place, e.g. if there is effective public transport or not. The efficiency of vehicles by comparison only has a minor impact.

City planning and transport infrastructure investments usually are the responsibilities of governments. The proposed government-level system therefore envisages that the host country government introduces PAMs to reduce sectoral emissions and receives the corresponding carbon credits. If designed carefully, PAMs can be very effective and economically efficient in reducing emissions. In addition to transport, such a system could for example also be very suitable for countries with state-owned electricity generation monopolies. Where electricity generation is anyway controlled by the state and all revenues accrue to the government treasury, there may not be much advantage in crediting individual installations.

As the system would require sectoral emissions accounting with stringent MRV, it would provide for some evolution towards an EU ETS compatible cap-and-trade system compared to the current situation where only very limited emission accounting is required of developing countries. However, as emissions are accounted for at the aggregate rather than the installation level, it would not provide as much evolution towards cap-and-trade as an installation-based system.

b) Methodology for distributing credits

Not applicable as no trading units are issued to companies.

c) Temporal flexibility

The main issues with regards to the temporal flexibility of new carbon market mechanism relate to (i) the length of the trading/crediting period, including the start and end of this period, (ii) the frequency and other timing modalities of issuing and surrendering emission allowances/credits, and (iii) the provisions or rules concerning the banking and borrowing of trading/crediting units across different commitment periods.

A ‘no-lose’ crediting mechanism allows for multiple options in how and when to generate/issue credits:

1. ***Aggregate-no-lose***. Performance against the baseline is evaluated over the whole crediting period, implying that the net generation/issuance of credits depends on balancing surpluses of credits (i.e. annual emissions below baseline) in some years against deficits of credits (i.e. annual emissions above baseline) in other years.
2. ***Year*-by-*year no-lose***. Annual emissions below baseline lead to the generation and issuance of credits, while annual emissions above baseline are ignored.
3. ***No-lose until crediting starts***. This is an intermediate position between the two options outlined above in the sense that crediting will only start from the year in which annual emissions are below baseline, but will be aggregated together with the performance over the next years of the crediting period. This implies that annual emissions above baseline before this starting year will be ignored, but after this year will be included in order to determine the net amount of credits generated and issued over the period as a whole.

As assessed in Annex A, the three priority criteria constitute rather diverging requirements regarding temporal flexibility. The environmental effectiveness of a sectoral carbon market mechanism is likely to be highest or can be safeguarded best (i) when the mitigation baseline is set for, and regularly renewed after, relatively short crediting/trading periods as this gives the possibility to quickly correct potential baseline inflation, (ii) with aggregate no-lose crediting, and (iii) when borrowing is not allowed. By contrast, economic efficiency is most likely served best in case of (i) long, fixed crediting/trading periods over a certain number of years (not necessarily harmonized with commitment periods), and (ii) allowing both banking and borrowing.

Preparedness for evolution towards an EU ETS compatible cap-and-trade system is met best if crediting/trading periods of sectoral carbon market mechanisms are harmonized with both UNFCCC commitment periods and EU ETS trading periods, and if these mechanisms allow banking but not borrowing.

A further consideration is that the nature of some developing countries' participation in the international climate regime may change substantially after 2020. The time until 2020 should also be sufficient to establish robust sectoral inventories. Depending on when a country starts implementation of a sectoral mechanism, one may therefore consider to have one or two short crediting periods up to 2020 and longer ones thereafter.

As for which type of "no-lose" target to chose, "aggregate no-lose" may seem as the option with the highest environmental effectiveness. However, it implies that credits will only be received after several years. This increases uncertainty and may prevent actions that would be undertaken if crediting occurred annually. For instance, the host country government might be deterred from introducing PAMs that include the provision of financial incentives or from undertaking costly investments, e.g. in transport or energy infrastructure, as the government would need to pre-finance these measures for several years. We therefore recommend the use of year-on-year no-lose.

Requirements for data collection, monitoring and reporting

For market-based mechanisms where emissions are traded, environmental integrity is one of the most important criteria ('a tonne is a tonne'), and MRV can provide this credibility. National systems would therefore need to comply with standards developed by the international regulatory body. Principles and criteria that an MRV system should meet could include:

- Completeness: coverage of all emission sources and greenhouse gases
- Accuracy: low uncertainty and no systematic under or overestimation
- Conservativeness: in case of uncertainty it is better to underestimate emission reductions
- Materiality: only MRV those elements which significantly influence emission reduction outcome
- Consistency: data should be comparable over time and methodologies only updated if this improves accuracy, completeness or conservativeness
- Cost effectiveness: MRV should not lead to unreasonable high cost, and be balanced against accuracy
- Adjustability: methodology can be improved over time
- Transparency: possibility to check all data and calculations by third parties, and secondly maximise publicly available data

As outlined above, the proposed government crediting system envisages regular reporting by the host country government to the international regulatory body. The details depend on the design specifics, such as which sector is chosen. The proposed government crediting system envisages to account for emissions at an aggregate level. For example, for the electricity, heat or transport sectors this could be done on the basis of the carbon content of fossil fuels that are sold in the country rather than source by source. MRV may therefore take place on the basis of aggregate data such as national fuel statistics. However, some adjustments would be necessary depending on the chosen sectoral coverage. For instance, if land transport is to be covered, the emissions associated with the electricity used for trains and electric vehicles would need to be added to the emissions associated with transport fuels.

Governance

a) National governance

Even if no credits are to be issued to individual installations, substantial institutional capacity is needed in the host country to ensure environmental integrity and market functioning. The following functions would need to be fulfilled:

- Development of the scheme and international submission, including collection of sector-specific data, identification of mitigation potential and costs, development and planning of policies, measures and mechanisms to provide incentives for the sector to reduce emissions, and an evaluation of the potential emission reductions from these instruments;
- Verification of GHG amounts and system performance either by the agency itself or through external auditing. In the case of external auditing, the agency would be responsible for accreditation of third-party verifiers;
- Operation of a registry;
- Stakeholder involvement.

Chapter 2 identified three basic options for governing institutions:

- Governmental: Governance of the scheme may take place within a relevant ministry or government agency;
- Independent: An independent agency beyond governmental control may be tasked to govern the sectoral mechanism. Such an agency could be conceived similar to a central bank;
- Self-regulation: The actors within the sector themselves are responsible for governing the system.

Self-regulation would hardly be applicable in the proposed government crediting system, as it would be based on government PAMs rather than issuance of credits to companies.

Host country governments have an incentive to overstate baselines and understate actual emissions during the crediting period in order to maximize the amount of credits they may receive. In addition, management by the government would tend to be influenced by political motivations. Decisions that are based on such motivations would probably usually not be the most economically efficient ones. A completely independent entity similar to a central bank would probably be the least susceptible to such motivations and would hence probably provide for the most climate-friendly and economically efficient management. However, it can be expected that host country governments would want to keep management of a sectoral scheme under their control.

As for verification for GHG emissions, the proposed government crediting system envisages emissions accounting on the basis of aggregate data, such as government statistics. As the government data are anyway verified by the international regulatory body (see section on compliance framework and penalties below), there may not be a need for further external verification at the national level. In particular verification of government data by private verifiers may rather raise sovereignty concerns.

A registry is needed for the host country government to be able to receive credits and make transactions. However, as no credits are issued to individual installations, there might not be a need for a national registry. Instead, the host country government could be given an account in an international registry maintained by the international regulatory body. This would facilitate participation for countries who have only limited technical capacity.

b) International governance

Structuring the process for target approval and credit issuance has several sub-questions:

- Who is competent to assess and approve proposals and issuance of credits?
  - Approval may be done by a new regulatory body on its own, similar to how the CDM Executive Board approves projects.
  - Alternatively, sectoral proposals could be approved by the COP on the basis of the assessment by the regulatory body.
- How should the regulatory body be structured?
  - The new body could be structured similarly to the CDM Executive Board, that is, composed of political candidates that are nominated by the UNFCCC's regional groups and basically serve as volunteers.
  - Alternatively, one might envisage a full-time professional body.
- How should the assessment process be organised? Two basic options are conceivable for the assessment of sectoral proposals:
  - The CDM model, that is, assessment by private auditing companies.
  - The Annex I model, that is, an assessment by independent experts that is coordinated by the UNFCCC Secretariat.
  - Approval may also be granted at national level subject to the respect of all participation requirements and modalities for setting baselines and targets, with only a technical review undertaken at international level by some sort of International Expert Team designated by the COP.

Annex A has argued that to maximise environmental effectiveness and integrity decisions on sectoral schemes should be made by the regulatory body on its own authority rather than the COP. Having only a technical review without discussion of the level of ambition would probably lead to the weakest environmental outcome. The regulatory body should be composed of full-time professionals. As such a body would have a lower risk of political gaming than a body modelled on the CDM Executive Board, economic efficiency would probably also be enhanced together with environmental integrity.

As emissions would be accounted for at an aggregate level on the basis of sectoral emission inventories rather than source by source, verification could be done similar to the established system for reviewing Annex I reports under the Kyoto Protocol. Under the Kyoto Protocol, expert review teams (ERT) check Parties' initial reports and annual inventories to make sure they are complete, accurate and conform to the guidelines adopted by the CMP. The experts are drawn from a roster maintained by the Secretariat. Successful review of the initial report is precondition for being issued with AAUs and eligibility to participate in the flexible mechanisms. The annual inventory review is generally conducted as a desk review but there is at least one in-country visit for each Party during the commitment period. If the ERT finds any problems, it may recommend adjusting the data. If there is no agreement between the Party and the ERT, the Compliance Committee will intervene. In addition to recommending adjustments, the ERT may raise any apparent implementation problems with the Compliance Committee, triggering the compliance procedure as discussed in the following section.

Compliance framework and penalties

Chapter 2 identified three options for the international compliance framework: an approach modelled on the Kyoto Protocol, an approach modelled on the Montreal Protocol and arbitration.

If sectoral crediting is chosen there would be no penalties for missing targets, but nevertheless a compliance framework that ensures compliance with accounting and reporting obligations is crucial to ensuring environmental integrity. Due to its *ex post* focus and lack of facilitation arbitration appears the least suited to ensuring compliance with monitoring and reporting obligations. Merging elements of the Kyoto Protocol and Montreal Protocol systems may be the best option.

Of the three models, the Kyoto model embodies the most sophisticated assessment of monitoring and reporting obligations. Expert review teams conduct annual assessment of Parties' methodologies and data usage against the standards adopted by the CMP and non-compliance proceedings are triggered automatically if evidence of non-compliance is found. The Montreal model takes a less structured, more responsive approach. The implementation committee has worked with the secretariat to encourage Parties to improve and enhance their data, and has been important in making access to funding conditional upon compliance with reporting obligations. Together with helping to direct funding under the Protocol towards improved data collection and reporting, this has proved effective in improving compliance with reporting obligations. Unlike the Kyoto Protocol's compliance committee the implementation committee is only empowered to investigate compliance, seek an amicable solution and make recommendations. Substantive decisions on providing assistance or imposing punitive consequences lie with the MOP. Unlike under the Kyoto model, the MOP retains flexibility regarding its application of the consequences.

The Montreal model has arguably been more successful in operationalizing the facilitation function due to its flexibility with respect to process and application of consequences. On the other hand, the certainty of the Kyoto model arguably provides a greater deterrence effect. In consequence, an approach that provides greater flexibility to incorporate facilitation measures while as a last resort ensuring certain enforcement measures, if facilitation does not prove effective, may be a worthy compromise. This should incorporate periodic reviews of data and methodologies, expedited compliance procedures and a targeted combination of facilitation, enforcement, and Party engagement, potentially including providing conditional funding, in bringing Parties back to compliance.

The type of facilitative support available should be tailored to other design elements. In the case of the proposed government crediting system, where only the host county government would be active on carbon markets, facilitation could focus on establishing robust sectoral inventory systems.

While it is open to Parties to provide for financial penalties for non-compliance in compliance procedures, Parties to Kyoto and Montreal were reluctant to do so. On the other hand, the suspension of trading under both mechanisms has proven quite effective where a Party gains substantial economic benefits from such trade. Penalties under a sectoral trading mechanism could thus include suspension of the right to buy or sell credits internationally, though the inclusion of financial penalties may also be appropriate in cases where Parties do not have much to lose through suspension from trading.

Ways of managing the transition from CDM to new market mechanisms

Introducing a sectoral scheme in sector where CDM projects are taking place raises the question of how to the relationship between these two mechanisms. Available options are:

- **Option 1 – Carve out CDM projects from the sectoral boundary**
  - Option 1.1 Exclude existing CDM projects from coverage of the sectoral scheme but do not allow new projects in the sector
  - Option 1.2 Exclude existing CDM projects from coverage of the sectoral scheme and allow new projects in the sector, which would then also be excluded from the coverage of the sectoral scheme

- **Option 2 – Phase-out CDM in sector**
  - Option 2.1 Do not allow new projects but continue crediting of existing ones and deduct CERs from sectoral performance
  - Option 2.2 Stop crediting of existing projects after their current crediting period and deduct CERs from sectoral performance
  - Option 2.3 Stop crediting of existing projects immediately
- **Option 3 – Continue existing and allow new CDM projects and deduct CERs from sectoral performance**
- **Option 4 –Existing CDM projects are integrated into the sectoral scheme**
  The specifics would probably be very case-specific. For example, if industrial installations are credited based on a certain benchmark, the CDM benchmark might be adapted to the benchmark used in the sectoral scheme. Another thinkable example is that if a policy-based scheme in the electricity sector includes a renewables feed-in tariff, the FIT may be extended to existing CDM projects in lieu of getting CERs. Sub-options are:
  - Option 4.1 Integrate existing projects immediately.
  - Option 4.2 Integrate existing projects after their current crediting period.

All options where two crediting systems exist in parallel in the same sector may lead to double counting of emission reductions as well as shifting of production between the systems in order to maximize the amount of credits received, that is, intra-sectoral leakage. Phasing out the CDM immediately is hence generally the most favourable option from the environmental perspective.

However, the participants of existing CDM projects could probably mount legal challenges against phasing out the CDM immediately. In addition, dismantling the CDM may damage the confidence of the private sector in the carbon market's ability to create value for the long term.

A viable compromise may therefore be to allow crediting of existing projects until the end of their current crediting period and deduct the issued credits from the sectoral performance. Another option could be to fold the CDM projects into incentive schemes that are set up by the host country government to achieve the sectoral target, but to prevent legal challenges project participants would need to be given the option to stay with the CDM if they prefer.

Finance of the system

Establishing and operating a new market mechanism entails substantial administrative costs. In particular the upfront financing could be a barrier to participation in certain less developed countries. Financing options are:

- Financing from the host nation
- Financing from donor countries
- Financing from multilateral donors

Host country governments will likely not be able or willing to finance the establishment the system entirely from their own resources. But as all trading units would accrue to the host country government, once issuance of credits has started the government should be able to finance all on-going implementation costs from carbon revenues.

As for financing the international infrastructure, the most straightforward approach would probably be to charge fees for the approval of schemes and levy a share of proceeds on the issuance of units.

2.1.3 *Assessment of the Entire Package Against All Assessment Criteria*

Environmental effectiveness and integrity

The system envisages coverage of entire sectors, maximising the potential for environmental effectiveness and eliminating risks of intra-sectoral leakage. With a sectoral crediting system, whether the reduction potential is actually realised depends not only on the stringency of the target but also on whether the host country government is willing and able to introduce ambitious policies and measures to reduce emissions. This willingness would partly depend on whether the international carbon price is high enough to provide a meaningful incentive.

The carbon price signal would not be directly passed on to installation operators, but policies and measures can in principle also be very effective in inducing emission reductions. The system could be particularly effective for state-owned sectors, such as the power sector in many countries.

Accounting for emissions on the basis of aggregate data generally has a higher level of uncertainty than installation-level accounting. The aggregate-level accounting should therefore use conservative values for all relevant parameters such as fuel emission factors.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

As the system would require sectoral emissions accounting with stringent MRV, it would provide for some evolution towards an EU ETS compatible cap-and-trade system compared to the current situation where only very limited emission accounting is required of developing countries. However, as emissions are accounted for at the aggregate rather than the installation level, it would not provide as much evolution towards cap-and-trade as an installation-based system.

Economic efficiency

The broad coverage implies that a broad range of mitigation options is included in the system, which enhances economic efficiency. Annex A has argued that depending on which policies and measures the government introduces, static efficiency may be lower than in an installation-based crediting system but dynamic efficiency may be higher. If CO_2 pricing is the only instrument that is employed, investment decisions tend to be based on current technology prices. This disadvantages new technologies that are still at the beginning of their learning curve but may in the longer term become the cheapest options.

To safeguard environmental integrity, short crediting periods have been chosen, which reduces economic efficiency.

Political Feasibility

If at all, developing countries will probably opt for sectoral crediting rather than sectoral trading. Political feasibility is further enhanced by the proposal of using indexed targets instead of absolute targets. The political feasibility of national implementation will very much depend on which policies and measures the host country government introduces. If the government mainly uses voluntary “carrots” domestic political resistance can be expected to be much lower than if it uses mandatory “sticks”.

If many CDM projects are already on-going in the sector, there may be some political resistance from CDM business interests, even if existing projects may be continued until the end of their current crediting period.

The proposed international governance system of a full-time professional body that takes decisions independently from the COP would maximise environmental effectiveness and integrity but may not be politically feasible. Parties will probably prefer a body with elected members such as the CDM Executive Board.

Private sector participation/potential to mobilize private capital

As the system does not envisage the issuance of credits to individual installations, private businesses would not be directly exposed to the carbon price signal. The host country government would either force companies to invest through measures such as mandatory performance standards, or it would provide incentives to invest, or a mix of both. The mobilisation of private capital therefore depends on the host government's aptitude for designing effective policies. Some incentive schemes such as renewables feed-in tariffs haven proven very effective at quickly scaling up private investments.

Potential impacts on competitiveness of EU enterprises

The impacts would depend on which policies are pursued by the host country government. If the government mainly uses voluntary "carrots" such as financial incentives, this would tend to improve the competitive position of the covered companies. If the government mainly uses mandatory "sticks" such as performance standards, this would lead to higher costs for the covered companies and hence a negative impact on their competitiveness.

Low risk of perverse outcomes

Indexed targets have been chosen to minimise the risk of baseline inflation, but they entail an implicit incentive to increase production in order to maximise credit generation. Short crediting periods give the opportunity of frequent adjustment to minimise perverse outcomes.

Administrative feasibility (including transaction costs)

Overall, administrative requirements are relatively modest. As individual installations would not participate in the carbon market, administrative costs would be lower than in the case of installation-level crediting. Administrative efforts are also eased by accounting for emissions at an aggregate level, rather than monitoring emissions installation by installation. Challenges for the host country government can be further eased by having an international registry perform the necessary transaction functions. Efforts to implement policies and measures depend on which ones are chosen. Some policies such as banning outdated technology can achieve very considerable emission reductions at low transaction costs

Some proposals that are made to maximise environmental effectiveness entail higher administrative costs than the alternatives. Indexed targets entail higher administrative costs than absolute targets as the index needs to be monitored in addition to emissions and short crediting periods pose higher administrative costs than long ones.

2.1.4 Applicability to Sectors and Countries

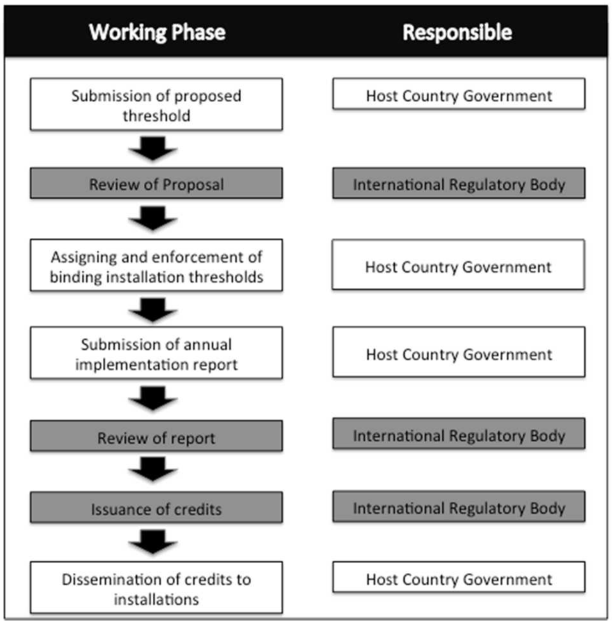
As emissions accounting is done on the basis of aggregate sectoral data, MRV requirements are much less onerous than for installation-based accounting. All that is needed is the capacity to have a robust sectoral inventory, which may be established on the basis of aggregate data such as fuel statistics, and to implement and enforce robust emission reduction policies. The design should therefore in principle be applicable to all countries and all sectors, though many countries would still require substantial capacity building to establish sectoral inventories and to help with policy design and implementation.

2.2 Proposal 2: Tradable Intensity Standard

2.2.1 Basic Design, Rationale and Mechanism Cycle

As opposed to Proposal 1, in this system, the sectoral crediting threshold would be devolved to the individual emission sources. That is, each emission source in the sector would be assigned an individual crediting threshold and would receive credits if it reduced emissions below the threshold.

To avoid the problem that the reductions at one installation may be offset by emission increases at another installation, we propose that the host country government should make the installation-level targets mandatory. The basic steps of the mechanism's cycle would hence be as follows:



- The host country government submits a proposed crediting threshold to the international regulatory body. This proposals needs to include at least a definition of the system boundary, a baseline projection, the proposed target, modalities for MRV and details on how installation-level targets will be determined and monitored.
- An international team of experts conducts a technical assessment of the proposal. On this basis, the international regulatory body reviews the proposal and approves it, requests changes or rejects it.
- Once the proposal has been approved, the host country government imposes binding targets on the sector's individual installations. Installations whose annual emissions are above the target will need to buy trading units to cover the shortfall whereas installations that reduce emissions below their targets are issued credits by the government. The government may complement the crediting system by further policies and measures to reduce emissions.
- The host country government submits regular, e.g. annual, implementation reports to the international regulatory body.
- The international body reviews the report and approves it, requests changes or rejects it.
- If the report is approved and emissions are below the target, the host country government receives credits. If emissions are above the target, there are no further consequences.
- The host country government passes the credits it has received on to the individual installations corresponding to their respective emission reductions.

The proposed system is rather similar to a full-fledged cap-and-trade system. However, to implement a cap-and-trade system the host country would need to adopt a binding target in order to be able to issue trading units to installations ex ante, or it would need to establish a separate domestic carbon currency. Under the proposal presented here, installations would be issued with internationally fungible carbon units. Issuance to the installations could hence only take place after the host country government has been issued credits. This means that there would be a certain time lag, but it is assumed that investors would prefer internationally fungible units over a domestic currency. In addition, if a domestic currency was used, the domestic market would need to have a minimum size in order to ensure sufficient liquidity, whereas with the use of international units the system would be connected to the international carbon market.

Installations that do not meet their targets would also need to surrender internationally fungible carbon units. The host country government would hence receive carbon units from two sources: the international regulatory body and the installations that do not meet their targets. The sum of those two is exactly equal to the amount of credits the government needs to issue to those installations that have successfully reduced their emissions.

The table below summarises the specific choices that were made for each individual design element that are different from the other two proposals. The following section goes into more detail on these design elements.

Table 25 Specific Design Elements of Proposal 2: Tradable Intensity Standard

#	Design element	Selection
1	**Crediting or trading**	Crediting is much more acceptable to most developing countries
2	**Coverage of the mechanism**	
	a) Sector/activity boundaries	All emitters above certain threshold in order to balance environmental impact and economic efficiency on the one hand and transaction costs on the other hand
	c) Upstream versus downstream coverage	Upstream or downstream, suitability depends on sector
4	**Operational/incentive framework**	
	a) Operation/incentives at government/installation level	Mandatory at installation level to directly expose emitters tofull carbon price signal and eliminate risk that emission reductions at some sources are offset by increases at other sources.
	b) Methodology for distributing credits	Benchmarking if possible with available data

2.2.1 Detailed Choice of Design Elements to Maximise Towards Priority Criteria

Crediting or trading

The considerations for Proposal 1 apply here as well: The proposed installation-based crediting system therefore envisages the use of sectoral crediting.

Coverage of the mechanism

a) Sector/activity boundaries

The proposed installation-based crediting system envisages the coverage of all emitters above a certain de minimis threshold. The threshold would be set by the host country government.

Maximising environmental impacts and economic efficiency both argue for having the broadest possible coverage. As discussed in Annex A, research has identified examples of countries and sectors where small installations are the most inefficient. However, covering all installations with a downstream approach would incur substantial transaction costs. Establishing a de minimis threshold may therefore strike a reasonable balance, depending on where the threshold is set in relation to the sectoral abatement cost curve.

As for compatibility with the EU ETS, it has been argued in Annex A that coverage is not a matter of institutional compatibility, nor does it affect the environmental effectiveness of a linked trading scheme.

b) Types of GHGs to cover

The considerations for Proposal 1 apply here as well: The proposed installation-based crediting system therefore envisages to initially focus on CO_2 and cover other gases only if reliable data is available, possibly at a later data.

c) Upstream versus downstream coverage

The terms ‘upstream’ versus ‘downstream’ coverage refer to the point of application of the GHG emissions reduction target in the production and consumption chain of an economy. An upstream system focuses on any point prior to the direct emissions source, i.e. the entities accountable for meeting the GHG emission reduction target are, e.g., the importers, producers or other suppliers of fossil energy or, in the transport or household sector, the manufacturers of cars or other products using fossil fuel. By contrast, in a downstream approach, the system applies to the end-users of fossil fuel energy, i.e. the actual, direct emitters of CO_2, and other, direct sources of GHGs. In addition to these two ‘pure’ systems, a third option is a hybrid approach in which some sectors or entities are covered upstream and other downstream.

Which approach is preferable strongly depends on which sector is supposed to be covered. Vendors of fossil fuels have only limited options to reduce emissions, most options are at the point of combustion. In addition, upstream coverage does not cover some end-of-pipe technologies such as carbon capture and storage. Downstream coverage is therefore preferable for sectors with large point sources, such as power and industry.

However, a country might also wish to cover the heat or transport sectors. In this case upstream coverage should be chosen to minimise transaction costs, e.g. by covering fossil fuel vendors. As the proposed system envisages binding installation-level targets, the upstream operators would need to raise their product prices in order to induce the buyers to reduce their emissions. The system would hence be essentially equivalent to a carbon tax.

Sector target or crediting threshold

a) Nature of target/threshold

The considerations for Proposal 1 apply here as well: The proposed installation-based crediting system therefore envisages the use of indexed targets.

b) Method for setting target/threshold

As assessed in Chapter 2, setting targets in terms of deviation from BAU or emission benchmarks seem to be the least problematic options. While posing risks of biased baseline setting, the other options have even higher risks and may even result in perverse policy incentives and punish early movers.

c) Interaction with other policies and measures

The considerations for Proposal 1 apply here as well: The proposed installation-based crediting system envisages to include PAMs that are introduced up to a certain date in the baseline but not new PAMs.

Operational/incentive framework

a) Operation/incentives at government/installation level

The proposed installation-based crediting system envisages to issue trading units to the individual installations in the sector. This would expose the installation operators to the full carbon price signal, providing for economic efficiency, and would also be a major step in evolving towards an EU ETS-compatible cap-and-trade system.

However, it may occur that some installations are successful in reducing emissions while others are not. Issuance to the individual installations must therefore be decoupled from the overall sectoral performance as otherwise companies would not have an incentive to invest. Chapter 2 discusses various options how this might be achieved, the most straightforward one would be to make the targets binding on the installation owners.

In addition, the host country government could complement the crediting system by further policies and measures to reduce sectoral emissions. It has been argued in chapter 2 that such a hybrid of emissions trading and government policies could potentially also achieve the best combination of static and dynamic efficiency, depending on the details of the policy package.

b) Methodology for distributing credits

Installation-level crediting thresholds may be determined on the basis of historic emissions or on the basis of benchmarks. The proposed installation-based crediting system envisages to use benchmarking if sufficient data can be made available.

The proposed installation-based crediting system envisages that installation-level targets should be binding. The way in which credits are distributed would hence have no impact on the environment since this is determined by where the targets are set. Approaches based on historic emissions have been widely criticized as they tend to privilege incumbent installations, which lowers economic efficiency. Approaches to distribute credits according to a standard not directly linked to historic emissions alleviates this problem.

However, benchmarking poses additional requirements for data gathering and analysis. Data need to be compiled and compared in detail in order to determine appropriate benchmarks. In addition, if a sector is very heterogeneous in terms of what technologies or processes are used, one benchmark may no be sufficient and several benchmarks would need to be established.

c) Temporal flexibility

The same considerations as in Proposal 1 apply, we therefore propose to use year-on-year on-lose targets and to have one or two short crediting periods up to 2020, depending on when implementation starts in a country, and longer ones thereafter.

Requirements for data collection, monitoring and reporting

General requirements are the same as discussed for Proposal 1, the detailed requirements very much depend on which sectors are supposed to be covered. These requirements would therefore probably be covered in sector-specific methodologies rather than the general modalities and procedures of the new market mechanism.

Governance

a) National governance

If credits are to be issued to individual installations, strong oversight is needed to ensure environmental integrity and market functioning. The same considerations as for Proposal 1 apply: A completely independent entity similar to a central bank would probably provide for the most climate-friendly and economically efficient management.

From an environmental integrity point of view it might also be recommendable to have the agency do the verification of installation emissions by itself. However, it can be expected that host country governments would want to keep management of a sectoral scheme under their control. In addition, due to lack of capacity most developing countries would probably need to rely on third-party verifiers. To maximise international transparency and consistency, it might be preferable if those verifiers were accredited by the international regulatory body. If accreditation is left to host country governments, it should be based on a uniform international accreditation standard.

A registry and transaction log are needed for the host country government to be able to receive credits and issue them to the installations, and for the installation operators to make transactions and surrender carbon units to the government in case they do not meet their targets. To facilitate participation for countries who have only limited technical capacity one may consider to have these functions performed by an international registry operated by the international regulatory body. On the other hand, the country would in any case need substantial technical capacity to determine installation-level targets and maintain sufficient oversight. Operating a national registry is mostly a question of IT capacity and hence may be the least of the host countries' problems in establishing an installation-level crediting system. Having the registry run by the country itself would also contribute to the country being able to maintain proper oversight and to the evolution towards an EU ETS-compatible cap-and-trade system. We therefore propose to use the international registry only as an interim step if at all, in the medium term countries should be enabled to operate their own registries.

b) International governance

The same considerations as in Proposal 1 apply. To maximise environmental effectiveness and integrity, decisions on sectoral schemes should be made by the international regulatory body on its own authority. The regulatory body should be composed of full-time professionals.

The operational framework (see above) foresees that the host country government would receive credits for the overall sectoral performance, who would then in turn issue credits to the individual installations. International monitoring and reporting could hence be restricted to the sectoral emission inventory; international verification could then be done similarly to the established system for reviewing Annex I inventories as discussed for Proposal 1.

Compliance framework and penalties

The same considerations as in Proposal 1 apply. If sectoral crediting is chosen, there would be no penalties for missing targets, but nevertheless a comprehensive compliance framework that incorporates compliance with accounting and reporting obligations is crucial to ensuring environmental integrity. Merging elements of the Kyoto Protocol and Montreal Protocol systems as discussed above for Proposal 1 may be the best option. As governments are to pass on binding targets to installations, facilitation could focus on helping governments build strong national systems for enforcing those obligations.

Ways of managing the transition from CDM to new market mechanisms

The same considerations as in Proposal 1 apply, we therefore propose to allow crediting of existing projects until the end of their current crediting period and deduct the credits from the sectoral performance.

Finance of the system

Host country governments would likely require start-up finance to establish the system. As all credits would first be issued to the government, it would be able to retain a share of them to finance all on-going implementation costs once crediting has started. Alternatively, it could issue all units but levy fees from the participants.

As for financing the international infrastructure, the same considerations as in Proposal 1 apply. The most straightforward approach would probably be to charge fees for the approval of schemes and levy a share of proceeds on the issuance of units.

2.2.2 Assessment of the Entire Package Against All Assessment Criteria

Environmental effectiveness and integrity

The system would cover all installations in a sector above a certain size, which provides for substantial coverage and hence gives a good potential for substantial emission reductions. However, as not the entire sector would be covered, there may be some risk of intra-sectoral leakage: as installations would be subject to binding targets, there would be an incentive to shift production to installations outside the system boundary (that is, installations that are below the size threshold and hence not covered by the system), which may be less efficient. The strength of this incentive would depend on the level of the carbon price and the overall cost structure of covered compared to non-covered installations. As the system would use intensity targets, the incentive would also depend on the carbon intensity of the individual facility: installations with a high emission intensity and high abatement costs would have an incentive to decrease their liability by shifting production whereas installations with low intensity and/or low abatement costs would on the contrary have an incentive to increase production in order to maximise credit generation.

Environmental effectiveness would strongly depend on the stringency of the target. As the sectoral target is proposed to be devolved to the individual installations in the form of binding targets, the environmental outcome would be assured unless the national compliance system was faulty.

Preparedness for evolution towards EU ETS compatible cap-and-trade system

Several design features would be relatively similar to the EU ETS. Binding targets would be imposed on all individual emitters above a certain threshold and there would be short crediting periods. On the other hand, indexed targets might not be compatible as they provide an implicit production subsidy. The net effect on companies' competitive position would depend on the stringency of the targets.

Economic efficiency

The relatively broad coverage means that a broad range of mitigation options will be available, which promotes economic efficiency. In addition, emitters would be directly exposed to the carbon price signal, which also promotes economic efficiency. If the government complements the crediting system with further policies and measures, this could enhance or weaken economic efficiency, depending on the details of the policy package. Economic efficiency is impaired by short crediting periods, which are nevertheless proposed to enhance environmental integrity.

Political Feasibility

While on balance sectoral trading may be more able to achieve the three priority criteria, the political acceptability of sectoral crediting for developing countries is probably much higher.

The proposal envisages to impose binding targets on the individual emitters, which would probably generate substantial political resistance domestically. Setting the de minimis threshold may also give rise to political controversy and complaints about unequal treatment of sources. The proposal to use indexed targets may alleviate such political resistance somewhat as there would be no risk that targets might become a "cap on growth".

If many CDM projects are already on-going in the sector, there may be some political resistance from CDM business interests, even if existing projects may be continued until the end of their current crediting period.

The proposed national governance system based on an independent body would maximise environmental effectiveness and economic efficiency but national governments will probably not be willing to give the management of the mechanism to an entity that is beyond their control.

Similarly, while the proposed international governance system of a full-time professional body that takes decisions independently from the COP would maximise environmental effectiveness and integrity, Parties will probably prefer a body with elected members such as the CDM Executive Board.

Private sector participation/potential to mobilize private capital

Private businesses would be directly involved in the carbon market. Depending on the carbon price, the proposal could therefore mobilise substantial private investment. In addition, as installation-targets would be mandatory, there would be no risk for investors that successful reductions at one installation could be offset by increased emissions at other installations. As noted in the introduction to this proposal, installations would be issued with internationally fungible carbon units, so not only domestic but also international market actors would have an incentive to participate in the system. Private sector participation is probably impaired by having short rather than long crediting periods, but short ones are nevertheless proposed to enhance environmental effectiveness.

Potential impacts on competitiveness of EU enterprises

Indexed targets entail an implicit subsidy for increasing production. The exact impact depends on companies' abatement costs vis-à-vis the carbon price. Companies with higher abatement costs would lose competitiveness while companies with cheap abatement potential would get a financial benefit and hence competitive advantage from the system.

If the host country government complements the crediting system with further policies and measures, these would also have an impact on competitiveness. If the government mainly uses voluntary "carrots" such as financial incentives, this would improve the competitive position of the covered companies. If the government mainly uses mandatory "sticks" such as performance standards, this could lead to higher costs for the covered companies and hence a negative impact on their competitiveness.

Low risk of perverse outcomes

Imposing mandatory targets on only a subset of installations provides an incentive to shift production to installations outside the sector boundary that may be less efficient. In addition, with indexed baselines there is an incentive for emitters to increase output in order to gain more credits. Short crediting periods give the opportunity of frequent adjustment to minimise perverse outcomes.

Administrative feasibility (including transaction costs)

Administrative requirements would be high. As individual installations would participate in the carbon market, installation-level data would need to be gathered to set the installation-level targets and MRV would also need to be conducted installation by installation. The proposal to have a de minimis threshold tries to strike a balance between environmental effectiveness on the one hand and administrative costs on the other.

Basing the baseline on BAU projections poses high administrative demands ex ante, but relatively low demands to determine and MRV reduced emissions ex post. Benchmarking poses low requirements for both setting baselines ex ante and determining/MRVing reduced emissions ex post in case of homogeneous, well-defined sectors, but poses relatively high requirements in more heterogeneous sectors with a large variety of products, technologies and installations.

Some proposals that are made to maximise environmental effectiveness entail higher administrative costs. Indexed targets entail higher administrative costs than absolute targets as the index needs to be monitored in addition to emissions and short crediting periods pose higher administrative costs than long ones.

2.2.3 Applicability to Sectors and Countries

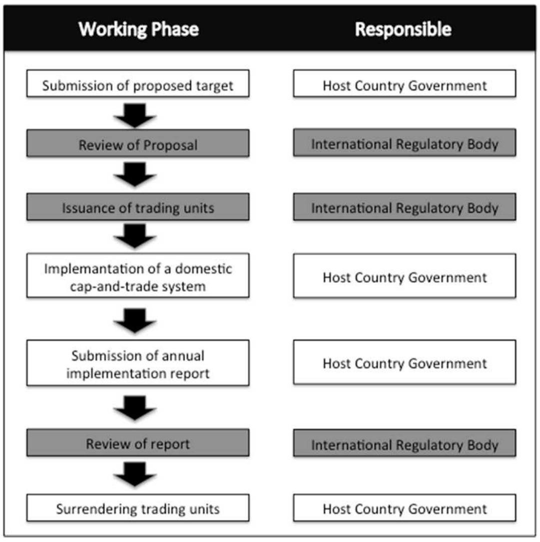
Installation-based crediting implies substantial transaction costs. It is therefore most suitable for sectors with large point sources, that is, the power and industry sectors. With upstream coverage it would also be applicable to heat and transport. But as discussed in Proposal 1, it is doubtful whether carbon pricing alone is a sufficient means to tackle transport emissions. Most developing countries will probably have substantial capacity constraints in implementing installation-level emissions accounting.

2.3 Proposal 3: Installation-Based Emission Trading System

2.3.1 Basic Design, Rationale and Mechanism Cycle

In this system, the host country government would adopt a "trading" target and introduce a domestic emission trading system.

The basic steps of the mechanism's cycle would hence be as follows:



- The host country government submits a proposed target to the international regulatory body. This proposals needs to include at least a definition of the system boundary, a baseline projection, the proposed target and modalities for MRV.
- An international team of experts conducts a technical assessment of the proposal. On this basis, the international regulatory body reviews the proposal and approves it, requests changes or rejects it.
- Once the proposal has been approved, the regulatory body issues trading units to the host country government.
- The host country government implements a domestic emission trading system.
- The host country government submits regular, e.g. annual, implementation reports to the international regulatory body.
- The international body reviews the report and approves it, requests changes or rejects it.
- Once the report is approved, the host country government needs to surrender trading units corresponding to the total sectoral emissions.

The domestic emission trading system might be based on the trading units that are issued to the host country government or the government might create a domestic currency. In the latter case, however, the domestic market would need to have a minimum size in order to ensure sufficient liquidity.

Naturally, governments might also introduce domestic emission trading systems before seeking international approval. However, in such a situation the domestic regulations might not be in line with the international requirements for participation in the new market mechanism. Such a situation might therefore not fall under the new market mechanism but rather be governed by the "framework for various approaches" that may be developed in parallel to the new market mechanism according to the decisions taken in Durban.

The table below summarises the specific choices that were made for each individual design element. The following section goes into more detail on each individual design element and why which respective option was chosen in order to maximise the design towards the three priority criteria: environmental effectiveness and integrity, preparedness for evolution towards an EU ETS compatible cap-and-trade system and economic efficiency.

Table 26 Specific Design Elements of Proposal 3: Installation-Based Emission Trading System

#	Design element	Selection
1	**Crediting or trading**	Trading to explore range of options as other proposals are based on crediting

#	Design element	Selection
2	**Coverage of the mechanism**	
	a) Sector/activity boundaries	All emitters above certain threshold to balance environmental effectiveness and economic efficiency with transaction costs
	c) Upstream versus downstream coverage	Upstream or downstream, suitability depends on sector
4	**Operational/incentive framework**	
	a) Operation/incentives at government/installation level	Mandatory at installation level to directly expose emitters to full carbon price signal and eliminate risk that emission reductions at some sources are offset by increases at other sources.
	b) Methodology for distributing trading units	Preferably auctioning to minimise distortions, otherwise benchmarking

2.3.2 *Detailed Choice of Design Elements to Maximise Towards Priority Criteria*

Crediting or trading

As discussed for Proposals 1 and 2, it hardly seems possible to determine whether sectoral crediting or sectoral trading would be a better option to achieve the three priority criteria. As Proposals 1 and 2 are based on sectoral crediting, Proposal 3 is based on sectoral trading to explore the whole range of approaches that may be possible.

Coverage of the mechanism

a) Sector/activity boundaries

The same considerations as for Proposal 2 apply, the proposed installation-based trading system therefore envisages the coverage of all emitters above a certain de minimis threshold.

b) Types of GHGs to cover

The same considerations as for Proposals 1 and 2 apply, the proposed installation-based trading system therefore envisages to initially focus on CO_2 and cover other gases only if reliable data is available, possibly at a later data.

c) Upstream versus downstream coverage

The same considerations as for Proposal 2 apply, which approach is preferable strongly depends on which sector is supposed to be covered. Downstream coverage is preferable for sectors with large point sources, such as power and industry, while upstream coverage is preferable for sectors with many small emission sources such as buildings or transport.

Sector target or crediting threshold

a) Nature of target/threshold

The same considerations as in Proposals 1 and 2 apply, the proposed installation-based trading system therefore envisages the use of indexed targets..

b) Method for setting target/threshold

The same considerations as in Proposals 1 and 2 apply, setting targets in terms of deviation from BAU or emission benchmarks seem to be the least problematic options.

c) Interaction with other policies and measures

The same considerations as in Proposals 1 and 2 apply, zhe proposed installation-based trading system therefore envisages to include PAMs that are introduced up to a certain date in the target but not new PAMs.

Operational/incentive framework

a) Operation/incentives at government/installation level

The same considerations as in Proposal 2 apply. The proposed installation-based trading system envisages to issue trading units to the individual installations in the sector. This would expose the installation operators to the full carbon price signal, providing for economic efficiency, and would also be a major step in evolving towards an EU ETS-compatible emission trading system. As the targets would be binding, there would be no risk for investors that good performance of their own installations could be offset by bad performance of others.

In addition, the host country government could complement the trading system by further policies and measures to reduce sectoral emissions. It has been argued in chapter 2 that such a hybrid of emissions trading and government policies could potentially also achieve the best combination of static and dynamic efficiency, depending on the details of the policy package.

b) Methodology for distributing trading units

In an emission trading system, there are two basic options for allocating trading units, auctioning or free distribution. Free distribution schemes can be based either on past GHG emissions (“grandfathering”) or on benchmarks. As assessed in chapter 2, auctioning is the best option, benchmarking the second-best and grandfathering the third-best.

Grandfathering has been widely criticized in the past, as it tends to privilege large installations with high GHG emissions. Approaches to distribute allowances according to a standard not directly linked to historic emissions may alleviate this problem somewhat. If a benchmark is used to compare reductions achieved to set targets, a robust inventory system is needed in order to correctly determine the amount of credits used.

However, critics have claimed that free allocation in the EU ETS has generally led to windfall profits for utilities. Auctioning off allowances is more economically efficient as it creates a source of income for the issuing government from the start, while at the same time creating a higher incentive to make use of existing resources and circumventing controversies of free allocation methods. However, as initial costs for participants may be high, a system may transition from free allowances to partial or full auctioning, as is the case with the EU ETS.

c) Temporal flexibility

The same considerations as in Proposals 1 and 2 apply: In order to minimise risks of baseline inflation and taking into consideration that the nature of some developing countries’ participation in the international climate regime may change substantially after 2020, we propose to have one or two short trading periods up to 2020, depending on when implementation starts in a country, and longer ones thereafter. To further safeguard environmental integrity, issuance and compliance assessment should be on an annual basis.

Requirements for data collection, monitoring and reporting

General requirements are the same as discussed for Proposal 1, the detailed requirements very much depend on which sectors are supposed to be covered. These requirements would therefore probably be covered in sector-specific methodologies rather than the general modalities and procedures of the new market mechanism.

Governance

a) National governance

The same considerations as in Proposals 1 and 2 apply. A completely independent entity similar to a central bank would probably provide for the most climate-friendly and economically efficient management. From an environmental integrity point of view it might also be recommendable to have the agency do the verification of installation emissions by itself.

However, it can be expected that host country governments would want to keep management of a sectoral scheme under their control. In addition, due to lack of capacity most developing countries would probably need to rely on third-party verifiers. To maximise international transparency and consistency, it might be preferable if those verifiers were accredited by the international regulatory body. If accreditation is left to host country governments, it should be based on a uniform international accreditation standard.

As for the registry, as in Proposal 2 we propose to use the international registry only as an interim step if at all, in the medium term countries should be enabled to operate their own registries.

b) International governance

The same considerations as in Proposals 1 and 2 apply: To maximise environmental effectiveness and integrity, decisions on sectoral schemes should be made by the international regulatory body on its own authority. The regulatory body should be composed of full-time professionals.

The operational framework (see above) foresees that the host country government would receive trading units ex ante, who would then in turn issue trading units to the individual installations. International monitoring and reporting could hence be restricted to the sectoral emission inventory; international verification could then be done similarly to the established system for reviewing Annex I inventories as discussed for Proposal 1.

Compliance framework and penalties

Similar considerations as in Proposals 1 and 2 apply: Merging elements of the Kyoto Protocol and Montreal Protocol systems as discussed above for Proposal 1 may be the best option. In addition, as the system is based on sectoral trading, there would be consequences if the host country does not submit sufficient carbon units to cover sectoral emissions. The most straightforward approach may be to use the same system as in the Kyoto Protocol, that is, a multiplier of 1.3 for each tonne of excess emissions, to be delivered in the next trading period.

Ways of managing the transition from CDM to new market mechanisms

The same considerations as in Proposals 1 and 2 apply. Phasing out the CDM immediately is generally the most favourable option from the environmental perspective but the participants of existing CDM projects could probably mount challenges against such an approach. A viable compromise may therefore be to allow crediting of existing projects until the end of their current crediting period and deduct the credits from the sectoral performance.

Finance of the system

Host country governments would likely require start-up finance to establish the system. As all trading units would be issued to the government ex ante, it would be able to retain a share of them to finance all ongoing implementation costs. Alternatively, it could issue all units but levy fees from the participants.

As for financing the international infrastructure, the same considerations as in Proposal 1 apply. The most straightforward approach would probably be to charge fees for the approval of schemes and levy a share of proceeds on the issuance of units.

2.3.3 Assessment of the Entire Package Against All Assessment Criteria

The strengths and weaknesses of this proposal are very similar to those of Proposal 2, as in both systems binding targets would be imposed on emitters. The main differences are:

- The host country government adopts a “trading” target. This may provide a somewhat greater assurance that the installation targets will actually be enforced as otherwise the government would need to offset excess emissions by itself.
- By the same token, however, the willingness of developing countries to choose the “trading” route is probably much lower than their willingness to choose the crediting route. The political feasibility of Proposal 3 is therefore probably much lower than of Proposal 2.
- Emission units are issued ex ante, which facilitates private sector participation. As units are issued ex ante, they could be traded under standardised contracts. This would probably result in exchange-based trading, which would further facilitate operation of the mechanism. Entities could manage their allowances as assets and sell them whenever they liked, rather than having to wait for the ex-post assessment of their performance.

2.3.4 Applicability to Sectors and Countries

The applicability is similar to Proposal 2: Proposal 3 is most suitable for sectors with large point sources, that is, the power and industry sectors. Most developing countries will probably have substantial capacity constraints in implementing installation-level emissions accounting.

3 Annex C: Emission Reduction Potential of the NMM in different Case Studies

In this Annex we present the case studies in which the emission reduction potential of a New Market Mechanism is assessed in five different sectors in different countries.

This Annex provides insight in the impact sector-wide market mechanism could have in developing countries. This is provided in five case studies: combinations of countries and sectors in which the impact of the New Market Mechanism (NMM) is assessed in a number of scenarios with different ways of defining emission targets.

For information on the emissions in a sector, production figures, forecasts on production and emission growth we had to consult different sources. These sources were not always consistent and sometimes even contradictory. As a result, the case studies show the conditions in which an NMM could work and the 'readiness' of specific sectors for participation in an NMM and the order of magnitude of the reduction potential. To determine the emission reduction potential more accurately, define a reasonable emission cap level or present an equitable or fair business as usual emission scenario, more research is needed, for example, to ensure that the data used from different sources all refer to the same installations or activities.

The following five countries and sectors were selected by the consultants and DG Climate Action, key criteria being a geographical spread and variety of sectors as well as data availability. The sectors selected are: steel in Brazil, power in Chile or, refineries in Indonesia, power in South-Africa and cement in Vietnam.

In the next sections, the full five case studies will be presented of which an overall summary (Chapter 5) is included in the Draft Final Report.

Table 27 Selected case studies for Task 4

Country	Shortlisted sector	Justification of choice	Data Availability
Brazil	Steel	• Brazil's National Climate Change Policy (PNMC) plans to target the iron and steel industry, with an estimated emissions reduction potential of 8 – 10 million tonnes CO_2e in 2020. • The iron and steel sector accounts for 58% of emissions from the industrial processes sector	• Abatement costs and potential curves available[6] • There are 5 CDM heat recovery projects in the Brazilian steel sector. • There are two CDM coke oven projects in Brazil.

6 McKinsey & Company (2010) Pathways to a low carbon economy for Brazil; World Bank (2010) ENERGIA: Low Carbon Emissions Scenario in Brazil

Country	Shortlisted sector	Justification of choice	Data Availability
Chile	Electricity generation	• Largest emissions sector (23.5 $MtCO_2e$; 15 % of national GHG emissions) • High priority sector in Chile's climate change strategy • Large emissions growth is expected from this sector[7,8]	• Marginal abatement cost curve available for Chile's energy sector, with additional details[9] • There are 83 CDM projects in the power sector in Chile, of which 61 hydropower, 15 wind and 6 solar PV, 1 geothermal and one fuel switch.
South Africa	Power	• The total abatement potential in the South African power sector is estimated at 10 $MtCO_2e$. • Most of the abatement potential is financially viable. • The power sector is largely coal based.	• Abatement costs available for the power sector in South Africa.[10] • South Africa has 22 CDM projects in the power sector, all renewables.
Vietnam	Cement	• Cement sector has significant untapped emission reduction potential; • Is a nationally recognised priority area for mitigation action; • Is one of the most energy intensive industries in Vietnam, with demand for cement increasing by 10% annually.	• Abatement costs available for Vietnam's cement sector[11] • Vietnam has one CDM waste heat recovery project in the cement sector.
Indonesia	Refineries	• Emissions from Indonesian refineries are expected to increase from 91 to 114 to 124 $MtCO_2e$ from resp. 2005 to 2020 to 2030.[12] • Most of the abatement potential in the oil and gas sector is in the processing.	• Abatement costs available for Indonesia's downstream oil and gas processing.[8] • Indonesia has one CDM project in an LPG plant.

7 Chile (2011) Template for Organizing Framework for Scoping of PMR activities. Available at: http://wbcarbonfinance.org/Router.cfm?Page=PMR&FID=61218&ItemID=61218&ft=DocLib&ht=63206&dtype=63207&dl=0

8 http://www.energycommunity.org/documents/Aplicacion%20de%20LEAP%20en%20Chile,%202010.pdf, pg 41

9 PROGEA (2009) Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile, 2007 – 2030.

10 ECN (2007) GHG Marginal Abatement Cost curves for the Non-Annex I region

11 Tatrallyay & Stadelmann (2011). *Country Case Study Vietnam – Removing barriers for climate change mitigation*. University of Zürich.

12 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).

3.1 Case Study 1: Brazil – Steel Sector

Brazil, the steel sector at a Glance			
Number of installations in the country	29 mills	**Absolute emissions**	57.2 $MtCO_2e$
Number of companies	14 private companies (controlled by 11 business groups)	**Percentage of national emissions**	45%
Number of CDM projects in pipeline	5 (heat recovery projects)	**Estimated emission growth**	120% per year till 2030
Emissions reduction potential	Up to 26 $MtCO_2e$/year in 2012-2020	**Emissions intensity in 2011**	1.17 tCO_2e/t steel output
Carbon leakage potential	Minimal given EU experience and generally high competitiveness of Brazilian steel makers.	**Emission intensity of the steel sector in the EU**	Less than 1 tCO_2e/t steel output
Sector boundaries	Mills that produce (crude) steel and pig iron from coke and iron ore with a capacity exceeding 2.5 tonnes per hour.	**Typical abatement measures**	Energy efficiency measures Use of charcoal as a reducing agent over coal Increased use of recycled steel Carbon capture and storage

3.1.1 Description of the Sector

The Brazilian steel sector produces (crude) steel and pig iron from coke and iron ore. In 2011, Brazil was the 9th largest producer of steel globally with a production of 35.2 Mt crude steel, which also makes it the largest steel producer in Latin America[13]. The total quantity of steel produced in Brazil has steadily increased by 52% between 1990 and 2005. The country has 29 operational mills with a mix of integrated (from iron ore) and semi-integrated installations (from processing pig iron and scrap).

The current mills are managed by fourteen private companies[14]. Brazil's steel sector was privatized in 1993, leading to the aggregation of steel companies under eleven industrial and financial groups. In 2009, three of such groups were responsible for 61% of the nation's steel production.

3.1.2 Trends in Production and Emissions

Greenhouse gas emissions originating from the steel sector result primarily from the combustion of fossil fuels in the melting process. In 2009, the energy consumption of Brazil's steel sector reached approximately 480 million GJ. From the energy consumption coal was responsible for 60% of energy used in steel production, 11% from petroleum coke, 8% from natural gas, 7% from charcoal, 7% from electricity from the grid, 4% from electricity generated on-site and 2% from coke. More

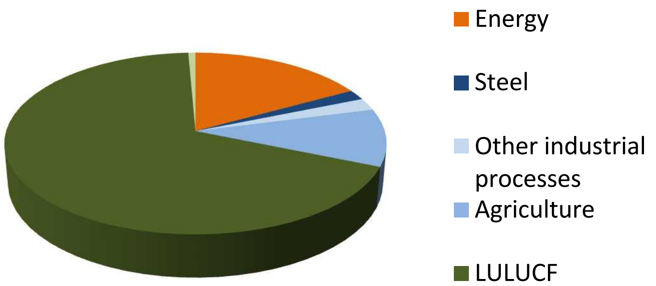
[13] Brazil Steel Institute, <http://www.acobrasil.org.br>, accessed 9 May 2012.

[14] ArcelorMittal Brasil (including ArcelorMittal Acos Longos, ArcelorMittal Inox Brasil and ArcelorMittal Tubarao), CSN, Gerdau (including Acos Villares, Gerdau Acominas, Gerdau Acos Especiais, Gerdau Acos Longos), Thyssenkrupp CSA Siderurgica do Atlantico, Siderurgica Norte Brasil SINOBRAS, Usiminas, V&M do Brasil, Villares Metals and Votorantim Siderurgia.

than half of the steel installations have cogeneration units, generating 5.2 million MWh of electricity in 2009.[15]

Brazil's latest National Communication estimates the country's 2005 greenhouse gas emissions at 1.8 Gt CO_2e. Of these emissions 68% were from land use and forestry (Figure 4).

Figure 4 Brazil's national emissions

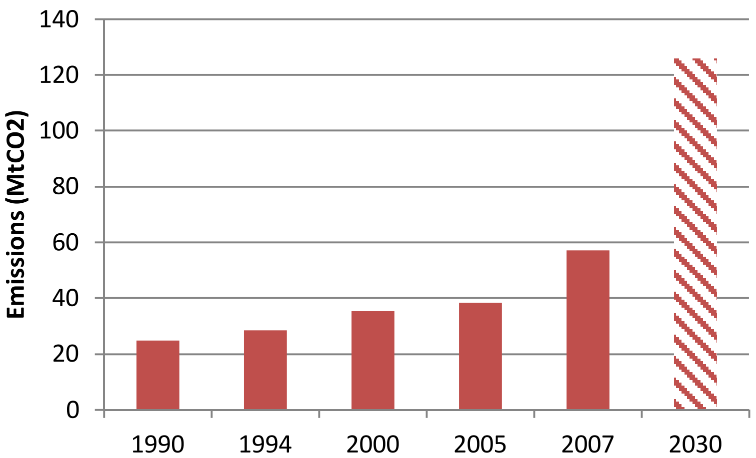


The iron and steel sector in Brazil accounted for 45% of the total CO_2 emissions in the industrial processes sector, or 57.2 $MtCO_2$ in 2007.[16] These emissions are the result of high consumption levels of both fossils fuels and non-renewable biomass. Brazilian steel mills obtain around 60% of their energy from coal, most of which is imported.

According to the Brazilian Steel Institute's sustainability report, all steel installations have been reporting on their CO_2 emissions since 2009, based on a methodology developed by the World Steel Association[17].

Up to 70% of the CO_2 emissions from steel manufacturing occur during production of pig iron in the blast furnace and the iron ore reduction process. The remaining 30% results from the transportation of raw materials and the generation of electric energy and heat.

Figure 5 Historical emissions from Brazil's steel sector



15 Instituto ACO Brasil (2010) Relatorio de Sustentabiladade, page 35

16 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 96, available on: <http://documents.worldbank.org/curated/en/2010/01/13720908/energia-low-carbon-emissions-scenario-brazil-synthesis-report>.*

17 Instituto ACO Brasil (2010) Relatorio de Sustentabiladade, page 38

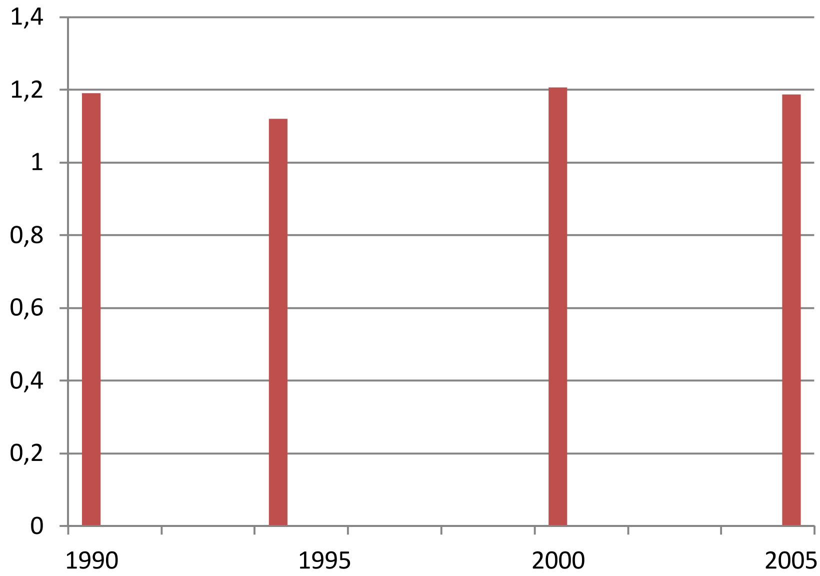
The production capacity is expected to reach some 95 Mt (a tripling from today's capacity) by 2030, driven by Brazil's own development and the export of semi-finished goods following the 'Pathways to a Low-Carbon Economy in Brazil' study of McKinsey & Company (hereafter "McKinsey"). Overall, McKinsey estimates that the production of steel will increase by 4.6% per year between 2005-2030.[18] Moreover, the sector's emissions would reach about 126 $MtCO_2$ per year by 2030 in the base case.[19] The base case is based on the expectation that the production of pig iron will increases to 80 Mt/year in 2030, that the current energy mix is maintained and that no mitigation action is taken.

Brazil's Steel Institute (BSI) adjusted the growth expectations downwards since the sector suffered from the economic crisis and high prices for raw materials. The sector's profitability became under pressure due to the high raw material prices in 2011. Many steel companies are trying to cut operational costs and do not expect to expand the production capacity in the near term.[20] According to the BSI, investments are expected to be lower than in previous years[21].

3.1.3 Carbon Intensity

In 2009 the Brazilian steel sector consumed 18 GJ of energy per ton of steel produced[22]. Since 1990 the absolute CO_2 emissions in the steel sector in Brazil have grown to reach almost 40 $MtCO_2e$ in 2005 (Figure 5). The emissions intensity of the sector per unit of output, however, has remained fairly stable since 1990 at an estimated 1.17 tCO_2e per tonnes of steel produced (Figure 6)[23].

Figure 6 Amount of CO_2 produced per unit of steel



18 McKinsey & Company, *Pathways to a Low-Carbon Economy for Brazil*, p. 9.

19 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 96,*

20 http://emergingmoney.com/stocks/analysts-say-steel-in-brazil-doomed-by-global-economy-ggb-mt-sid-usnzy/; http://www.marketwatch.com/story/brazil-steel-industry-almost-at-crisis-analyst-2011-06-28

21 Brazil Steel Institute, *Brazil Steel News,* December 2011, available on : <http://www.acobrasil.org.br/site/portugues/biblioteca/pdf/public/acobrasilinformaingles16.pdf>.

22 Instituto ACO Brasil (2010) Relatorio de Sustentabiladade, page 34

23 Based on reported steel production quantities and emissions from the sector as reported in Brazil's 2010 National Communication.

To put these figures in perspective: in 2007 and 2008 the average world steel carbon intensity was 1.8 tonnes of CO_2 per tonne of steel[24]. In 2005 the European average carbon intensity was less than one tonne.[25]

3.1.4 *Policies and Measures*

Brazil formulated sectoral emission reduction targets in its national pledges after the COP-15 in Copenhagen. The vast majority of emission reductions are in the land-use sector. For example, for reducing deforestation in the Amazon Brazil estimates that voluntary mitigation action can reduce emissions with 564 $MtCO_2e$ in 2020. Targets that refer to measures that affect the steel sector include:

- Iron & Steel (replace coal from deforestation with charcoal from planted forests) 8-10 $MtCO_2e$ by 2020,
- Energy efficiency 12-15 $MtCO_2e$ by 2020,
- Alternative energy sources 26-33 $MtCO_2e$ by 2020[26].

Furthermore, Brazil is developing plans for ETS implementation in certain states and sectors. However, these developments are in a stage too early to determine whether this ETS will make use of the targets specified above.

The steel sector is listed as a target sector for mitigation actions in Brazil's National Communication,[27] Partnership for Market Readiness submissions and National Plan on Climate Change[28]. Mitigation actions in this sector focus on the use of charcoal as an iron ore reducing agent in the production of steel.

Charcoal, if derived from renewable biomass, has lower carbon intensity than the conventional cokes. The Brazilian government supports the planting of 'energy forests' intended for use in charcoal production through offering fiscal incentives. This has been promoted since the 1960s, with various degrees of success. The privatisation of the sector in 1994 lead to the closure or conversion of many charcoal furnaces to coke furnaces since coal prices were lower. In addition, almost half of the charcoal supplied to the Brazilian market was obtained from non-renewable wood stocks.[29] Enforcing legislation to reduce illegal logging for charcoal has traditionally lead to an increased uptake of coal as a reducing agent due to the sudden reduced quantities of charcoal available, leading to a complex feedback loop with limited impacts on reducing greenhouse gas emissions.

3.1.5 *Abatement Potential*

McKinsey[30] estimated the abatement potential of the steel sector in Brazil at 50 $MtCO_2e$ by 2030. Almost half of this potential would occur with the employment of carbon capture and storage (CCS) technologies. Opportunities to reduce steel plant emissions include:

- Improvements in the energy efficiency of the production process;

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[24] See: <http://www.worldsteel.org/steel-by-topic/sustainable-steel/environmental/climate-change.html>.

[25] Peterson Institute for International Economics (World Resources Institute), *Levelling the carbon playing field,* May 2008, p. 47, available on: <http://pdf.wri.org/leveling_the_carbon_playing_field.pdf>.

[26] Submission from Brazil under Appendix II of the Copenhagen accords on Nationally Appropriate Mitigation Actions, 29 January 2010.

[27] Federative Republic of Brazil (2010) Second National Communication of Brazil to the United Nations Framework Convention on Climate Change, page 319

[28] Brazil (2008) National Plan on Climate Change

[29] Federative Republic of Brazil (2010) Second National Communication of Brazil to the United Nations Framework Convention on Climate Change, page 320

[30] McKinsey & Company, *Pathways to a Low-Carbon Economy for Brazil*, p. 9.

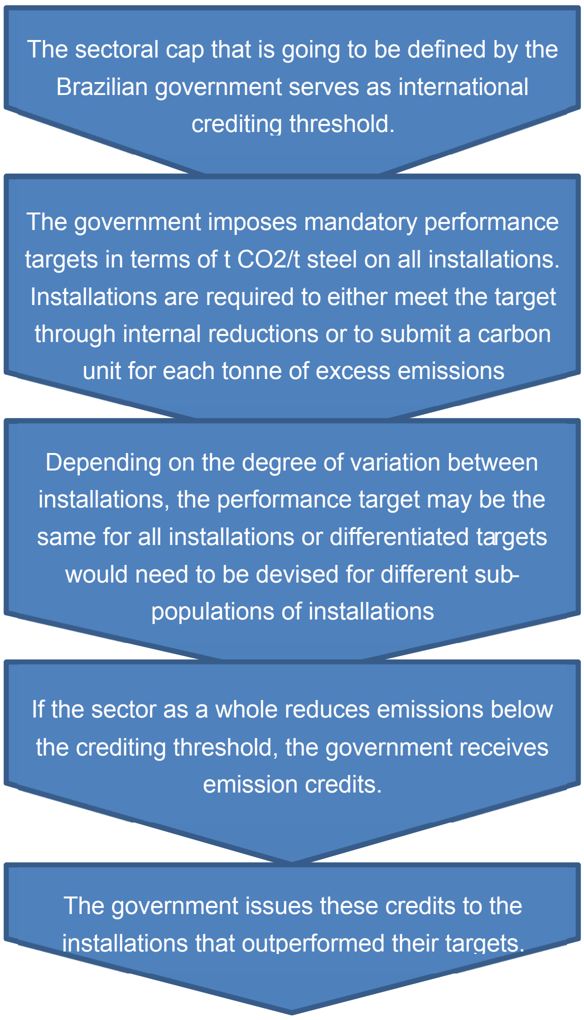
- The use of renewable energy sources (such as replacing coke with charcoal from replanted forests);
- Carbon capture and storage (CCS)[31].

However, CCS remains a high cost abatement measure and given its premature state of development it is unlikely that it will be deployed at wide scale up to 2020.

Table 28 Marginal abatement costs potential in 2030.[32]

Measure	Cost (EUR/tonne)	Potential in 2030
Increased energy efficiency, new	-60	7
Coke substitution, new	-5	2
Coke substitution, retrofit	-5	1
More efficient machinery and processes	20	13
CCS, new	40	12
CCS, retrofit	60	10
More efficient facilities and technologies	63	5

Energy efficiency measures are most cost effective. Examples include the use of cogeneration facilities in new plants to generate electricity, improved preventive maintenance, optimized process flows (management, logistics, IT), improved heat-recovery, pre-heating scrap and laser-based scrap analysis. Electric arc furnaces in the region will be encouraged to utilize pig iron produced from charcoal up to the technically feasible limit, so that more scrap can be used by integrated mills and thus requiring less coal. All these measures (listed in Table 28 but excluding CCS) would cost EUR 4 on average and would save some 28 $MtCO_2e$ per year. Furthermore, CCS opportunities would cost EUR 46 per tCO_2e on average and save some 22 $MtCO_2e$. This total of 50 $MtCO_2e$ abatement potential would reduce 2030 base case emissions by 38%.[33]



The increased use of charcoal to replace coal in steel plants "mainly through the encouragement of forestation in degraded areas" is stated as a key mitigation action in Brazil's 2007 National Plan on Climate Change[34]. Another option is to enforce legal restrictions on the use of this non-renewable source in the steelmaking sector, in parallel with increasing planted forests to ensure that the supply

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31 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*. Pg 16
32 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*.
33 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*.
34 National Plan on Climate Change – Brazil, Interministerial Committee on Climate Change, Decree No. 6263 of November 21, 2007, p. 9.

of sustainable charcoal meets demand[35]. The World Bank estimated that the gross abatement potential of this measure would be on average 24 $MtCO_2e$ per year over the period 2010-2030[36]. However, it should be noted that the success of these measures depends largely on the implementation of a set of public interventions targeted at increasing investments in 'new' forest plantations.

The World Bank presents the following mitigation options in energy efficiency concerning the adoption of more modern and efficient processes[37]:

- Introduction of new reduction and simultaneous fusion processes with the potential to reduce energy consumption by 20 to 30%. This process combines the gasification of coal with direct reduction of iron oxide minerals, negating the need to use coke and prepare the ore;
- The deactivation of obsolete, small capacity and low efficiency blast furnace plants;
- Installation of coke dry quenching and advanced wet quenching processes;
- Recovery of blast furnace gases for electricity production;
- Reduced coke consumption with pulverized coal injection in blast furnace plants and use of natural gas as an auxiliary fuel in the blast furnace and the Basic Oxygen Furnaces;
- Introduction of the 'continuous-casting' process at the steel refining stage.

The sector also has clear prospects for obtaining emission reductions through re-using scrap metal rather than producing new metals. Re-processing recycling metal is less energy intensive than the production of new metals. In 2007 Brazil recycled about 29%, representing around 9.8 million tons of scrap per year. About 43% of the salvaged metal processed originates from so-called "obsolescent scrap" from the collection of disused products such as old cars, metal containers, etc. (i.e. 67% of the steel production of the Gerdau Group in 2007 came from scrap). The estimated energy saving potential of recycling was about 0.4 Mtoe[38] in 2007, or 2.3% of the overall sector's energy consumption[39].

The main barriers to scaled-up recycling by the industry according to the World Bank are:

1. the difficulty of securing appropriate financing;
2. the high costs of selective collection;
3. the low levels of interest shown by municipal authorities, and;
4. the price fluctuations of many commodities and raw materials. For example, while the prices of bauxite and alumina remain low the price paid for scrap aluminium is reduced, resulting in a shortage of scrap for recycling[40].

3.1.6 *Application of a Tradable Intensity Standard*

A tradable intensity standard for the Brazilian steel sector could build on the initiatives that are already in place. Brazil's pledge to the UNFCCC has sector targets and the government may soon announce sector caps. A tradable performance standard could hence work as indicated above. In any case, given Brazil's relatively high GDP per capita the country might be able to support its no-regret potential as well as abatement costs with moderate positive costs, from its own resources. Section 7 discusses several scenarios of where the tradable intensity standard could be set.

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35 One example is the State of Minas Gerais, which represents approximately 70% charcoal-fired steel production in Brazil. A bill of law is currently being examined by the State's Legislative Assembly which will outlaw the use of non-renewable charcoal over the next 8 to 10 years.

36 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 97,*

37 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 78,*

38 Mt of oil equivalent

39 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 81.*

40 bid., p. 99.

The steel sector is operated by private companies and data availability may be sufficient for an installation-level crediting system as all steel plants have been reporting on their CO_2 emissions since 2009.
However, the sector is highly concentrated. Companies are aggregated under eleven industrial and financial groups and three of these groups were responsible for 61% of the nation's steel production in 2009. If the system operated in isolation from other carbon markets, there might hence not be much liquidity. Without liquidity the system cannot provide flexibility for companies to choose whether to reduce their own emissions or rather buy emission units from others. Companies with a shortage of credits might not find sellers, putting strong upward pressure on prices. First, because installations that outperform their targets may not generate enough credits to supply those that do not meet their targets. Second, because credits would only be issued after the overall sectoral performance has been assessed by the international regulatory body. Given these supply constraints, there might hence be substantial fluctuation in the availability and price of credits within the system. It would therefore be recommendable to link the system to other carbon markets, such as the CDM or other systems that may evolve domestically in Brazil.

Domestic developments in Brazil may go faster than the establishment of a NMM under the UNFCCC. The states of Rio de Janeiro and Sao Paolo have announced the development of state-level cap-and-trade systems and other states may follow soon. As a result, instead of Proposal 2 Brazil may rather go for Proposal 3, but as a bottom-up initiative rather than through a top-down UNFCCC framework. The EU might then need to explore whether such a Brazilian ETS would be robust enough to link to the EU ETS.

As for carbon leakage, steel is one of the sectors in the EU that is generally held to be highly vulnerable. In particular regarding primary steel production in blast oxygen furnaces (BOF) Brazil has a strong competitive advantage vis-à-vis the EU due to lower labour and raw material costs. The average BOF plant in the Western EU has about 40% higher operating costs than a plant in Brazil. The EU's position vis-à-vis other competitors such as Russia is similar[41]. Nevertheless, a study by de Bruyn et al[42] found that steel producers in the EU have probably been able to fully pass through the EU ETS carbon price, which indicates that at least so far the EU ETS probably has not had major negative implications for steel makers.

As it is suggested that the crediting threshold should include all abatement potential up to 20€/tCO_2e, the sectoral scheme would probably impose some net costs on Brazilian producers and correspondingly somewhat weaken Brazil's competitive position. However, the EU experience has been that steel makers have been able to pass through the carbon price despite already having higher overall costs than some major competitors. In addition, in the proposed system emission units would only need to be bought for excess emissions rather than each tonne of emissions. Overall, the impact on Brazilian producers' competitiveness may be therefore minimal. A more definite statement would require a detailed analysis of relative production costs, impacts of carbon pricing and trade intensities.

Table 29 Barriers to implementation of a sectoral mechanism and suggested solutions

Barriers	Solutions
High sector concentration leading to	Link to international carbon market

41 Hourcade, C., D. Demailly, K. Neuhoff, M. Sato, M. Grubb, F. Matthes, V. Graichen (2007): Differentiation and Dynamics of EU ETS Industrial Competitiveness Impacts. Cambridge: Climate Strategies.

42 De Bruyn, S., A. Markowska, F. de Jong and M. Bles (2010): Does the energy intensive industry obtain windfall profits through the EU ETS? An econometric analysis for products from the refineries, iron and steel and chemical sectors. Delft: CE Delft.

low carbon market liquidity	
Domestic cap-and-trade may come faster than establishment of UNFCCC mechanism	Explore possibility to link possible Brazilian and EU ETS

3.1.7 Emissions Reduction Potential under Different Scenarios

In this section we assess the emission reduction potential of the steel sector in Brazil for different policy relevant scenarios. A no-abatement scenario has been established based on steel sector's capacity and emission projections in Brazil[43]. The emission reduction which can be obtained under other scenario's, including the BAU scenario, are compared to the emission projections of the no-abatement scenario. One of the scenarios (the 'NMM carbon intensity cap scenario') includes the assumption that a tradable intensity standard will be implemented and operationalized according to the selected design proposal for an NMM in this study (see chapter 4). For the Brazilian steel sector, four scenarios have been developed.

In developing the scenarios we applied the following assumptions:

- In all scenarios, we assume that the submitted targets and plans in the Brazilian Second National Communication to the UNFCCC for the steel sector and the targets listed in the submission for the Copenhagen accord on NAMAs will become reality and that the expected emission reductions will be achieved;
- Data on the sector's growth in terms of production capacity is based on the study 'Pathways to a low carbon economy for Brazil' from McKinsey[44] ;
- The abatement options with negative marginal abatement identified by McKinsey have actually been implemented in the period from 2010 to 2012;
- In 2016 the emission reduction potential of the 'more efficient machinery and processes' (with positive marginal abatement costs) will be implemented and operationalized;
- Moreover, we assume that it is not realistic that the indicated abatement options for CCS deployment will be realised before 2020 and as such we do not take these abatement options into account.
- Two scenarios will include the use of carbon market incentives or emission caps. These mechanisms will enter into force in 2016. This is in line with the foreseen time framework for concluding an agreement for the New Market Mechanism.

Table 30 Abatement potential in the Steel sector in Brazil under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement scenario	0 $MtCO_2e$/year
BAU scenario	17 $MtCO_2e$/year
NMM carbon intensity cap scenario	22 $MtCO_2e$/year
NMM carbon emissions cap scenario	26 $MtCO_2e$/year

No-abatement scenario

In the no-abatement scenario no abatement measures will be taken and emissions will keep pace with the forecasted steel production capacity of McKinsey. The same carbon intensity of 2005 (1.2 tCO_2e/t steel) will hold for the overall steel production until 2020. This is a hypothetical scenario which provides a reference to estimate the emission reductions in the following three scenarios.

43 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*
44 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*

BAU scenario

In the BAU scenario the planned policies and abatement measures for the steel sector of the Brazilian government will be implemented, along the lines of the sector forecasts for emission and sector growth of McKinsey. Emissions will grow from 66 MtCO_2e in 2010 to 81 (2015) and 96 (2020) MtCO_2e. Since the steel production capacity will increase progressively compared to the emission levels after 2010, the carbon intensity for the Brazilian steel producing installations will decrease over time from 1.9 tCO_2e/t steel in 2010 to around 1.5 tCO_2e/t steel in 2020. This is significantly higher than the average carbon intensity of the steel mills in the EU ETS of around 0.82 tCO_2e/t steel. This intensity level is based on the 2005 steel production (196 Mt crude steel) and verified emissions (161 MtCO_2e) levels[45].

Considering the MAC curve for the steel sector in Brazil,[46] the 'BAU scenario' could be achieved when:

- Between 2012-2015: the restructuring of the steel sector is realised and process-related emissions that can be reduced by abatement options with negative marginal abatement costs (i.e. coke substitution and increased energy efficiency) are implemented. In terms of abatement potential, the emissions in this period can be reduced with 10 MtCO_2e/year compared to the no-abatement scenario,
- Between 2016-2020: after restructuring the sector, the reduction potential for the remaining process-related emissions should be realised by making use of more efficient machinery and processes. For 2016-2020 these improvements would reduce emissions from the steel sector with another 13 MtCO_2e/year.

In this scenario the emission reductions compared to the no-abatement scenario for both existing and new capacity, will be on average 17 MtCO_2e/year throughout the period 2012-2020 when both the above measures are implemented.

NMM carbon intensity cap scenario

In the NMM carbon intensity cap scenario the Brazilian government commits to a carbon intensity performance benchmark for the steel sector. The benchmark will be enforced via a tradable intensity standard along the line of Proposal 2. The performance benchmark lies between the carbon intensity level of 0.82 tCO_2e/t steel of the steel sector within the EU-27 in 2005 (20%) and the carbon intensity level of the Brazilian sector in the BAU scenario in 2005 (80%). This carbon intensity provides a realistic perspective on further emission reductions beyond the emission reduction potential identified by McKinsey.

The carbon intensity of the sector has been significantly higher than the average carbon intensity of the steel sector of the EU. To meet the target the sector will have to make investments which go beyond the abatement potential identified by McKinsey. This might require replacing inefficient equipment with new, more efficient installations. If the sector succeeds in meeting the intensity target, its sector's emissions will decrease to 87 MtCO_2e by 2020 realising a reduction of 9 MtCO_2e/year compared to the BAU scenario of 96 MtCO_2e/year in 2020. On average, an abatement obligation of 22 MtCO_2e/year should be realised within this scenario for the period 2012-2020.

NMM carbon emissions cap scenario

In the NMM carbon emissions cap scenario the Brazilian government implements an absolute cap on the emissions of 71 MtCO_2e/year by 2020, corresponding to the announced national emission

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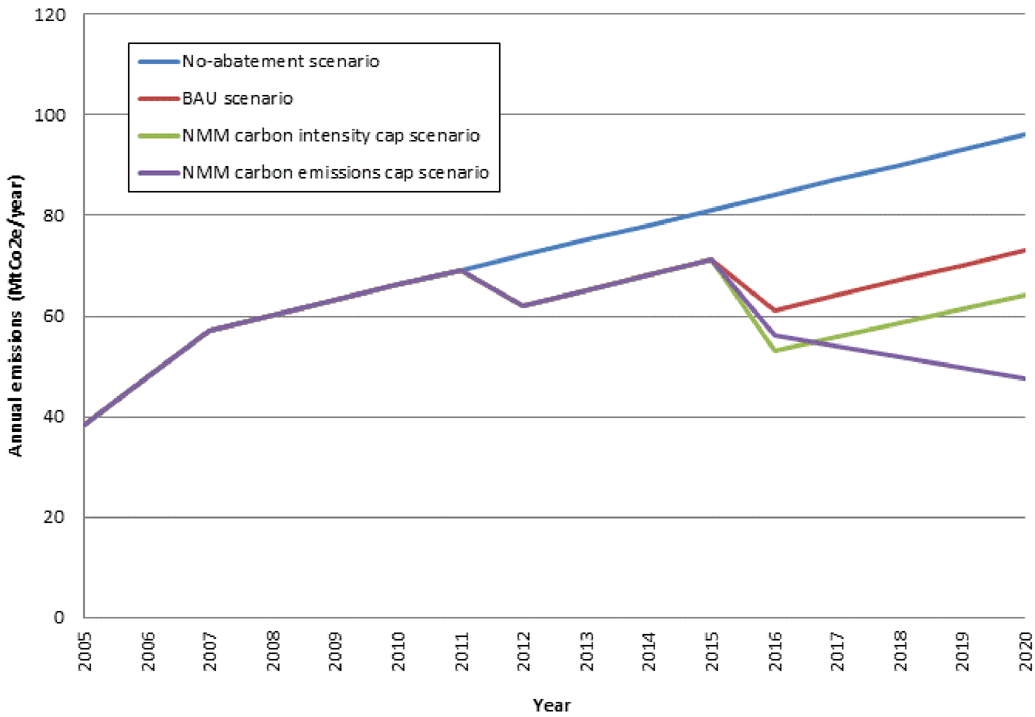
45 Eurofer production data for 2005, Ecofys BM study for the European Iron & Steel sector

46 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*

pledge of 36% below the BAU emission level in 2020. In absence of a sector-specific target, this national target will be used. The carbon intensity would need to decrease from 1.9 tCO_2e/t steel in 2010 to 1.1 tCO_2e/t steel in 2020 in order to achieve the emission target and as such significant improvements to the efficiency of the machinery and steel producing processes would be needed. The abatement obligation that should be realised within this scenario would be 26 $MtCO_2e$/year for the period 2012-2020.

Figure 7 below presents the trends in emissions for the steel sector in Brazil over time for the different scenarios. The vertical axis represents the level of emissions in $MtCO_2e$, where the horizontal axis represents the timescale for the scenarios.

Figure 7 Analysis of emission trends for Brazilian steel plants in different scenarios



In the above scenarios we have analysed the impact of emission caps and carbon intensity performance benchmarks for the Brazilian steel sector. However, there are other parameters as well that significantly impact the emission reduction potential of the sector.

Parameter	Impact on emission reductions
Energy (i.e. electricity prices)	Steel production is very energy-intensive. Increasing global energy prices (i.e. electricity prices) will put upward pressure on the operational costs for the sector. Depending on the sector's price elasticity, steel producers can or cannot pass this cost increase on to consumers. Steel is a mobile product and producers compete globally rather than locally. Therefore, the steel sector has an elastic price effect such that the impact of mark-ups (i.e. additional costs for abatement options to reduce emissions) in the steel price will have a more than significant impact on the sector's demand.
International steel price	The steel sector in Brazil has only been privatised in 1993 with large conglomerate steel companies that are part of a limited number of industrial and/or financial groups. Therefore, the Brazilian steel sector has an oligopolistic setting such that economic and other endogenous factors have a less significant impact on the Brazilian sector performance than comparable sectors that are in a competitive market structure. Therefore, some inelasticity has been taken up in passing through increases in the

Parameter	Impact on emission reductions
	operational costs of the production process to the sector's (main) consumers.
EU ETS price	If in the period up to 2020 the EU ETS price increases, more and more abatement options become financially attractive. However, the MACC for steel in Brazil, shows that most of the abatement options are already financially feasible without carbon incentives. A more expensive option that brings a major abatement potential is CCS. However, this is a rather new technology which may not be ready for commercial use before the end of 2020. As a result, the NMM in the Brazilian steel sector should focus on the 13 Mt/year abatement potential of "More efficient machinery and processes"

3.2 Case Study 2: Chile – Power Sector

Chile, Electricity at a Glance			
Number of installations in the country	~100 power / electricity plants (number of plants larger than $20MW_e$ unknown)	**Absolute emissions**	14.2 $MtCO_2e$ in 2006
Number of companies	43 generation companies	**Percentage of national emissions**	20% in 2007
Number of registered CDM projects	26 (15 hydro, 4 wind, 6 biomass) and 46 more under validation	**Estimated emission growth**	85 $MtCO_2e$ in 2030
Emissions reduction potential	Up to 22.5 $MtCO_2e$/year in 2012-2020	**Emissions intensity in 2005**	0.26 tCO_2e/MWh (but may reach 0.47 by 2030)
Carbon leakage potential	None due to lack of grid connection to neighbours	**Emission intensity of electricity sector in the EU in 2005**	0.36 tCO_2e/MWh
Sector boundaries	Aligned with the EU ETS: Power plants with a total rated input exceeding 20 MW_{th}	**Typical abatement measures**	Carbon capture and storage Non-conventional renewable energy Energy efficiency

3.2.1 *Description of the Sector*

Traditionally, the Chilean electricity market has administered resources based on their economic efficiency, creating a heavy focus on low-cost and traditional (coal-fired) generation technologies. Only recently the development of renewable energy policies found support in rising energy prices, an increase in national power demand and the rapid depletion of national fossil fuel sources in the country.

The electricity generation sector in Chile is majority privately owned and divided into four main grid regions. The largest system provides electricity mainly for the mining industry in the northern part of Chile.

Table 31 Chilean Power Grids[47]

Grid	Capacity installed	Characteristics
SING (Sistema Interconectado del Norte Grande)	3,600 MW_e	Northern Chile, fuelled with 60% gas fired and 33 % coal and supplying mainly to industry.
SIC (Sistema Interconectado Central)	9,400 MW_e	Supplying to urban areas and ~90% of the population, fuelled with 56% hydropower and 44% thermal capacity.
Aysen Grid	51 MW_e	Supplying the North of Chile with three separate systems.
Magallanes	98 MW_e	Generates electricity for the far South of Chile.

The SIC system contains thirty five electricity generation companies. However, almost 90% of the total generation capacity belongs to three large holding companies: Endesa, AES Gener and

47 International Energy Agency, *Chile: Energy Policy Review 2009,* p. 139, available on: <http://www.iea.org/textbase/nppdf/free/2009/chile2009.pdf>.

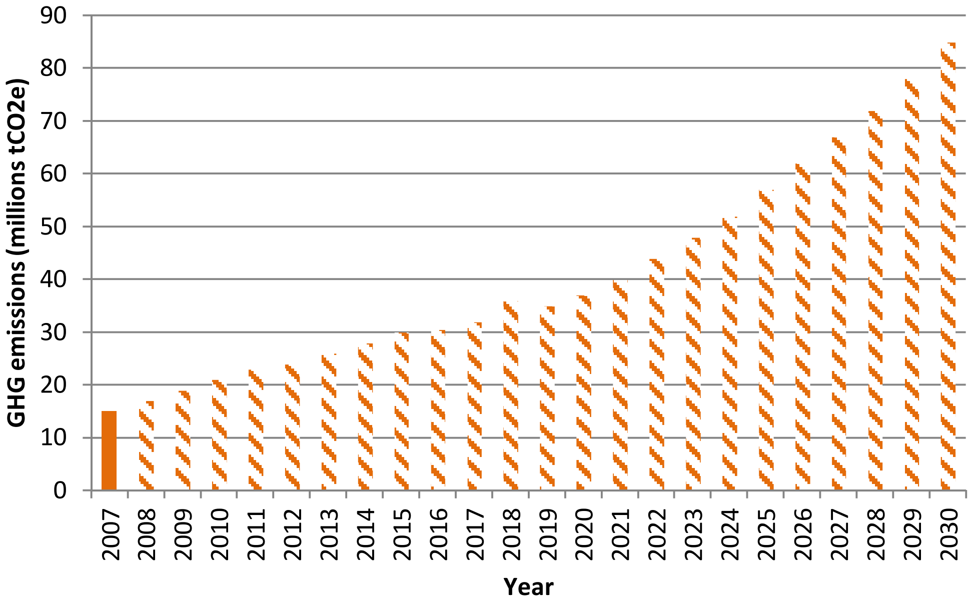
Colbun. The same holds for the SING system where three (AES Gener, Gas Atacama and Suez/CODELCO) out of the six companies own almost 95% of the generation capacity[48].

3.2.2 Trends in Production and Emissions

The energy consumption per capita in Chile has nearly doubled between 1990 and 2006, pushing the emissions per capita up with 70% to 3.9 tCO_2e.[49] In that same period the electricity sector was one of the fastest growing reaching 7% per year.[50] In 2006, 36% or 23.5 $MtCO_2e$ of the national emissions came from the energy industry. Within the 36%, a majority of 79% of the emissions originated from electricity production.

Up to 2030, the energy consumption in Chile is expected to increase at an annual rate of 5.4%. For the electricity generation sector to keep pace with national electricity demand the capacity would need to increase from 13,000 MW in 2007 to 40,000 MW in 2030. In 2007 the energy supply was dominated by natural gas and hydropower. According to O'Ryan this energy mix is may increase to 52% coal in 2030 with most of the increase taking place in the period 2020-2030.[51] The expected increase will be driven by a desire to reduce the country's dependence on imported coal and gas and rely on domestic coal sources in the south of the country. Along these lines, the emissions from electricity generation are projected to increase from 14.2 $MtCO_2e$ in 2006 to 85 $MtCO_2e$ in 2030. This increase parallels the forecasted electricity generation from 55 GWh to 180 GWh.[52]

Figure 8 Historical emissions and projected growth in the power sector of Chile



[48] Ibid., p. 142.

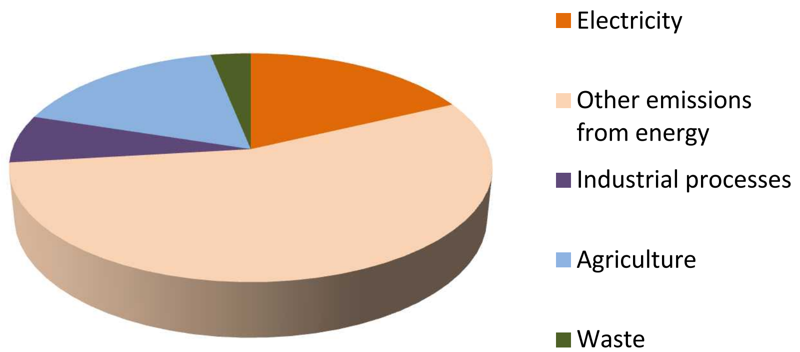
[49] O'Ryan, R.; Diaz, M. and Clerc, J., *Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile – 2007-2030,* PROGEA, University of Chile, 2010.

[50] Chile, *Template for Organizing Framework for Scoping of PMR activities,* 2011, available on: <http://wbcarbonfinance.org/docs/Chile_Organizing_Framework_May_23_2011.pdf>.

[51] O'Ryan, R.; Diaz, M. and Clerc, J., *Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile – 2007-2030,* PROGEA, University of Chile, p. 36, 2010.

[52] Ibid., p40.

Figure 9 Chile's national emissions in 2007

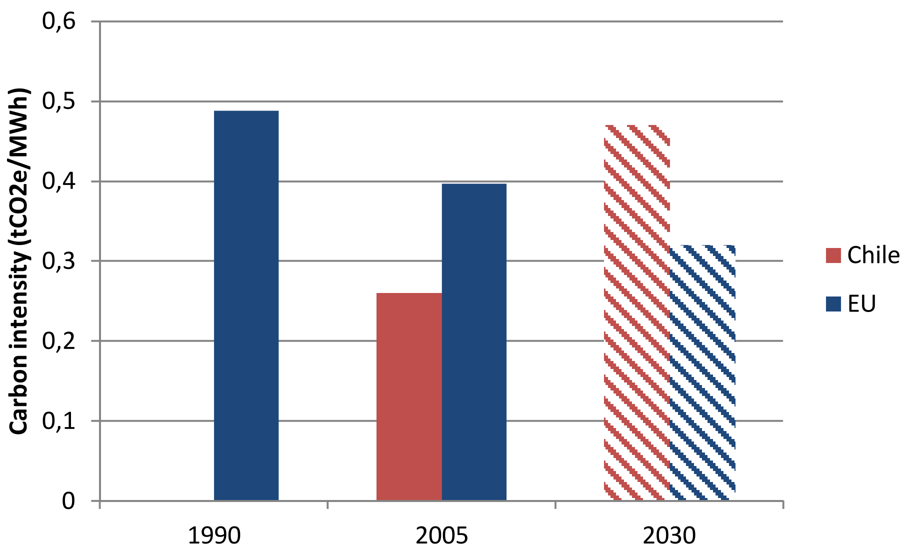


Note: the data presented in the national inventory deviates from the data presented by O'Ryan.

3.2.3 *Carbon Intensity*

In 2005 the Chilean carbon intensity was 0.26 tCO_2e/MWh. With the expected increase in use of coal this will reach 0.47 in 2030.[53]

Figure 10 Historic and forecasted carbon intensity of power production in the EU and Chile



The European Union has succeeded in reducing the carbon intensity of its power sector to 0.36[54] tCO_2/MWh and forecasts the EU ambition to reduce the carbon intensity of the sector further. Important to note is the re-emergence of coal and that the national policies of most EU Member States to replace controversial nuclear capacity will make it difficult for the EU to meet its ambitions[55].

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[53] O'Ryan, R.; Diaz, M. and Clerc, J. (2010) Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile, 2007 – 2030, PROGEA, University of Chile, pg 63 – 64.

[54] European Commission, *European Energy and Transport – Trends to 2030 (update 2007),* p. 71, available on: <http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2030_update_2007.pdf>. The figure is roughly confirmed by Eurelectic, Power Choices Pathways to Carbon-Neutral Electricity in Europe by 2050 (2010) which refers to 0.36 tCO_2e/MWh.

[55] Commission, *European Energy and Transport: Trends to 2030 and update 2007,* 2008, p. 70-71, available on: <http://ec.europa.eu/energy/observatory/trends_2030/doc/trends_to_2030_update_2007.pdf>.

3.2.4 *Policies and Measures*

Chile has implemented national legislation to improve the electricity payment system, to regulate electricity transmission, to open a spot market and to provide easier grid access to small-scale plants (>20MW)[56]. In 2008 the Chilean government adopted a law[57] defining Non-Conventional Renewable Energy ('NCRE') sources and requires that all electricity companies that operate over 200MW installed capacity must obtain 5% of their electricity annual sales from NCRE by 2010. From 2014, this percentage will gradually increase by 0.5% annually to reach 10% NCRE in the total capacity in 2024. Any electricity company failing to fulfil this obligation must pay a surcharge for every megawatt of deficit[58].

Important barriers to invest into NCRE remain despite the new legislation. The absence of stable long-term energy prices makes financing of projects by smaller and independent power companies in the oligopolian Chilean power sector difficult. These problems are only partly mitigated by the investment support provided by the Chilean economic development agency (CORFO)[59]. CORFO provides support for economic and technical feasibility studies as well as preferential sale and financing conditions[60].

Wind energy, geothermal, hydropower and biomass hold great NCRE potential for Chile of which biomass is particularly attractive for decentralized power supply. For example, in the Southern part of Chile, with its timber and wood industries, biomass could fuel a generation capacity of up to 470 MW of power[61]. A separate study estimates the industrial sawmill industry alone could generate up to 900 MW.[62]

3.2.5 *Abatement Potential*

The sector's carbon intensity is expected to increase significantly up to 2030 due to large portion of energy demand being met by coal-fired electricity generation. If this expectation becomes reality, the abatement potential is 37 $MtCO_2e$ at an average price or EUR 19. From all abatement options, carbon capture and storage (CCS) is the least cost effective at 52 EUR/tCO_2e, whilst the most cost effective is the installation of hydroelectric power plants with 1,000 MW capacity at -25 EUR/tCO_2e. However, large-scale deployment of CCS in the timeframe of an NMM, up to 2020, does not seem realistic given its high costs and state of development.

Table 32 Abatement options in the Chilean power sector[63]

Abatement option	Marginal abatement costs (EUR/tonne)[64]	Potential by 2030 (Mt/year)
Adoption of CCS at 10% or ~1GW of installed power capacity	52	4.1
Installation of a 1 GW nuclear power capacity by 2025	15	5.5

56 2004 Law no. 19.940 and 2008 Law no. 20.257
57 Law no. 20.257 or 'Ley Corta III'
58 For more detail see Dufey, A. (2010) *Opportunities and Barriers to Clean Energy Investment in Chile*, International Institute for Sustainable Development, available at: http://www.iisd.org/pdf/2010/bali_2_copenhagen_Chile_Jun2010.pdf.
59 CORFO is a Chilean governmental agency set up to promote economic development, innovation and competitiveness of Chilean industries.
60 International Energy Agency, *Chile: Energy Policy Review 2009,* p. 16-169, available on: <http://www.iea.org/textbase/nppdf/free/2009/chile2009.pdf>.
61 Rubilar, R. (2009) *Biomass and Bioenergy, is an alternative for forestry in Chile?* Available at: www.ces.ncsu.edu/nreos/forest/feop/Chile/RRubilar_08042009.pdf.
62 Embassy of Switzerland in Chile, The Chilean Energy Market, (Santiago de Chile, 2011)
63 O'Ryan, R.; Diaz, M. and Clerc, J. (2010) Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile, 2007 – 2030, PROGEA, University of Chile. Page 64.
64 Values calculated from USD at an exchange rate of 0.80 EUR/USD.

Abatement option	Marginal abatement costs (EUR/tonne)[64]	Potential by 2030 (Mt/year)
Installation of hydroelectric power plants with 1 GW capacity by 2025	-25	4
Implementation of a stricter NCRE law (1% increase after 2014, up from 0.5%)	22	23
Total	(Average) 19	37

CDM project activities also provide insight in the abatement costs. Chile hosts 26 registered CDM projects of which 15 hydro, 4 wind and 7 biomass related. There are 49 more CDM projects under validation, including solar and geothermal projects. Table 33 provides an overview of the investment costs per installed capacity and per tonne CO_2e reduced if the renewable energy replaces old fossil fuel capacity or replaces fossil capacity that would be built otherwise. For the investment costs per tonne CO_2 reduced we assumed an operational life time of 25 years. The data show that per tonne reduction biomass is has the lowest investment costs, followed by hydropower and wind.

Table 33 CDM projects and their investment costs

Project type	CDM projects with relevant data, registered or under validation	Capacity range (MW)	Investment per reduction over the lifetime (EUR/tCO_2)		
			Highest	**Average**	**Lowest**
Biomass power	4	1.2-30	11.9	5.3	1.7
Geothermal	1	50		22.9	
Hydro	34	0.8-531	49.9	26.1	10.7
Solar power	1	250		61.1	
Wind	13	18-240	127.4	43.5	18.0

Note: Not all CDM projects reveal information on the investment costs.

Next to wind energy, that already provides a significant part of the total energy supply of Chile, there are multiple opportunities for various other NCRE sources and are abundantly present in Chile. For instance, the Chilean Atacama desert includes the highest solar radiation in the world. Another example is the so-called "Pacific Ring of Fire", a line of faults that has intense volcanic and seismic activity that can be used to generate geothermal power. Table 34 indicates the estimated potential for all NCRE sources. Although the potential is high, there are still a lot of obstacles and barriers in Chile to make optimal use of the potential, such as the electricity market framework and the lack of investment conditions.[65]

[65] Global Energy Network Institute, *Renewable Energy Potential of Chile,* August 2011, p. 23, available on: http://www.geni.org/globalenergy/research/renewable-energy-potential-of-chile/Chile%202020%20Report%20II%20PBM%20final.pdf, accessed 3 July 2012.

Table 34 Renewable energy source estimated potential[66]

	Small hydro	Solar	Wind	Ocean	Geothermal	Biomass
Estimated potential	10,000 MW (at least)	275 MW / km2	40,000 MW	164,000 MW	16,000 MW (over 50 year period)	1,370 MW

3.2.6 *Application of a Tradable Intensity Standard*

Chilean electricity supply has historically been dominated by natural gas and hydropower, but this is expected to change to 52% coal under BAU by 2030. To prevent such a shift to coal, the Chilean government could impose a tradable performance standard on fossil fuel power plants. The standard could be set at the level of a natural gas power plant, that is at about 450g CO_2/kWh, to discourage the use of coal without CCS. If that is considered too ambitious, differentiated performance standards could be set for different types of fossil fuels. An inclusion threshold could be defined at the nameplate capacity (e.g. $20MW_e$ as in the EU ETS).

As noted above, the sector is rather oligopolistic, raising similar liquidity problems as discussed in detail in the Brazil case study. To enhance liquidity it would be recommendable to link the crediting system to the international carbon market, allowing installations to use CERs and possibly also other internationally fungible units to comply with their targets.

It bears noting that renewable energies and energy efficiency would be only indirectly incentivised through this system, through the resulting price increase of power from fossil fuels. And since crediting units would only need to be bought for excess emissions rather than each tonne of emissions, the price increase of fossil fuel power generation would probably be modest. The system should hence be complemented by further policies and measures to promote renewables and energy efficiency.

Chile is not electrically connected to its neighbours, except for the Salta CCGT plant, which is located in Argentina but electrically part of the SING. This plant has some parts dedicated to SING while others are reserved for Argentina, so that there is no connection between the two systems.[67] Accordingly, Chile has only very limited imports and exports.[68] There is therefore no risk of leakage.

Table 35 Barriers to implementation of a sectoral mechanism and suggested solutions

Barriers	Solutions
Possibly insufficient data	Capacity building
Oligopolistic sector structure leading to low carbon market liquidity	Link to international carbon market
Possibly insufficient government implementation capacity	Capacity building and trainings

3.2.7 *Emissions Reduction Potential under Different Scenarios*

In this section we assess the emission reduction potential of the power sector in Chile under different policy relevant scenarios. A no-abatement scenario has been established based on the

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66 Global Energy Network Institute, *Renewable Energy Potential of Chile,* August 2011, p. 23, available on: http://www.geni.org/globalenergy/research/renewable-energy-potential-of-chile/Chile%202020%20Report%20II%20PBM%20final.pdf, accessed 3 July 2012.

67 IEA 2009: Chile Energy Policy Review 2009, Paris: IEA, p. 138, http://www.iea.org/publications/free_new_Desc.asp?PUBS_ID=2159, accessed 19 July 2012.

68 In 2009, 1,348 GWh of imports and zero exports, IEA Energy Statistics, Electricity for Chile, http://www.iea.org/stats/electricitydata.asp?COUNTRY_CODE=CL, accessed 19 July 2012.

capacity and emission projections of the University of Chile. Emission levels are calculated, including the impact of potential abatement measures, under different scenarios are compared to the emission projections of the University. One of the scenarios (the NMM carbon intensity cap scenario) includes the assumption that an installation-based crediting mechanism will be implemented and operationalized. It is important to note that the reference and BAU scenario in this case study are based on the sector forecasts presumed by the University of Chile. Within the Chilean situation of the power sector, in which we take into account the large potential for coal-fired generated electricity by 2030, we have developed four relevant scenarios.

In developing the scenarios we applied the following assumptions:

- For the no-abatement scenario, we assume that the power sector, in terms of its emissions and capacity, will develop along the lines of the projections of the Chilean National Energy Commission (CNE). However, the projections are corrected for the NCRE law and its target of 20% power generation from renewable energy sources. As such, we assume that the NCRE law is not included in the no-abatement scenario but only includes the projects listed in the Work Plan from the National Energy Commission's (CNE) in 2008 ;
- For the BAU scenario, we assume that the power sector, in terms of its emissions and capacity, will develop along the lines of the projections of the CNE, listed in their Work Plan of April 2008, and includes the implementation of the NCRE law. The forecasted indicators are complemented with the data sources listed in the study of the University of Chile[69];
- It is assumed that the adopted NCRE law has been enforced in 2010 with half of the indicated abatement potential being realised from 2012 onwards in the BAU scenario. Only half of the indicated abatement potential has been taken into account given the fact that the overall abatement potential of 23 MtCO_2/year is would require an annual increase of power production from renewables by 1% between 2014 and 2024, rather than the 0.5% which is currently foreseen. The remaining potential of a stricter NCRE law (from 0.5% to 1%) is assumed to be developed in the NMM carbon intensity cap and the NMM carbon emissions cap scenarios after 2014;
- We assume that the other abatement options indicated will not be deployed before 2020. Moreover, we assume that it is not realistic that the indicated abatement option for CCS deployment could be realised before 2020 and as such we do not take this option into account at all;
- Two scenarios will include the use of carbon market incentives or emission caps. These will enter into force after 2015. This is in line with the foreseen time framework for concluding an agreement for the New Market Mechanism.

Table 36 Abatement potential for Electricity generation in Chile under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement scenario	0 MtCO_2e/year
BAU scenario	11.5 MtCO_2e/year
NMM carbon intensity cap scenario	20.5 MtCO_2e/year
NMM carbon emissions cap scenario	22.5 MtCO_2e/year

No-abatement scenario

In the no-abatement scenario no abatement measures will be taken and sector's capacity will keep pace with the forecast electricity generation capacity of the CNE. Emissions will also follow the same trend of the emission projections of the CNE, but are corrected for the NCRE law and its

[69] O'Ryan, R.; Diaz, M. and Clerc, J. (2010) Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile, 2007 – 2030, PROGEA, University of Chile.

target of 20% power generation from renewable energy sources. This means that for 2008-2011, the emissions are corrected by a factor 1.1 over the emission levels in the BAU scenario and by a factor 1.2 for 2012-2020. Since we exclude power generation from renewable energy sources (or the NCRE law) in this scenario, the carbon intensity increases significantly over time from 0.27 tCO_2e/MWh in 2005 to 0.32 tCO_2/MWh in 2010 and 0.39 tCO_2/MWh in 2020. This is a hypothetical scenario which merely provides a reference emission level for the following three scenarios.

BAU scenario

In the BAU scenario the planned policies for the power sector of the Chilean government, mainly the enforcement of the NCRE law, will be implemented. Emissions will increase from 21 $MtCO_2e$ in 2010 to 30 (2015) and 37 (2020) $MtCO_2e$. The capacity of coal-fired generated electricity will increase tremendously after 2010. However, the NCRE law will also be implemented under this scenario such that the carbon intensity increases over time but at a slower pace than in the reference scenario: from 0.29 tCO_2e/MWh in 2010 to around 0.31 tCO_2e/MWh in 2020. This is slightly lower than the average carbon intensity of the power sector within the EU-27. Their carbon intensity was around 0.36 tCO_2e/MWh in 2005[70].

Considering the abatement options for the Chilean power sector, the BAU scenario could be achieved when the NCRE law is properly implemented in 2008 and will become stricter (by 0.5%) in 2012. In terms of abatement potential, for the same electricity generation capacity of the no-abatement scenario, the emissions in this period can be reduced on average with 11.5 $MtCO_2e$/year throughout the period 2012-2020.

NMM carbon intensity cap scenario

In the NMM carbon intensity cap scenario the Chilean government commits to a carbon intensity performance benchmark for the power sector. The benchmark will be enforced with an installation-based crediting mechanism along the lines of Proposal 2. The performance benchmark lies between the carbon intensity level of 0.36 tCO_2e/MWh of the power sector within the EU-27 in 2005 (50%) and the carbon intensity level in the respective year of the Chilean sector in the BAU scenario (50%). Since there are already operational plants that generate power from renewable energy sources (e.g. 15 hydropower plants), it would not make sense to include these plants under the crediting mechanism. Therefore, the composition of the carbon intensity in this scenario aims to provide a realistic perspective, knowing the Chilean situation, on further emission reductions beyond the mandatory emission reductions under the NCRE law.

The additional impact of a performance target upon the NCRE law enforcement is rather small. The sector's emissions would decrease to 35 $MtCO_2e$ by 2020 for the same electricity generation capacity despite the forecasted capacity expansion of coal-firing, but under the assumption that the NCRE law becomes stricter (from 0.5% to 1%). As such, an additional abatement obligation should be realised of 14 $MtCO_2e$/year over the BAU scenario of 11.5 $MtCO_2e$/year in 2020. On average, an abatement obligation of 20.5 $MtCO_2e$/year should be realised within this scenario for the period 2012-2020. The additional abatement obligation could be realised via the estimated potential for renewable energy sources in Chile (see Table 34), with investment costs, depending on the type of renewable energy source that will be deployed, between 21-40 EUR/tCO_2 emission reduction.

NMM carbon emissions cap scenario

In the NMM carbon emissions cap scenario the Chilean government implements an installation-based crediting mechanisms with an absolute cap on the emissions of 31 $MtCO_2e$/year by 2020,

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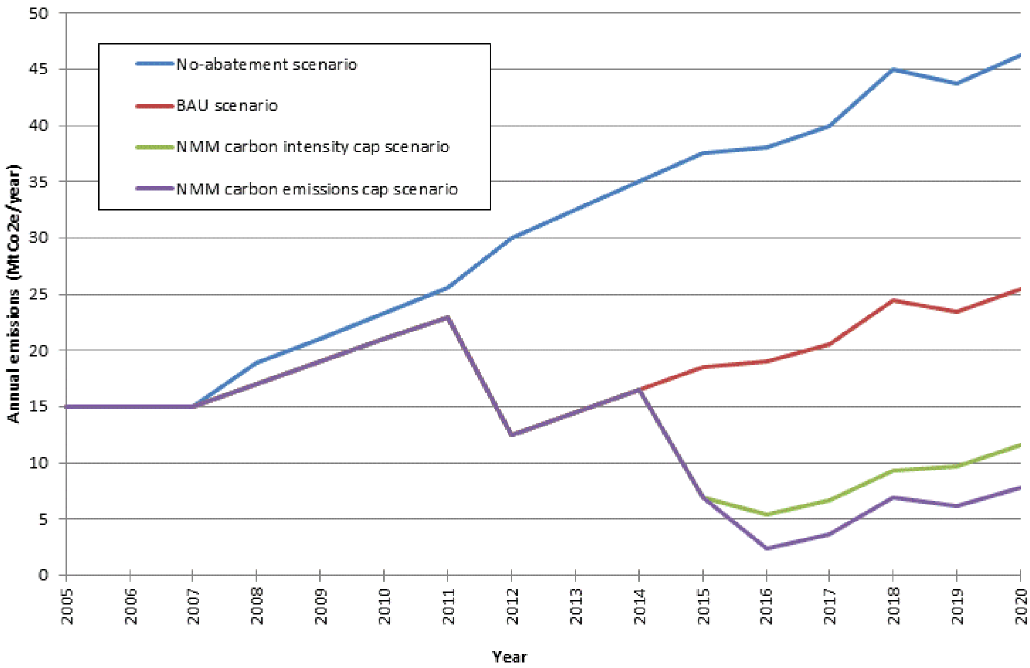
70 Source: Eurelectric, Power Choices study "Pathways to Carbon Neutral Electricity in Europe by 2050"

corresponding to the announced national emission pledge of 20% below the BAU emission level in 2020. This simplistically assumes that all sectors should contribute equally to the national pledge, but in the absence of sector targets announced by the government is nevertheless a useful starting point for the analysis. The carbon intensity will need to decrease from 0.29 tCO_2e/MWh in 2010 to 0.26 tCO_2e/MWh in 2020 in order to achieve the emission target and as such only minor improvements to the sector's efficiency would be needed, but major efforts would be needed to comply to the abatement obligation. The abatement obligation that should be realised within this scenario is 22.5 $MtCO_2e$/year for the period 2012-2020.

Figure 11 below presents the trends in emissions for the power sector in Chile over time for the different scenarios. The vertical axis represents the level of emissions in $MtCO_2e$, where the horizontal axis represents the timescale for the scenarios.

Figure 11 Analysis of emission trends for the Chilean power sector in different scenarios



3.3 Case Study 3: Indonesia – Refineries

Indonesia Refineries at a Glance			
Number of installations	~8 refineries (depending on source)	**Absolute emissions**	estimated at 22.5 $MtCO_2e$ (2005)
Number of companies	2 (state owned)	**Percentage of national emissions**	
Number of CDM projects in Indonesian refineries	0	**Estimated emission growth**	36% by 2030
Emissions reduction potential	30% of emissions in 2030	**Emissions intensity in 2005**	Estimated at around 0.4
Risk for carbon leakage	Small since Indonesian refineries are state owned, Indonesia is a net importer of refinery products and there is high no-regret abatement potential	**Emission intensity of refineries in the EU**	~0.21 tCO_2e/tonne crude oil processed.
Sector boundaries	Including refineries but excluding gas and oil transport from and to the refineries. Covering CO_2 and CH_4.	**Typical abatement measures**	Co-generation, Energy efficiency projects Improved maintenance and process control

Note: some of the data sources provided contradicting information on the greenhouse gas emissions from Indonesian refineries. The figures used are based on expert opinions.

3.3.1 Description of the Sector

The aggregated capacity of Indonesian refineries increased in 2010 to just over 1.1 million barrels/day, equal to around 1.3% of the world's refining capacity.[71] The refinery capacity in Indonesia is distributed over around 8 refineries. Sources differ on the number of refineries that is actually operational in Indonesia. While some refer to 7 other state 9 refineries.[72]

The market is controlled by a single state-owned entity, Pertamina, who operates the majority of the country's refining capacity. Fuels in Indonesia are subsidised but Pertamina expects that the subsidies might be lifted in 2014.[73] The company is purchasing its crude oil against world prices while supplying its refined products in a subsidised market at fixed prices. According to the IEA this creates a cash-flow problem that makes it difficult for the company to invest in new capacity or energy efficiency.[74] The IEA therefore recommends corporatizing Pertamina and raise cash by selling shares.

The oil and gas industry in Indonesia is a vital source of state revenues of around EUR 7 billion in 2009.[75] However, on the other hand the government of Indonesia spends significantly more on fuel subsidies, up to EUR 14 billion in 2011, of which EUR 6 billion on gasoline.[76]

71 BP Statistical Review of World Energy 2011, excel sheets.

72 The web-site of Pertamina lists 6 operational refineries (http://www.pertamina.com/index.php/detail/read/refinery), while an IEA report from 2008 refers to 9 refineries (IEA, Energy Policy Review of Indonesia, 2008). Also PriceWaterhouseCoopers refers to 9 refineries: 8 from Pertamina and 1 (Tuban Refinery) operated by the Department of Energy and Mineral Resources (Oil and gas in Indonesia, 2010).

73 Bloomberg, Pertamina Expects Indonesia Fuel Subsidies to Be Lifted by 2014, (Jakarta, 2011).

74 IEA, Energy Policy Review of Indonesia, 2008.

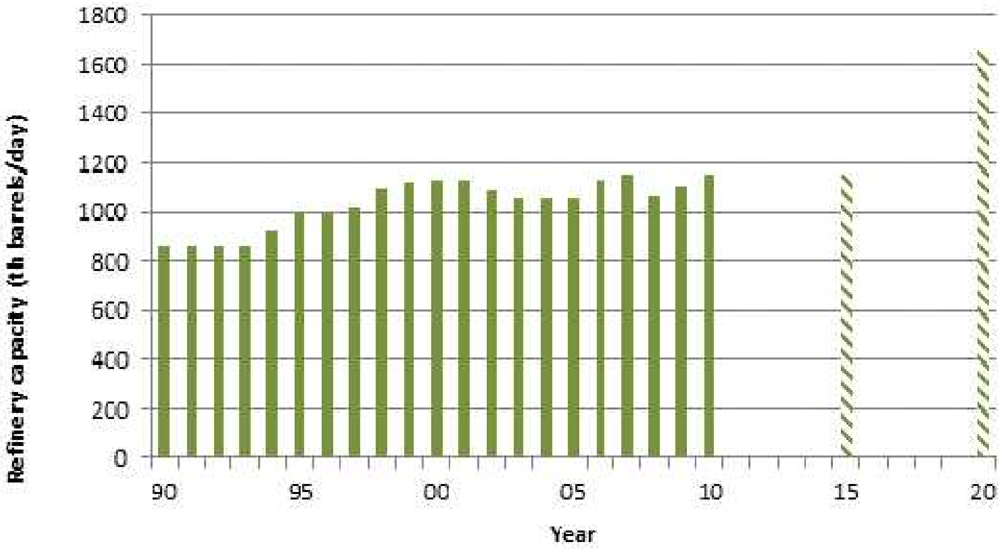
75 PriceWaterhouseCoopers, Oil and gas in Indonesia, 2010.

76 IISD, Indonesia's Fuel Subsidies: Action plan for reform, (Geneva, 2012), values converted from USD at a rate of 0.8 EUR/USD.

3.3.2 Trends in Production and Emissions

Indonesia is producing around 1.1 million barrels of crude oil per day and this is expected to remain relatively constant. The refining capacity in the country is currently 1 million barrels per day and the country relies partly on imported refined products. To reduce the dependence on imports, Pertamina announced plans to expand the capacity to 1.5 million barrels per day by 2015 or 2020.[77] If its financial position allows, Pertamina may decide to increase the capacity by replacing some of its old refineries with larger, more efficient refineries.[78]

Figure 12 Development of refinery capacity in the past and forecast for the future.



Indonesia's latest National Communication estimates the country's 2005 greenhouse gas emissions (hereafter "emissions") at 1.8 Gt. With 63% the majority of these emissions are from land use, forestry and peat fires (Figure 12). Indonesia reports total GHG emissions for the energy sector to be 280 Mt, increasing to 370 in 2005. However, only 84 Mton is from electricity, heat, oil & gas refining, increasing to 130-135 Mton in 2005.[79] When comparing this with the figures from on a study on the abatement potential far higher emissions are reported for 2005. This study estimated the 2005 emissions for the power sector at 110 $MtCO_2e$/year in 2005 and 122 $MtCO_2e$/year for oil and gas. These figures exceed what is reported in the national communication. These emissions are also high compared to the national production capacity and the emissions in the EU and US. Therefore, this analysis is based on GHG emissions from refineries of 22.5 $MtCO_2e$ in 2005, based on an expert opinion from Indonesia. In comparison with emissions from refineries in other countries and with the fuel production in Indonesia, this figure is more realistic.

Note however that there is a study planned by the Centre Data and Information for Energy and Mineral Resources (DCIEMR) for the refineries for 2013. That might shed light on the emissions from this sector.

Refineries generate most of the greenhouse gas emissions in the oil and gas sector. Emissions from refineries were responsible for around 75% of total oil and gas related emissions in the country

77 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010), BP Statistical Review of World Energy 2011, excel sheets.

78 IEA, Energy Policy Review of Indonesia, 2008., Indonesia's greenhouse gas abatement cost curve (2010).

79 Ministry of Environment, 2nd National Communication under the UNFCCC, (Jakarta, 2010), pages XI and II-4.

in 2005.[80] The remainder stemming from flaring of associated gas and methane leakage during transport and liquefaction of natural gas.

According to the report from Dewan Nasional Perubahan Iklim, emissions from Indonesian refineries are expected to increase with 36% between 2005 and 2030, mainly due to the planned expansion of refinery capacity.[81] With the use of more efficient refineries, the country foresees an increase in emissions that remains below the increase in production. While the emission figures are contradicted by the national communication we assume this conclusion holds.

3.3.3 *Carbon Intensity*

Comparing the carbon intensity of Indonesian refineries with those in the EU provides insight in the technical abatement potential.

The EU has 110 refineries under the EU ETS whose aggregated GHG emissions are just over 150 Mt CO_2e in the period 2005-2008.[82] According to the BP statistical survey the EU processed between 722 and 696 Mt crude oil in the same period. However, since some refineries under the EU ETS are outside the EU, e.g. in Norway the emission data might cover more refineries than the throughput data from BP. Still, considering that emissions might be over-estimated, these figures give a carbon intensity for refineries in the EU of around 0.21 tCO_2e/t crude oil.

Total emissions from refineries in the US were 214 Mt CO_2e in 2005.[83] In that year the sector processed around 758 Mt crude oil.[84] This gives a carbon intensity of around 0.28 tCO_2e/t crude oil.

The reported 2005 emissions from Indonesian refineries as being 91 MtCO_2e, including indirect emissions,[85] would give an exceptionally high emission factor. The installed capacity in that year was around 52 Mt/year crude oil.[86] If the refineries operated at full capacity the carbon intensity would be around 1.80 tCO_2e/t crude oil. If they operated below full capacity the carbon intensity would be even higher. Experts from ECN in Indonesia provided estimated that the refinery emissions are more in the range of 15-30 MtCO_2e/year. This would give a carbon intensity in the range of 0.29 and 0.58 tCO2e/t crude oil. For this analysis we took the average of the two, making 0.43 tCO_2e/t crude oil. Table 37 provides an overview.

Still, emission data from European refineries cannot be directly compared with emissions from Indonesian refineries, partly because the data on Indonesian refineries include indirect emissions while the figures from the US and EU ETS installations may not. Furthermore, many European refineries also generate electricity and products may differ.

Table 37 Indicative estimates of the carbon intensity of refineries in the EU, US and Indonesia

Country/region	Carbon intensity of refineries (tCO_2e/t crude oil)
Refineries under the EU ETS	0.21
Refineries in the US	0.28
Refineries in Indonesia	1.80 (based on date from BP and Dewan)

80 Tatrallyay & Stadelmann (2011). *Country Case Study Vietnam – Removing barriers for climate change mitigation*. University of Zürich.
81 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).
82 Ecofys, Methodology for the free allocation of emission allowances in the EU ETS post 2012, sector report for the refinery industry (2009).
83 US EPA, Available and emerging technologies for reducing greenhouse gas emissions from the petroleum refining industry,(2010).
84 BP Statistical Review of World Energy 2011, excel sheets.
85 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).
86 BP Statistical Review of World Energy 2011, excel sheets.

Refineries in Indonesia	0.43 (assumption based on the performance in surrounding countries)

3.3.4 *Policies and Measures*

The government of Indonesia ranks on a similar level as Vietnam, well below Chile and Brazil on the World Bank Governance Indicators.[87] The country scores particularly low on regulatory quality, "the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development". Several sources[88] quote weak enforcement of environmental legislation and corruption as key challenges for the country's climate policy.

Fuels in Indonesia are subsidised but Indonesia implemented laws for equal regulatory and legal treatment of private investors in the oil sector. Despite this removal of legal barriers, there have been little private investments in Indonesian oil refineries to date.[89]

Indonesia currently has no incentive schemes or penalties in place to stimulate energy efficiency measures. National energy policies from 2006 describe a need to conserve energy and defined a target to decouple economic growth from energy consumption. Furthermore the government aims at increasing energy prices to a level that "reflects the economic value of energy". This policy aims at diversifying the energy mix of Indonesia rather than targeting energy efficiency.[90]

Indonesia is participating in the World Bank's Partnership for Market Readiness (PMR). In the country's application to the PMR it expressed interest in participation in market mechanisms for mitigation action but had not yet made decisions on the design features of such a system.[91]

3.3.5 *Abatement Potential*

For the abatement potential the relative rather than the absolute figures from the report from Dewan Nasional Perubahan Iklim have been applied. This avoided the discrepancy with the national communication and production figures in the absolute emission date. The abatement potential at Indonesia's refineries is estimated at is 30% of the forecasted emissions from refineries in 2030. When fully implemented, the abatement options will reduce emissions by 4% compared to 2005 despite a 50% increase in refining output.[92]

From the overall abatement potential, 46% is available at negative abatement costs (see Table 38). This implies that the measures bring significant cost savings during the lifetime of the investment. There is only one option where the investment will not be completely offset by cost savings: the installation of cogeneration at refineries that are using waste heat. However, with 5 EUR/tCO_2e the abatement costs of this option are still below the current price of allowances within the EU ETS of 6.7 EUR.[93]

87 World Bank Governance Indicators, available at: http://info.worldbank.org/governance/wgi/index.asp.
88 University of Gothenburg, Indonesia Environmental and Climate Change Policy Brief, (Gothenburg, 2008); Transparency International, Corruption training for judges applied to emission reduction mechanisms (2010).
89 IEA, Energy Policy Review of Indonesia, (2008)
90 Ministry of Environment, 2nd National Communication under the UNFCCC, (Jakarta, 2010). Also the Nationally Appropriate Mitigation Action (NAMA) proposed by Indonesia to the UNFCCC lists "promotion of energy efficiency" and "shifting to low-emission transportation mode" as proposed actions.
91 Presentation from the National Council on Climate Change of Indonesia, Overview on Indonesia Market Readiness, Barcelona PMR Meeting, 30-31 May, 2011, available at: http://wbcarbonfinance.org/docs/Indonesia_Organizing_Framework_May_30_2011.pdf
92 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).
93 IntercontinentalExchange, 14 July 2012, available at: www.theice.com/emissions.jhtml.

Table 38 **Marginal abatement costs and potential of abatement options for refineries in Indonesia**[94]

Abatement option	Marginal abatement costs (EUR/tonne)	Potential by 2030 in % of total emissions
Co-generation (where the plant uses waste energy for heat or power generation)	5	14%
Energy efficiency projects requiring CAPEX at process unit level	-53	7.7%
Improved maintenance and process control	-79	5.8%
Procedural changes	-81	0.16%
Total		30%

When applying the growth forecast of emissions from refineries based on the report from Dewan Nasional Perubahan Iklim with the assumption that emissions in 2005 were around 23 $MtCO_2e$/year, these emissions will increase to 31 $MtCO_2e$/year in 2030. A 30% mitigation potential would then constitute an abatement potential of around 9 $MtCO_2e$/year. This potential is available against a net costs savings over the lifetime of the investments of around EUR 249 million. Significant potential lies in improving procedures, maintenance and process control. The large, financially feasible abatement potential indicates that there are barriers beyond the feasibility of energy measures. On the general and sector-specific level these include:

- Gathering and provision of timely and accurate energy data, to support good energy policy.
- Further support liberalisation of the oil and gas market with an independent, transparent market regulator, operating independently from the government. This can help attract investors.
- Abolish subsidised pricing for market-based price setting to reduce misallocation of public and private investments.
- Provide information to benchmark the Indonesian industry and reveal the energy efficiency potential.
- Financial position of Pertamina who sells at fixed prices while purchasing at the international market with fluctuating oil prices.[95]

3.3.6 Application of a Tradable Intensity Standard

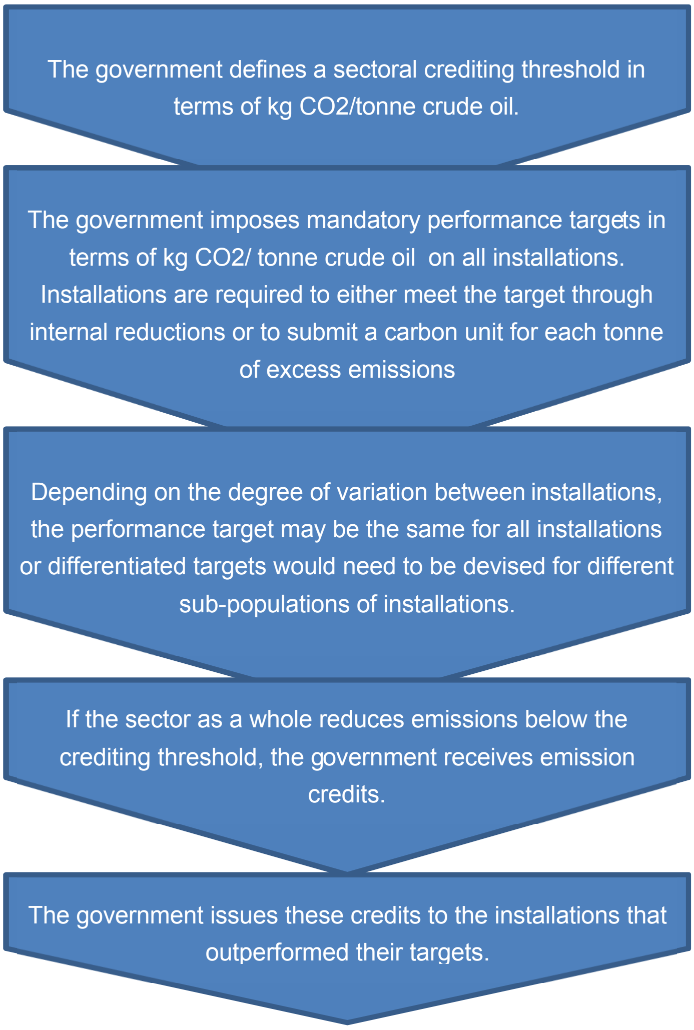
The Indonesian refinery sector would need to be reformed substantially in order for a carbon market-based instrument to be able to function. Carbon market mechanisms can put a price on carbon emissions, thereby incentivising emission reductions. This only works if the sector in which the mechanism operates is responsive to financial incentives. The large financially viable abatement potential in Indonesian refineries indicates that refineries are insufficiently responsive to financial incentives. Being state-owned, the companies' decision-makers might not show profit-maximising behaviour. Furthermore, Pertamina has a constant cash-flow problem and may lack the financial means, or access to the financial means for the necessary investments.

94 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).

95 IEA, Energy Policy Review of Indonesia, (2008).

Only once the low-cost mitigation measures have been developed, it may make sense to implement an emission crediting scheme based on a tradable performance standard as an intra-company trading system. The high level of government influence on the sector may help overcome concerns on the weak enforcement of environmental regulations in Indonesia.

The system would consist of only around 8 installations and, if small refineries are replaced with few larger ones, in the future potentially less. If the system operated in isolation from the international carbon market, there would hence not be much liquidity. As discussed in detail in the Brazil case study, it would therefore be recommendable to link the system to the international carbon market, allowing installations to use CERs and possibly also other internationally fungible units to comply with their targets.



Given the high level of government regulation in the sector, reforms are needed before a carbon crediting mechanism could work. Proposal 1 (government crediting system) might be more suitable for this specific case. In Proposal 1, the host country government would implement policies and measures to reduce sectoral emissions. All emission reduction credits would accrue to the host country government, which could use them to (co-)finance implementation costs. In parallel, supported NAMAs can lay the basis for a more market-based approach for the long term.

Before providing any kind of international support to reduce emissions from Indonesian refineries it should be clear what barriers exist currently to improve efficiency and reduce emissions. If this barrier, for example, is a lack of investment capital, a financing scheme might be more effective on the short term.
Under an approach defined in Proposal 1, the Indonesian government could negotiate for a loan from international donors to improve the efficiency of the refineries, lower production costs and thereby fuel prices, and re-pay the loan with the money the government can save on subsidies.

Credits should arguably only be generated for emission reductions that go beyond the no-regret potential. An appropriate crediting threshold might therefore be to set an intensity target that would be equivalent to stabilising emissions at about 25 Mt/year and then reduce to about 22.5 Mt/year by 2030. Quantification would require further research on the carbon intensity of the Indonesian refineries and the abatement potential in a scenario where capacity is expanded.

Carbon leakage is a small risk for Indonesian refineries. Studies on the EU ETS identify refineries as being at risk for carbon leakage,[96] However, the risk that due to mandatory carbon constraints Indonesian refining capacity will be moved abroad is low because:

- Indonesian refining capacity is currently state –owned,
- Indonesia is so far not even self-sufficient in refined products and domestic demand is projected to increase substantially,
- Indonesian refineries have a substantial financially feasible abatement potential. Imposing and enforcing a carbon constraint may therefore actually enhance their competitiveness because it would force operators to actually mobilise this potential and thereby lower their production costs.

A more definite statement would require a detailed analysis of relative production costs, impacts of carbon pricing and trade intensities.

Table 39 Barriers to implementation of a sectoral mechanism and suggested solutions

Barriers	Solutions
Insufficient data	Capacity building and research, potentially under a NAMA
Lack of competition and profit-maximising behaviour	Market liberalisation and a programme to reduce fuel subsidies
Pertamina owns most refining capacity and investment decisions are probably made centrally	Privatise Pertamina and increase the number of companies that are participating in the scheme
Lack of investment capital	Move to market-based pricing and raise funds by selling shares from the refineries
Small sector size leading to low carbon market liquidity	Link the sectoral market to international carbon market
Weak government enforcement capacity and corruption	Capacity building and trainings

3.3.7 Emissions Reduction Potential under Different Scenarios

In this section the emission reduction potential is defined against the emission level in a BAU scenario. It is important to note that the assumptions underlying the BAU scenario are arbitrary and hence political, specifically if the scenario is used to define the reference level of emissions against which emission reductions are determined. Within the Indonesian situation of the refinery sector, and knowing the economic and political context, we have developed four relevant scenarios. To all scenarios we applied the following assumptions:

- The Indonesian government has announced plans that Pertamina would increase its refining capacity with 500,000 barrels per year within the next 5-10 years. In all scenarios, we assume that these plans will become reality and that capacity will gradually increase to the foreseen level in 2020;
- The load factor for Indonesian refineries was 94% in 2005. Since there is no indication that this will change we assume that the load factor will not change until 2020.

Table 40 Abatement potential for Indonesian refineries under different scenarios

Scenario	Emission reductions (average 2012-2020)
No-abatement scenario	0 $MtCO_2e$/year
BAU scenario	3 $MtCO_2e$/year
NMM carbon intensity cap scenario	10 $MtCO_2e$/year
NMM carbon emissions cap scenario	6 $MtCO_2e$/year

96 Dröge, S. and S. Cooper (2010): Tackling Leakage in a World of Unequal Carbon Prices. Cambridge: Climate Strategies.

No-abatement scenario

In the no-abatement scenario no abatement measures will be taken and emissions will keep pace with the expansion of refinery capacity. This will happen if the new capacity will have the same carbon intensity as the existing capacity (i.e. the carbon intensity (0.43 tCO_2e/t crude oil) of refineries in 2005 holds until 2020). This is a hypothetical scenario which merely provides a reference for the following three scenarios.

BAU scenario

In the BAU scenario the planned policies and abatement measures will be implemented. Emissions will grow but not proportionally, from 22.5 $MtCO_2e$ in 2005 to 28 (2020) and 31 (2030) $MtCO_2e$. This means that the carbon intensity for the Indonesian refineries will decrease from 0.43 tCO_2e/t crude oil in 2005 to 0.35 tCO_2e/t crude oil in 2020. That would be closer to the average carbon intensity of refineries in the US in 2005 (0.28 tCO_2e/t crude oil) but is above the average emission level of installations under the EU ETS (0.21 tCO_2e/t crude oil).

Considering the abatement costs curves for Indonesian refineries, the BAU scenario could be achieved when:

- In existing capacity: implementing the improved procedures, maintenance and process control from 2012 onwards, reducing emissions from existing capacity with 1.9 $MtCO_2e$/year in 2020 compared to the no-abatement scenario;
- In existing capacity: further improvement of the existing capacity between 2015 and 2020 by implementing energy efficiency measures. For 2016-2020 these improvements would reduce emissions from existing capacity with 2.3 $MtCO_2e$/year.

In this scenario the emission reductions compared to the no-abatement scenario in both existing and new capacity, will be on average 3 $MtCO_2e$/year in 2020 when both the above measures are implemented.

NMM carbon intensity cap scenario

In the NMM carbon intensity cap scenario the Indonesian government commits to a carbon intensity performance benchmark for the refinery sector. The benchmark will be enforced with an installation-based crediting mechanism. The benchmark for both existing and new plants will be 0.21 tCO_2e/t crude oil, similar to the level in the EU ETS in 2005. Note here, however, that the Indonesian emission data includes indirect emissions while the EU ETS data does not.

Achieving this intensity target requires serious abatement effort in existing refineries up to even replacing existing refineries with a new, larger and more efficient installations to benefit from new technologies and economies of scale. In either case serious investments will have to be made. Given the cash constraints refinery operators are facing, emission intensity targets should be balanced against their ability to attract the funds required for these investments.

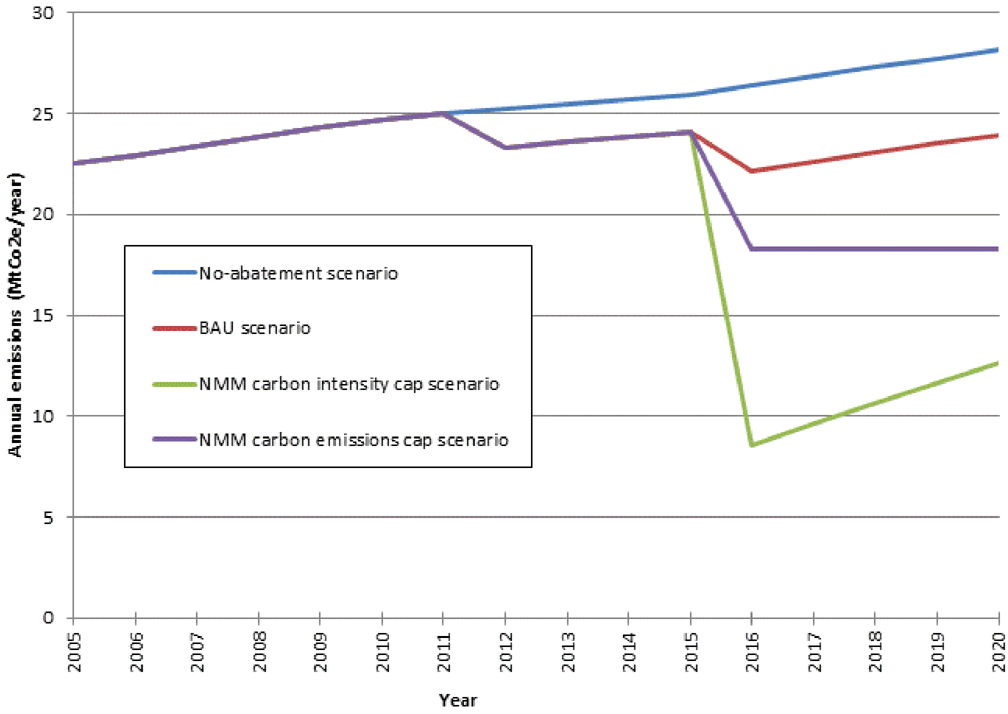
If the benchmarks are complied with, the sector's emissions will decrease to 17 $MtCO_2e$ by 2020 for the same refinery capacity, realising a reduction of 11 $MtCO_2e$/year compared to the BAU scenario of 28 $MtCO_2e$/year in 2020. On average, an abatement potential of 10 $MtCO_2e$/year could be realised within this scenario for the period 2012-2020.

NMM carbon emissions cap scenario

In the NMM carbon emissions cap scenario the Indonesian government implements an installation-based crediting mechanisms with an absolute cap on the emissions of 22.5 $MtCO_2e$/year, the emission level of the sector in 2005. Since production capacity will expand, the carbon intensity of the refineries will have to improve to comply with this absolute target. The carbon intensity will need to decrease from 0.43 tCO_2e/t crude oil in 2005 to 0.28 tCO_2e/t crude oil in 2020. The abatement potential that could be realised would be 6 $MtCO_2e$/year for the period 2012-2020. If the carbon intensity would remain at the same level as in the BAU scenario then the refinery capacity would decrease significantly: from 81 Mt crude oil to 65 Mt crude oil in 2020.

Figure 13 below presents the trends in emissions for the Indonesian refineries over time for the different scenarios. The vertical axis represents the level of emissions in $MtCO_2e$, where the horizontal axis represents the timescale of the scenarios (2005-2020).

Figure 13 Analysis of emission trends for Indonesian refineries in different scenarios



In the above scenarios we have analysed the impact of emission caps and carbon intensity performance benchmarks for the refinery sector in Indonesia. However, there are other parameters as well that significantly impact the emission reduction potential of the sector.

Table 41 Sensitivity of the emission reduction estimates

Parameter	Impact on emission reductions
Energy prices (e.g. oil price)	Increasing world energy prices (i.e. oil prices) will put upward pressure on the operational costs for the Indonesian refineries. The cost increase cannot be passed through to consumers directly since consumer fuel prices are periodically fixed. As such, the refineries will face cash-flow issues limiting their ability to make investments in energy efficiency, unless the Indonesian government decides differently on Pertamina's refinery capacity.
EU ETS price	If in the period up to 2020 the EU ETS price increases, a larger part of the abatement potential becomes financially attractive. However, in the case of the existing Indonesian refineries, the abatement option with the highest marginal costs is cogeneration at 5 EUR/tonne emissions reduced. That option would be viable even at the current price level of allowances under the EU ETS of around EUR 6. For new refineries a higher carbon price might incentivise the adoption of more efficient installations than those would have been installed at lower prices.
Subsidy scheme	The Indonesian government subsidizes the price of refined oil for domestic consumers,

	such that the domestic price is lower than the world market price. Per year, the difference is calculated and paid out to Pertamina for the refined oil forthe domestic market. An increase or decrease in the subsidy scheme will significantly impact the sector's refining capacity and production potential. The subsidy scheme predominantly determines the direction, policy and (growth) plans for the sector.

3.4 Case Study 4: South Africa – Power Sector

South Africa's power sector at a Glance			
Number of installations	~35 power stations of which 19 coal based.	**Absolute emissions**	291 $MtCO_2e$ in 2000
Number of companies	6 companies	**Percentage of national emissions**	66%
Pipeline of CDM projects	22 (all renewable)	**Estimated emission growth**	1,640 MtCO2e by 2050 with unconstrained emissions
Emissions reduction potential	Up to 31 MtCO2e in 2012-2020	**Emissions intensity in 2010**	0.80 tCO_2e/MWh
Carbon leakage potential	Low, since the impact of the proposed scheme on the power price is expected to be low.	**Emission intensity of power sector in the EU**	0.36 tCO_2/MWh in 2010
Sector boundaries	Power stations that generate electricity from coal.	**Typical abatement measures**	Combustion of discarded coal IGCC power generation Super-critical coal Catalytic combustion of coal

3.4.1 *Description of the Sector*

South Africa has considerable fossil fuels reserves, primarily coal (figures vary between 15-60 billion tonnes) and uranium. About 92% of South Africa's electricity is generated via coal-firing[97]. If the available coal reserves allow, it is expected that coal-firing will continue to dominate power generation until 2040. However, recent publications point at an over-estimation of the South African coal reserves, challenging the likelihood that these expectations become reality.[98]

South Africa is a middle-income country with a GDP of USD 357.3 billion in 2010 of which 31% is attributable to the industry sector[99]. The electricity demand is closely following supply, which is threatening the reliability of power supply in South Africa.[100] The growth in electricity demand mainly comes the urban areas: only 55% of the rural population and 88% of the urban population has access to electricity in South Africa[101]. A publication from Statistics South Africa estimated the annual electrification rate in 2008 at 82,6%. [102]

The electricity sector in South Africa has an important and strategic regional function, because it generates about 45% Africa's electricity. According to the Ministry of Energy of South Africa, it is one of the four cheapest electricity producers in the world. [103] The largest power company is Eskom and produces about 96% of South Africa's electricity. In 2002, Eskom became a public, limited

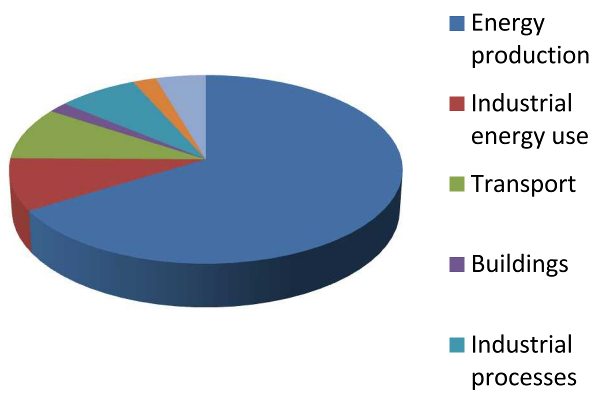
97 South Africa (2010), *PMR Template for Organizing Framework for Scoping PMR Activities.*
98 Hartnady, C.J.H., South Africa's diminishing coal reserves, South African Journal of Science, Article #369.
99 U.S. Department of State, available on: <http://www.state.gov/r/pa/ei/bgn/2898.htm>. The industry sector includes mining, the production of minerals, motor vehicles and parts, machinery, textiles, chemicals, fertilizer, information technology, electronics, other manufacturing, and agro-processing.
100 Business live, SA's electricity reserve margin below global norm, 23 March 2012.
101 Energy Information Administration, *Country Analysis Brief - South Africa,* October 2011, available on: <http://www.eia.gov/emeu/cabs/south_africa/pdf.pdf>.
102 Statistics South Africa , Statistical release - General Household Survey, (Pretoria, 2008), Page 29.
103 Ministry of Energy of South Africa, see: <http://www.energy.gov.za/files/electricity_frame.html> and <http://www.eskom.co.za >

liability company, completely owned by the government. Next to Eskom, another small number of international and national energy companies are active in the market, such as BHP Billiton and Exxaro. These are typically mining companies for which power generation is in support of their mining activities. Besides Eskom, private generators are responsible for about 3% of generation and municipalities for 1%[104].

3.4.2 Trends in Production and Emissions

South Africa is highly dependent on fossil fuels. In 2005, South Africa was responsible for about 1% of global greenhouse gas emissions and about 18% of emissions in Sub-Saharan Africa came from South Africa[105]. South Africa's population is expected to reach 62 million by 2025, coupled with a steady growth in GDP. If South Africa continues on its current growth pathway, its emissions are expected to quadruple by 2050, reaching 1,600 $MtCO_2e$.

Figure 14 South Africa's national emissions in 2000



As part of the country's strategy to curb emissions, a report on Long Term Mitigation Scenarios (LTMS) was developed for the South African Department of Environment Affairs and Tourism in 2006. The report considers South Africa's emissions growth under different scenarios and discusses mitigation options, emission reduction potential and abatement costs. The LTMS outcomes were the basis for the South African government's decision that the country's absolute GHG emissions must peak by 2020-2025 at the latest and then decline.[106]

In the LTMS, the government developed two scenarios:

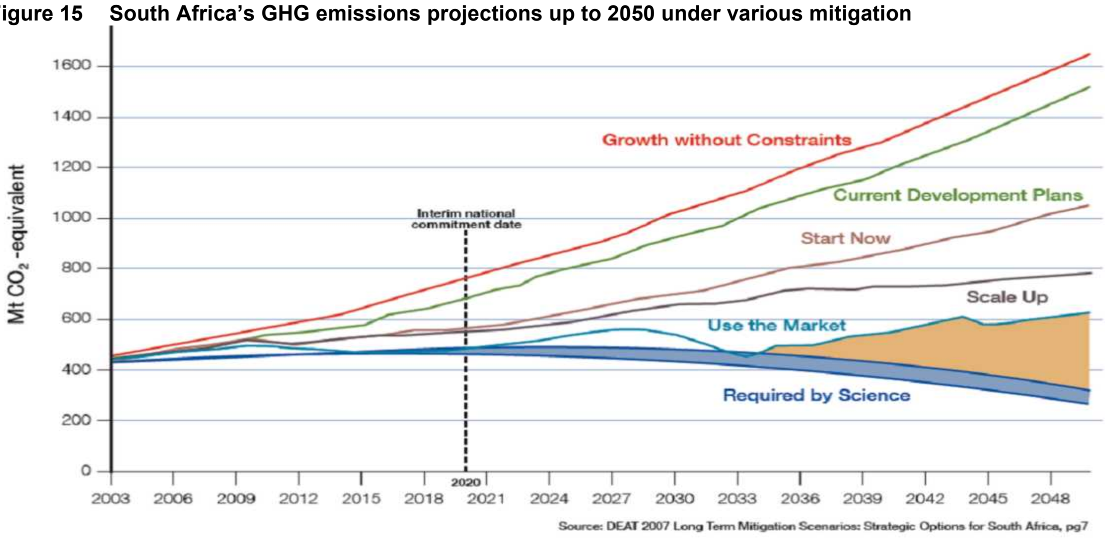
1. "Growth Without Constraints" ('GWC') is the scenario without any mitigation action. It is expected to lead to an almost four-fold increase in GHG emissions – from 446 $MtCO_2e$ in 2003 to 1,640 $MtCO_2e$ by 2050. The main driver for the emission growth would be rising energy demand in industry and transport.
2. "Required By Science" ('RBS') is the scenario depicting what would happen if South Africa reduces absolute emissions to 30%-40% below 2003 emission levels by 2050. (See Figure 15).

[104] South Africa (2011), *South Africa's Second National Communication under the UNFCCC,* Department of Environmental Affairs, Pretoria, p. 14.

[105] World Resource Institute, *Annual Report – 2010,* available at: <http://www.wri.org/publication/wri-annual -report-2010>.

[106] Energy Research Centre 2007 Long Term Mitigation Scenarios: Technical Summary, Department of Environment Affairs and Tourism, Pretoria, October 2007.

Figure 15 South Africa's GHG emissions projections up to 2050 under various mitigation

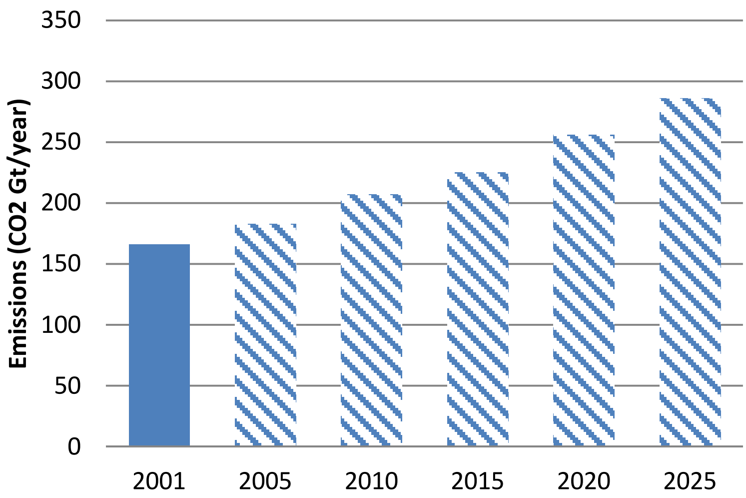


Total emissions from energy production in 2000 were 291 $MtCO_2e$, accounting for 66% of national emissions[107]. The energy production saw the largest emissions growth between 1990 and 2000 of 37%. Capacity expansion is likely to come from coal, as it is the least expensive option. Therefore, renewable energy sources would need support to compete with fossil fuelled generated electricity.

3.4.3 *Carbon Intensity*

South Africa hosts one CDM project that uses renewables[108]. This project uses a grid baseline of about 1 tCO_2/MWh. In comparison, the carbon intensity in the EU is about 0.36[109] tCO_2/MWh against 0.80 tCO_2e/MWh of South Africa[110]. If the projected growth of electricity demand will be met by increasing the use of coal without use of CCS, the carbon intensity of the sector will grow. However, large-scale deployment of CCS in the timeframe of an NMM, up to 2020, does not seem realistic given its high costs and state of development.

Figure 16 Emission forecast for the South African power sector



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[107] South Africa (2011), *South Africa's Second National Communication under the UNFCCC,* Department of Environmental Affairs, Pretoria, p. 32.

[108] Bethlehem Hydroelectric project, UNFCCC reference 2692.

[109] Eurelectic, Power Choices Pathways to Carbon-Neutral Electricity in Europe by 2050 (2010).

[110] OECD, *Climate Change, Sustainable Development and Energy: Future Perspectives for South Africa,* 2002, p. 11.

3.4.4 Policies and Measures

In the South African Integrated Resources Plan for Electricity (IRPE) of March 2011, the government decided to improve the electricity distribution network and fast-track projects by independent power producers[111]. This policy also aims at opening reducing the market share of the state owned power company Eskom to the benefit of other producers.

The most prominent policy measure is the increase in electricity tariffs for all consumers. Eskom's latest tariff increase has been approved by the National Energy Regulator of South Africa (NERSA), the agency which is responsible for regulating energy prices and reducing the monopolistic market structure in the energy sector[112]. The standard tariffs of Eskom have increased with 24.8% between 2010-2011 and will be increased further by 25.8% between 2011-2012 and another 25.9% for 2012-2013. As a result the average electricity tariff will double over the next three years[113].

The market for CDM projects in South Africa for renewable energy projects is significant. Currently there are twenty-two renewable energy projects in the pipeline of which one has been registered. Most of the projects are based on solar and wind energy. Certified Emission Reductions (CERs) issued from South African CDM projects that are registered after 2012 will not be eligible for compliance under the EU ETS, since eligibility will be limited to CERs from Least Developed Countries. This may reduce demand for these credits and affect the attractiveness of the CDM for project developers in South Africa.

3.4.5 Abatement Potential

The costs and potential for various abatement options, listed in the LTMS report, are presented below. Abatement costs vary depending on the source and the underlying assumptions used. Abatement cost estimates are therefore presented from two different sources. According to the LTMS report, the abatement potential in the power sector is 14 Mt/year at an average cost of 3.1 EUR/tonne. Nuclear options have been excluded.

Table 42 Mitigation options and abatement costs in the power sector in South Africa[114]

Mitigation option	National potential ($MtCO_2e/yr$)	Costs ($EUR/tCO_2e/year$)
Fuel switch to natural gas	0.4	14
IGCC power generation	4.4	5
Super-critical coal	3.6	3
Gas-coal substitution for synfuel feed	5.8	1.4
Total potential within power sector	**14**	**Annual costs: 44 mln EUR** **Average costs: 3.1 EUR/tCO_2e /year**

The mitigation potential at the power demand side exceeds the potential at the power generation installations. This potential is with 15 $MtCO_2e$/year at 1 EUR/tonne/year for residential consumers and another $MtCO_2e$/year at the same price for industrial consumers. On the supply side of coal there is an abatement potential of 6.5 Mt/year at a negative costs of EUR 10. The demand side measures and mitigation action in coal supply could potentially be supported with a domestic offset scheme operating in parallel to targets for the power sector.

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111 Department of Energy of South Africa, *Integrated Resources Plan for Electricity, 2010-2030,* March 2011, p. 72, available on: <http://www.idasa.org/media/uploads/outputs/files/irp2010-2030_final_report_25mar2011.pdf>.

112 Department of Energy of South Africa, see: <http://www.energy.gov.za/files/electricity_frame.html>.

113 NERSA, see: <http://www.nersa.org.za/>.

114 World Bank (2002), *South African national strategy study on Clean Development Mechanism,* Program of national CDM/JI strategy studies (NSS program), Washington DC.

With regard to renewable energy, solar and wind energy are the primary options for South Africa. The theoretical and technical potential of solar and wind energy are large. The technical capacity potential for wind is estimated at 80 TWh and for solar water heating (SWH) at 47 TWh a year. So far this potential has been explored only to a limited extend. The total installed wind capacity in 2009 was 8.4 MW with wind farms in Kipheuvel and Darling. The solar energy potential in use is 744 MW. The main solar energy technologies applied are solar water heaters for domestic use and small photovoltaic (PV) systems for off-grid applications. In 2009 there were no large solar power plants operational in South Africa.[115] If South Africa wants to meet its target to have 42% of all new electricity generation capacity up to 2030 from renewable energy sources, it will have to significantly speed-up the adoption of renewable energy sources. As a first step, a number of solar power plants are planned to be built.[116]

Table 43 Potential energy supply from the different renewable energy technology by 2030 (TWh)[117]

	Theoretical potential	Technical potential	Mid-term potential	Economic potential
SWH	70	47	31	17
Wind	184	80	28	23
Concentrating solar power	2 361 300	1 000	121	52
PV (>1 MW)	2 361 300	+/- 1 000	2	0

3.4.6 Application of a Tradable Intensity Standard

Electricity production is basically a state-owned monopoly, with Eskom producing about 96 % of South Africa's electricity. A tradable performance standard would hence need to be established as an intra-company trading system. Given the currently very high reliance on coal, this threshold would probably be correspondingly high initially, e.g. at about the current grid intensity of 800g CO_2/kWh. An inclusion threshold could for example be defined at the level in the EU ETS, which is 20MW.

If the inclusion threshold was set at 20MW, the system would include at least 35 power plants. This may be enough for internal trading, but as discussed in detail for the Brazil case study to enhance liquidity it would be recommendable to link the system to the international carbon market, allowing installations to use CERs and possibly also other internationally fungible units to comply with their targets.

Due to its character as a state-owned monopoly, the sector may not be very responsive to financial incentives. Therefore, market-based instruments may only have a limited effectiveness. Analysts even question the viability of a multi-sector trading system which would in principle have more market actors, but still very few in the case of South Africa - "when the particular market structure of the South African energy sector is examined, it is apparent that the existence of concentrated energy supply markets, monopoly power in power generation, and a small number of liquid fuels

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115 United Nations Energy Programme, *Enhancing Information for Renewable Energy Technology Deployment in Brazil, China and South Africa,* 2011, available on: https://www.ises.org/ISES.nsf/f3e5b699aa79d0cfc12568b3002334da/91280b54fe251040c125799e0055e05d/PageContent/M2/UNEP%20Enhancing%20Report_pda_200112_links_high.pdf?OpenElement , accessed 5 July 2012.

116 See: http://www.electronicsweekly.com/Articles/13/02/2012/52951/soitec-funded-for-50mw-solar-power-plant-in-south-africa.htm and http://www.abb.com/cawp/seitp202/381159470001e783c1257910002d2e31.aspx, accessed 5 July 2012.

117 Edkins, M., A. Marquard and H. Winkler, *Assessing the effectiveness of national solar and wind energy policies in South Africa,* June 2010, p. iii, available on: http://www.erc.uct.ac.za/Research/publications/10Edkinesetal-Solar_and_wind_policies.pdf, accessed 5 July 2012.

refineries impose serious concerns about the ability to construct a competitive, liquid and efficient emissions trading market."[118]

Therefore, Proposal 1 might be more suitable for this sector than Proposal 2. In this system, the South African government would directly implement or mandate actions to reduce sectoral emissions. All emission reduction credits would accrue to the South African country government, which could use them to (co-)finance implementation costs.

In addition, renewable energy and energy efficiency would be only indirectly incentivised through a power plant intensity standard, through the resulting price increase of power from fossil fuels. And since crediting units would only need to be bought for excess emissions rather than each tonne of emissions, the price increase of fossil fuel power generation would probably be modest. Under Proposal 1, it would be possible to define a crediting threshold for all power production.

The risk that production capacity may move to other countries when faced with a carbon constraint is highly location- and sector-specific. In the South African power sector Eskom, as main producer, could increase import of electricity potentially together with expanding capacity in the country's to which South Africa. This would avoid increasing capacity in South Africa and paying for possible excess emissions. In the proposed NMM system emission units would only need to be bought for excess emissions rather than for each tonne of emissions, so the impact on generation costs in South Africa might be relatively modest. The risk of leakage is therefore probably low. Another indication for this may be that literature on the possibility of introducing emissions trading in South Africa apparently discusses leakage only with respect to industry.[119]

Table 44 Barriers to implementation of a sectoral mechanism and suggested solutions

Barriers	Solutions
Possibly insufficient data for installation-level scheme	Capacity building
Relatively small sector size leading to low carbon market liquidity	Link to international carbon market
Monopolistic sector structure limits applicability of emissions trading	Use Proposal 1 rather than 2
Possibly insufficient government implementation capacity	Capacity building and trainings

3.4.7 Emissions Reduction Potential under Different Scenarios

In this section we assess the emission reduction potential of the power sector in South Africa under different policy relevant scenarios. A no-abatement scenario has been established based on the 'Base case' for the power generation capacity and emission projections in South Africa by the Department of Energy (DoE) in their 'Integrated Resource Plan for Electricity 2010-2030'(IRPE 2010-2030). Emission levels are calculated, including the impact of potential abatement measures, under different scenarios are compared to the emission projections of the IRPE 2010-2030. One of the scenarios (the NMM carbon intensity cap scenario) includes the assumption that a tradable intensity standard will be implemented and operationalized. It is important to note that the reference and BAU scenario in this case study are based on the sector forecasts presumed by the South African DoE. Within the South African situation of the power sector, in which we take into account the large potential for coal-fired generated electricity by 2030, we have developed four relevant scenarios.

[118] Goldblatt, M., 2010a, 'A comparison of emission trading and carbon taxation as carbon mitigation options for South Africa', in: H. Winkler, A. Marquard, M. Jooste (eds), Putting a Price on Carbon: Economic Instruments to Mitigate Climate Change in South Africa and Other Developing Countries, Proceedings of a Conference held at the University of Cape Town, 23 – 24 March 2010, www.erc.uct.ac.za/Research/publications/10Winkler- et-al_ERC_Conference_Proceedings. pdf, accessed 17 July 2012.

[119] See e.g. Vorster, V, Winkler, H and Jooste, M. 2011. Mitigating climate change through carbon pricing: An emerging policy debate in South Africa. Climate and Development Vol. 3, No. 3, pp. 242–258

In developing the scenarios we applied the following assumptions:

- For the no-abatement scenario, we assume that the power sector, in terms of its emissions and capacity, will develop along the lines of the 'Base case' of the South African DoE, listed in their IRPE 2010-2030.[120] As such, we assume that the 'Base case' of the IRPE 2010-2030 represents the power sector in the "Growth Without Constraints" scenario of the LTMS report. This implies that we assume that no abatement potential will be realised in the n-abatement scenario;
- For the BAU scenario, we assume that the power sector, in terms of its emissions and capacity, will develop along the lines of the 'Emissions-1' scenario of the South African DoE, listed in their IRPE 2010-2030. The emissions projection in the 'Emissions-1' scenario is in line with the emission growth of the sector that is reported upon in the National Communication, indicating that the sector will face an emission constraint of 275 MtCO2/year after 2024. In the BAU scenario, we assume that the emission constraint serves as a ceiling for emission growth;
- It is assumed that the abatement options for the power sector will be implemented during 2011-2012 with the indicated abatement potential being realised from 2012 onwards. We assume that it is not realistic that CCS will be deployed before 2020 and as such we do not take this option into account;
- Two scenarios will include the use of carbon market incentives or emission caps. These will enter into force after 2015. This is in line with the foreseen time framework for concluding an agreement for the New Market Mechanism

Table 45 Abatement potential for Electricity generation in South Africa under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement scenario	0 $MtCO_2e$/year
BAU scenario	14 $MtCO_2e$/year
NMM carbon intensity cap scenario	23 $MtCO_2e$/year
NMM carbon emissions cap scenario	31 $MtCO_2e$/year

No-abatement scenario

In the no-abatement scenario no abatement measures will be taken and emissions will keep pace with the forecast electricity generation capacity of the IRPE 2010-2030. The same carbon intensity of 2005 (0.82 tCO_2e/MWh) will hold for the overall electricity generation until 2020. This is a hypothetical scenario which merely provides a reference for the following three scenarios.

BAU scenario

In the BAU scenario the planned policies of the IRPE 2010-2030 for the power sector, mainly the 'Emissions-1' scenario, will be implemented, in line with the emission constraint of 275 $MtCO_2$/year indicated in the National Communication. Emissions will grow from 237 $MtCO_2e$ in 2010 to 259 (2015) and will be capped to 275 $MtCO_2e$ after 2017. The capacity of coal-fired generated electricity will increase tremendously after 2010. However, since the sector faces and emission constraint, the carbon efficiency will improve over time with the carbon intensity decreasing from 0.91 tCO_2e/MWh in 2010 to around 0.77 tCO_2e/MWh in 2020. This is significantly higher than the average carbon intensity of the power sector within the EU-27 of around 0.36 tCO_2e/MWh in 2005[121].

[120] South African Department of Energy (2011) Government notice: Electricity regulations on the Integrated Resource Plan 2010-2030, Government Gazette of 6 May 2011, Pretoria, South Africa.

[121] Source: Eurelectric, Power Choices study "Pathways to Carbon Neutral Electricity in Europe by 2050"

Considering the abatement options for the South African power sector, the BAU scenario could be achieved when the abatement options for the power sector itself are implemented. In terms of abatement potential, the emissions can be reduced with 14 $MtCO_2e$/year compared to the reference scenario for the same electricity generation capacity. Moreover, next to the abatement potential in the sector a lot of demand-side abatement opportunities exist. However, these opportunities would require investments from the power sector consumers.

NMM carbon intensity cap scenario

In the NMM carbon intensity cap scenario the South African government commits to a carbon intensity performance benchmark for the power sector. The benchmark will be enforced via a tradable intensity standard along the line of Proposal 2. The performance benchmark lies between the carbon intensity level of 0.36 tCO_2e/MWh of the power sector within the EU-27 in 2005 (10%) and the carbon intensity level in the respective year of the South African sector in the BAU scenario (90%). This composition of the carbon intensity provides a realistic perspective on further emission reductions beyond the emission constraint of 275 $MtCO_2e$/year of the National Communication.

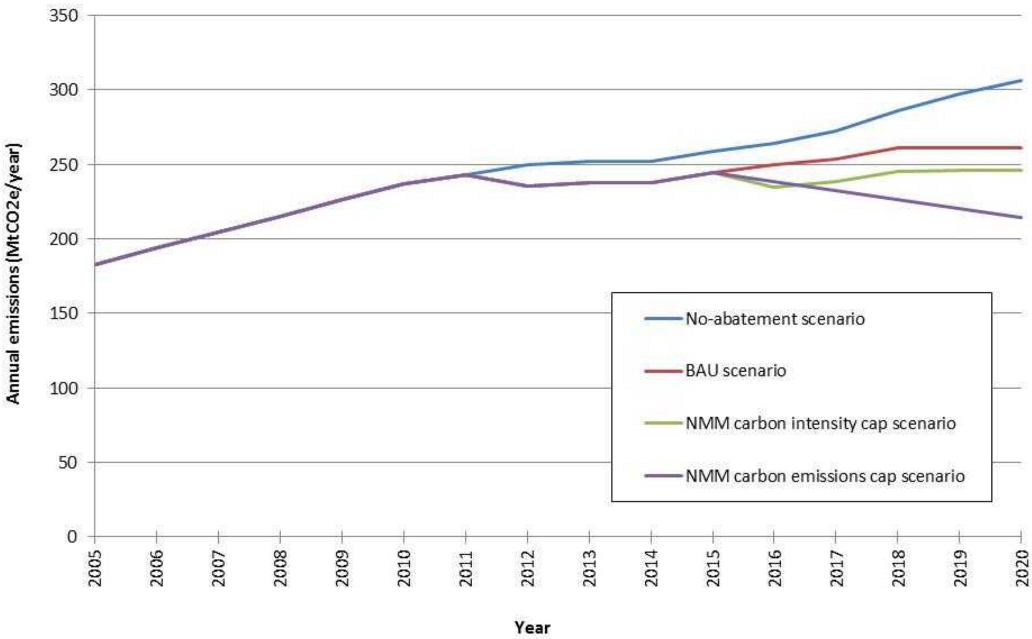
The carbon intensity performance of the sector has been rather stable over time, but significantly higher than the EU's average carbon intensity of the power sector. Therefore, the additional impact of a performance target upon the 'indicated' abatement options are significantly high and could only be realised when a large part of the existing capacity would be replaced by renewable energy sources. The sector's emissions would decrease to 260 $MtCO_2e$ by 2020 despite the capacity expansion of coal-firing forecasted in the IRPE 2010-2030, realising a reduction of 29 $MtCO_2e$/year in 2020 compared to the BAU scenario. On average, an abatement obligation of 23 $MtCO_2e$/year should be realised within this scenario for the period 2012-2020. Part of the additional abatement obligation, compared to the obligation in the BAU scenario, could be realised via the 92 TWh of economic potential for renewable energy sources in South Africa.

NMM carbon emissions cap scenario

In the NMM carbon emissions cap scenario the South African government implements an absolute cap on the emissions of 228 $MtCO_2e$/year by 2020, corresponding to the announced national pledge of 34% below the emission level in the no-abatement scenario by 2020. The carbon intensity will need to decrease from 0.91 tCO_2e/MWh in 2010 to 0.64 tCO_2e/MWh in 2020 in order to achieve emission target and as such also here significant improvements to the sector's efficiency would be needed. The abatement potential that could be realised within this scenario would be 31 $MtCO_2e$/year for the period 2012-2020.

Figure 17 below presents the trends in emissions for the power sector in South Africa over time for the different scenarios. The vertical axis represents the level of emissions in $MtCO_2e$, where the horizontal axis represents the timescale for the scenarios.

Figure 17 Analysis of emission trends for the South African power sector in different scenarios



3.5 Case Study 5: Vietnam – Cement Sector

Vietnam, Cement Sector at a Glance			
Number of installations in Vietnam	110 installations with a total capacity of 71 Mt.	**Absolute emissions**	40 Mt CO_2e in 2010
Number of companies	51 integrated cement plants (2012)	**Percentage of national emissions**	± 25% in 2010, including both process and fuel and energy related emissions
Number of CDM projects in the pipeline	None	**Estimated emission growth**	40 Mt in 2010 to 55 Mt in 2020
Emissions reduction potential	Up to 41 MtCO_2e/year	**Emissions intensity in 2009**	0.8 tCO2/t cement
Carbon leakage potential	Probably low due to high no-regret potential	**Emission intensity of cement sector in the EU**	0.7 tCO2/t cement
Sector boundaries	Aligned with the EU ETS: Production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day.	**Typical abatement measures**	Blending to reduce clinker content, Substitution of limestone, Fuel switch, Energy efficiency, Power cogeneration

3.5.1 Description of the Sector

Vietnam is the eighth largest cement producer in the world, after China, India, Russia, United States, Russia, Japan and South Korea. In 2012, there were 51 integrated cement plants in Vietnam, with another eight plants expected to come online this year.[122] Most of these included rotary kiln cement production, with vertical kiln cement production accounting for less than 5% of total production. Vietnam had a cement production capacity of 57 million tons of cement per year in 2010. In 2012, the production is expected to reach 73 Mt – in other words, a 30% increase over 2010.[123]

The economic value of the cement sector in Vietnam is estimated to be EUR 3 billion, assuming this year's forecasted output of 73 Mt and a price per tonne of EUR 44. The cement sector thereby contributes to almost 4% of the country's GDP.[124] This is expected to increase further to EUR 6.6 billion by 2020, given forecasted output of 128 Mt and a price per tonne of EUR 51 by 2020.[125]

The Vietnamese cement sector is being transferred from a centrally-planned, state-run enterprise into a market economy with different players. However, the state-owned Vietnamese Cement

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[122] Global Cement, available on: http://www.globalcement.com/images/stories/documents/articles/eGC-April2012-66.pdf
[123] Global Cement, available on: http://www.globalcement.com/magazine/articles/687-cement-in-vietnam
[124] The cement sector is estimated to be USD 4 billion, assuming this year's forecasted output of 73 Mt and a price per tonne of USD 55. Total GDP in 2011 was USD 104 billion. This is in line with data reported by the VNCA.
[125] Own calculation based on data from the draft Master Plan for the cement industry developed by the Vietnamese Ministry of Construction and the Vietnam National Cement Association ('Cement industry of Vietnam Status and Prospective' April 2007)

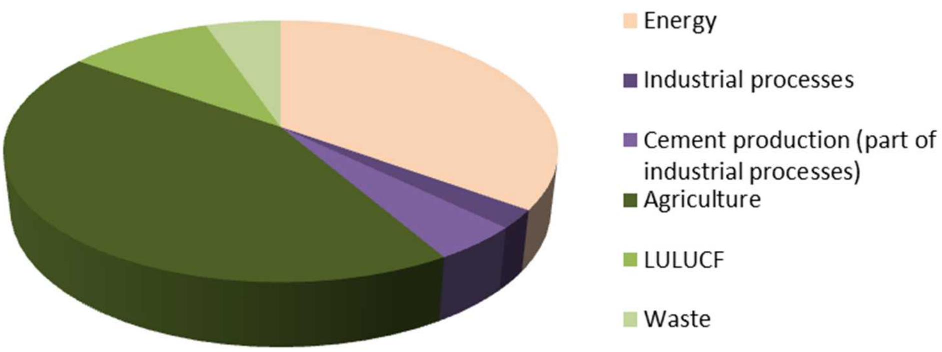
Industry Corporation (VICEM) still majorly controls the industry. The VICEM has a 34% market share in the sector through the ownership of 12 plants. Moreover, VICEM has decision-making power in the majority of Vietnam's other cement plants.[126] The Vietnam National Cement Association (VNCA) represents the interests of the cement sector. The VNCA encourages knowledge exchange of developments in the sector between the main players involved, coordinates relationships with other regional and international cement associations, and protects the interest of its members within the legal framework of Vietnam.[127]

Vietnam hosts 112 registered CDM projects. However, despite the significant GHG emission reduction potential in the cement sector there is no project activity. The Danish embassy, in an attempt to promote the CDM in 2010 identified emission reduction opportunities in several cement plants between 20,000 to 50,000 tCO_2e/year per plant. These reductions would stem from changing the blend, fuel switch and waste heat recovery. That, despite these efforts, no CDM projects were developed might be because cement projects under the CDM have proven difficult.[128] To date only 19 projects have been registered while 46 project were rejected at registration or terminated validation. [129] Important issues with CDM projects in the cement industry are methodological complexity and additionality.[130]

3.5.2 Trends in Production and Emissions

The 2nd National Communication of Vietnam to the UNFCCC estimates the country's GHG emission levels at 150 $MtCO_2e$ in 2000. The main sources of these emissions are agriculture (65 Mt), energy (53 Mt) and land-use (15 Mt). Industrial processes, of which the cement industry forms part, emitted 10 $MtCO_2e$ (Figure 18). The share of emissions from cement production within industrial processes has increased since 2000.[131]

Figure 18 Vietnam's national emissions in 2000



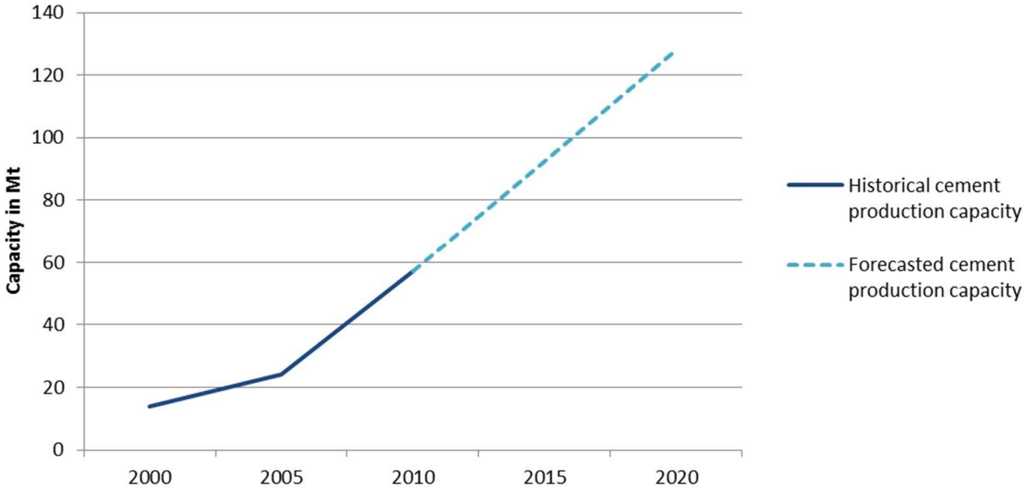
The main sources for the emissions of the Vietnamese cement sector are: i) the cement production process (process emissions) and, ii) the combustion of fossil fuel to generate heat and electricity for the production process (energy-related emissions). In 2000, the cement sector's process emissions accounted for 66% (or 6.63 Mt) of industrial process emissions.[132] The cement industry is one of the most energy-intensive industries in Vietnam and as such causes considerable energy-related

126 Global Cement, available on: http://www.globalcement.com/magazine/articles/687-cement-in-vietnam
127 Vietnam National Cement Association, available on: http://www.vnca.org.vn/en/.
128 RCEE Energy and Environment (2010). *Study on CDM application in cement industry in Vietnam. Final Report.* Royal Danish Embassy Hanoi.
129 UNEP Risoe CDM Pipeline. May 2012
130 See for example an analysis of the situation in India at: IGES- TERI CDM Reform Paper (2011*). Linking Ground Experience with CDM Data in the Cement Sector in India*
131 MONRE (2010).*Vietnam's Second National Communication to the UNFCCC.*
132 MONRE (2010).*Vietnam's Second National Communication to the UNFCCC.*

emissions. The main fuel source in cement production is coal that accounts for almost 90% of the sector's energy consumption.[133] Since 2000, the contribution of the cement industry in total national GHG emissions has grown rapidly, reaching 23 $MtCO_2e$ from process emissions and another 17 $MtCO_2e$ from energy- and fuel related emissions.[134]

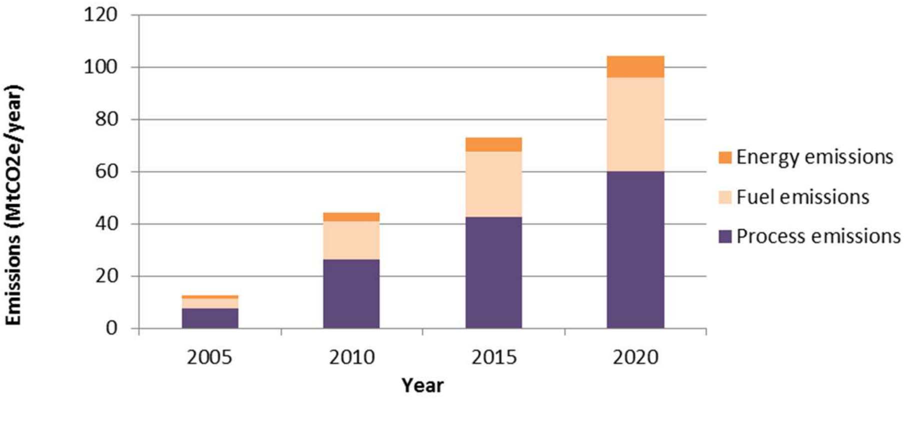
Demand for cement is projected to increase to 105 Mt/year by 2020 and 126 Mt/year by 2030 according to the draft Master Plan for the cement industry developed by the Vietnamese Ministry of Construction.[135] In a separate statement, the Ministry of Construction also indicated that between 2011 and 2020 an additional 55 projects will be put into operation with a total designed capacity of 66.96 million tonnes, increasing the total cumulative designed capacity of the cement sector to 130 million tonnes by 2020.[136]

Figure 19 Historical and forecasted cement production capacity until 2020



The sector growth is expected to continue despite the current overcapacity. The Vietnamese cement output is expected to reach 128 Mt by 2020, a 75% growth over current installed capacity. Figure 20 illustrates the evolution in capacity development and indicative forecasted capacity until 2020.[137]

Figure 20 Historical emissions in the cement sector and projected growth



[133] IIEC (2010). *Supporting Implementation of the National Energy Efficiency Program Project – Vietnam, Final Report*, ADB.

[134] RCEE Energy and Environment (2010). *Study on CDM application in cement industry in Vietnam. Final Report*. Royal Danish Embassy Hanoi.

135 Vietnamese Ministry of Construction (2011). *Draft Cement Industry's Master Development Plan.*

136 Report by Service of Science Technology and Environment - Ministry of Construction (2011). Presented at the workshop held in Hanoi by the Danish Embassy in coordination with the Vietnam Cement Corporation and FLSchmith Group

[137] Vietnam Cement Industry Corporation (2009). *Vietnam to Have 30M-35M Tons of Cement of Surplus by 2020*

Since 2010, increases in production capacity outpaced demand. Capacity is expected to reach 73 Mt in 2012, while domestic demand remains at 55 Mt, according to the Ministry of Construction. The general trend is in line with the draft Master Plan, which aims to develop excess production capacity to ensure more-than-sufficient domestic cement supply and stimulate export, predominantly to China (forecasted to reach around USD 200 million in 2012). However, due to the severity of the global recession and slow domestic as well as international growth, unanticipated overcapacity is building up. This is reflected by Vietnam's Ministry of Construction announcement in February 2012 that it would temporarily delay work on several approved cement projects.[138]

The growth trends in cement demand and production imply significant increases in GHG emissions. One source, based on forecasts made in 2010, predicts that total emissions from the sector are projected to increase from 40 Mt of CO_2e in 2010 to 55 Mt of CO_2e by 2020.[139] However, this forecast assumes a total output of only 68 Mt by 2020, which is already lower than this year's foreseen capacity levels. If the GHG emission forecast is adapted to the figures presented by the draft Master Plan for the cement industry, total GHG emissions from the sector are predicted to reach 72 Mt of CO_2e in 2015 and 105 Mt of CO_2e in 2020 (see Figure 20).

3.5.3 *Carbon Intensity*

Vietnam's current emission factor for cement of roughly 0.8 tCO_2/t cement is above the 2009 average of 0.653 tCO_2/t cement of the over 900 cement installations that report their emission data under the Cement Sustainability Initiative (CSI) of the World Business Council on Sustainable Development (WBCSD).[140] The average CO_2 intensity of the European cement industry is around 0.7 tCO_2/t cement.[141] The power consumption level of currently installed cement plants is around 100 kWh/t of cement, and most of this energy is provided through coal fired power plants.

3.5.4 *Policies and Measures*

The government of Vietnam ranks on a similar level as Indonesia, well below Chile and Brazil governance on the World Bank Governance Indicators.[142] The country scores particularly low on “regulatory quality”, the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development, as well as “voice and accountability”, which captures the extent to which a country's citizens are able to participate in selecting their government, as well as freedom of expression, freedom of association, and a free media.

Most of environmental aspects of cement industry, with the exception of air emissions, are controlled by the Environmental Protection Act and its relevant sub-laws. Cement plants are required to submit environmental reports every six months to local environmental authorities.

The cement price is currently regulated by the state, based on a proposal by VICEM in consultation with the VNCA. Such regulated pricing may pose challenges for introduction of new policies, especially such that utilise economic incentives and markets, as they may limit the effectiveness of the intended signals.

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138 Global Cement, available on: http://www.globalcement.com/magazine/articles/687-cement-in-vietnam

139 RCEE Energy and Environment (2010). *Study on CDM application in cement industry in Vietnam. Final Report*. Royal Danish Embassy Hanoi.

140 http://www.wbcsdcement.org/index.php?option=com_content&task=view&id=211&Itemid=171

141 National Centre for Scientific Research, Ecole Polytechnique (2012). *A proposal for the renewal of sectoral approaches building on the cement sustainability initiative.*

142 World Bank Governance Indicators, available at: http://info.worldbank.org/governance/wgi/index.asp.

Cement production is regulated by the Master Plan for cement development approved by the Prime Minister, including requirements:

- To complete new investment projects and expand cement factories according to the approved schedule;
- To give priority to investing in new capacity in southern provinces with high consumption; in areas facing economic difficulties, to give priority to investing in capacity expansions and investments for switching from vertical to rotary kiln technology;
- To develop large rotary-kiln cement plants with modern, mechanized, automated, and fuel-, material- and energy-saving and less polluting technologies;
- For existing production establishments to regularly invest in, and study the renewal of, production technologies and equipment to enhance labour quality and productivity, reduce production costs and save raw materials, fuels and material; and to regularly inspect the achievement of environmental standards; and to shut down installations which fail to satisfy environmental standards;
- Not to invest in new shaft-kiln cement factories and crushing plants without clinker-producing units; and
- To diversify cement types to meet domestic market demands and undertake trade promotion for their export when necessary.

The Ministry of Construction in Vietnam has also drafted a number of obligatory standards to improve energy efficiency in the cement sector. The main efficiency requirements are:

- thermal energy consumption should be less than 730 kcal/kg of clinker;
- power consumption should be less than 90 kWh/t of cement; and
- dust emission be less than 30 mg/Nm^3 for all newly built plants.[143]

3.5.5 *Abatement Potential*

The sector's energy-related emission reduction potential is estimated at around 19 $MtCO_2e$ annually.[144] Several more efficient technologies are available, if financial and technical barriers are tackled. Possible abatement options are listed in Table 46:

Table 46 Marginal abatement costs (MAC) and potential for the cement sector in Vietnam*

Abatement option	MAC (EUR/tonne)[145]	Potential by 2020 (Mt/year)
Blending: use of additives (fly ash) to reduce clinker content of cement	-20.5	7.8
Less lime: Substitution of limestone with alternative raw material in clinker production	*n/a*	1.5
Fuel switch: Fuel switch from coal/electricity to gas, biomass (such as rice husk, straw) or waste (such as tyres)	-4.7	4.6
Energy efficiency: Energy efficiency measures such as improving kiln combustion efficiency, optimizing air flow to the grate cooler, utilising cooler vent air as primary air to the kiln burner, etc.	*n/a*	2.1
Power cogeneration: Waste heat recovery and utilisation in electricity production	-21	2.7

* The presented MAC and emission reduction potential come from two different sources. Their correlation might not be as perfect as the table suggests.

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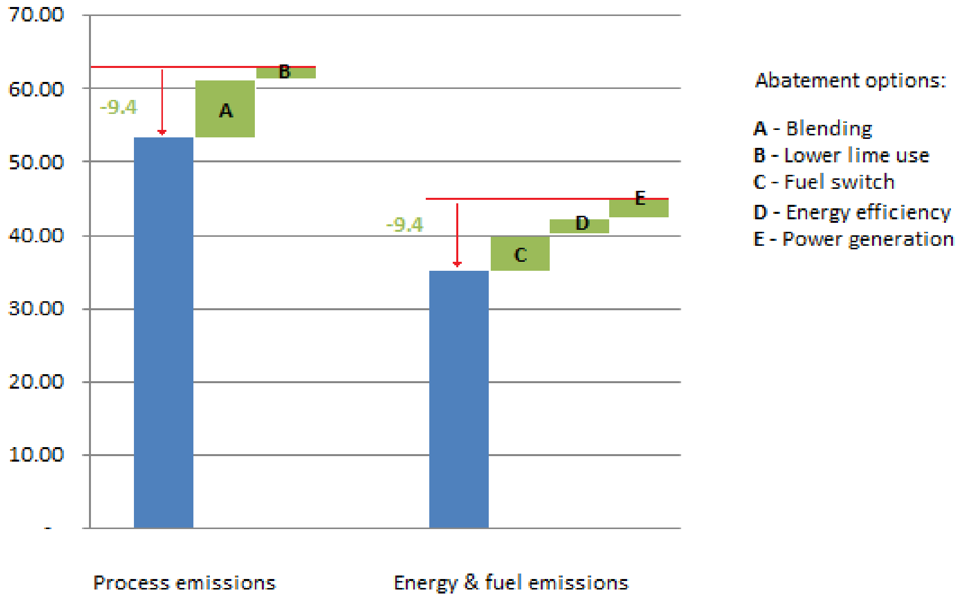
[143] Vietnam Chamber of Commerce and Industry (2011). *Vietnam Cement Industry: Energy-Efficient Technology Needed,* also: http://www.worldcement.com/sectors/materials-handling/articles/Less_Rejection_Less_Waste_in_the_cement_industry.aspx

[144] IGES & TERI (2011). *Linking Ground Experience with CDM Data in the Cement Sector in India*. IGES & TERI CDM Reform Paper, adjusted to Vietnamese production projections by Greenstream

[145] Tatrallyay & Stadelmann (2011). *Country Case Study Vietnam – Removing barriers for climate change mitigation*. University of Zürich.

Figure 21 illustrates the mitigation potential of selected measures, based on data from a recent study on India's cement sector, adjusted by the authors for Vietnam's current blending rate and projected cement production in 2020.[146] The sum of the annual mitigation potentials for the projected production levels in 2020 is close to 19 $MtCO_2e$. However, it is important to bear in mind that mitigation potentials of individual actions cannot be simply added up, since measures may be mutually exclusive or otherwise interlinked. Nonetheless, this analysis suggests that blending and fuel switch offer the largest individual mitigation potentials.

Figure 21 Cement sector emissions and mitigation potential by 2020



Feasibility studies of the CDM potential in the cement sector have already identified a number of potential projects, covering the full range of the abatement options described above (see Table 47).[147] These projects are the results of a preliminary market survey conducted by VICEM and the Vietnam Association of Building Material (VABM).

Table 47 List of potential projects in the cement sector identified in feasibility studies

Project description	Scope	Emission reduction potential (tonnes/year)	Investment costs (mln EUR)
Waste heat power generation, Hoang Thach	Power cogeneration	30,000	n/a
Waste heat power generation, Tam Diep	Power cogeneration	20,000	n/a
Waste heat power generation, Hai Phong	Power cogeneration	20.000	n/a
Waste heat power generation, But Son	Power cogeneration	20.000	n/a
Waste heat power generation, Chinfon	Power cogeneration	47,000	n/a

146 IGES & TERI (2011). *Linking Ground Experience with CDM Data in the Cement Sector in India*. IGES & TERI CDM Reform Paper, adjusted to Vietnamese production projections by Greenstream

147 RCEE Energy and Environment (2010). *Study on CDM application in cement industry in Vietnam. Final Report*. Royal Danish Embassy Hanoi

Project description	Scope	Emission reduction potential (tonnes/year)	Investment costs (mln EUR)
Replacement of two cement mills, Bim Son	Energy efficiency	24,000	11
Partly fuel switching from coal to waste, But Son	Fuel switch	29,000	
Increased blends, Hai Phong	Blending	10,000	

3.5.6 *Application of a Tradable Intensity Standard*

A tradable intensity standard could be defined in terms of CO_2/t cement. Given the rapid production growth and wide range of projections, e.g. production forecasts for 2020 ranging between 105 and 130 Mt cement, the use of absolute targets is not recommendable.

An inclusion threshold could be defined similar to the EU ETS, which would include production of cement clinker in rotary kilns with a production capacity exceeding 500 tonnes per day or in other furnaces with a production capacity exceeding 50 tonnes per day. This threshold would currently include 110 installations.

As noted above, the sector is controlled by the state-run Vietnamese Cement Industry Corporation (VICEM). Imposing mandatory performance standards would hence be relatively simple in regulatory terms. It also means that the system would be more like an intra-company trading system rather than a multi-company ETS. As discussed in further detail in the Brazil case study, to enhance liquidity it would be recommendable to link the system to the international carbon market, allowing installations to use CERs and possibly also other internationally fungible units to comply with their targets.

The large undeveloped financially viable abatement potential that has been identified and could be mobilised at negative costs even without a carbon price, suggests that non-economic barriers prevent implementation of actions. It may therefore be doubtful whether further improving the profitability of mitigation actions by issuing credits to individual installations would have the desired effect of incentivising emission reductions. As noted above, there is in fact no CDM project activity despite the large cost-effective mitigation potential.

Proposal 1 might hence be rather more suitable for this sector than Proposal 2. As the sector is state-controlled, the government could directly implement or mandate actions to reduce sectoral emissions. All emission reduction credits would accrue to the host country government, which could use them to finance of co-finance implementation costs.

The risk that production capacity moves to other countries when faced with emission targets is highly location-specific. On the one hand, the cost impact of CO_2 pricing relative to value-added is relatively high for cement, on the other hand transport of cement is relatively expensive.[148] Moving capacity might increase transport distances and may not outweigh the costs of compliance with a carbon regime. In addition, Vietnamese cement producers have a substantial no-regret abatement potential. Imposing and enforcing a carbon constraint may therefore actually enhance their competitiveness because it would force operators to actually mobilise this potential and thereby lower their production costs. Furthermore, in the proposed system emission units would only need

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[148] Hourcade, C., D. Demailly, K. Neuhoff, M. Sato, M. Grubb, F. Matthes, V. Graichen (2007): Differentiation and Dynamics of EU ETS Industrial Competitiveness Impacts. Cambridge: Climate Strategies.

to be bought for excess emissions rather than each tonne of emissions. A more definite statement would require a detailed analysis of relative production costs, impacts of carbon pricing and trade intensities.

Table 48 Barriers to implementation of a sectoral mechanism and suggested sdutions

Barriers	Solutions
Insufficient data	Capacity building
Lack of competition and profit-maximising behaviour	Market liberalisation, or implement Proposal 1 rather than 2
Sector dominated by state-owned corporation leading to low carbon market liquidity	Link to international carbon market, or implement Proposal 1 rather than 2

3.5.7 *Emissions Reduction Potential under Different Scenarios*

In this section we define the emission reduction potential of the cement sector in Vietnam under different scenarios. A no-abatement scenario has been established based on the Master Plan for the cement sector's capacity and emission projections in Vietnam by the Vietnamese Ministry of Construction and the Vietnam National Cement Association. The emission level in the no-abatement scenario is compared against different policy relevant scenarios. One of the scenarios (the NMM carbon intensity cap scenario) includes the assumption that a tradable intensity standard will be implemented and operationalized. It is important to note that the reference and BAU scenario are based on the sector forecasts presumed by the Vietnamese Ministry of Construction and the Vietnam National Cement Association. Hence, these forecasts could reflect the sector's ambition rather than provide a realistic forecast. Within the Vietnamese situation of the cement sector, and knowing the economic and political context, we have developed four scenarios.

The scenarios are subject to the following assumptions:

- In all scenarios, we assume that the announced plans and developments in the sector's Master Plan, prepared by the Vietnamese government, will become reality and that the expected capacity expansion will gradually increase to the foreseen levels in the Master Plan;
- In all scenarios, we assume that 2010 is the preferred reference year for the sector's caps for carbon emissions and carbon intensity. For 2010 there are reported data for the scenario parameters. However, the main reason is that there seems to be some data bias as reported emission data for 2005-2007 are not realistic compared to the production capacity;
- It is assumed that the sector's restructuring process has been started in 2010 with the first results achieved from 2012 onwards. For this restructuring phase, it is assumed that the abatement potential for the process-related emissions will be realised;
- In 2016 the reduction potential of the energy-related emissions (i.e. switching fuels and energy efficiency measures) will be implemented and operationalized, in line with the foreseen time framework for concluding an agreement for the New Market Mechanism (i.e. installation-based crediting mechanism).

Table 49 Abatement potential in the Cement sector in Vietnam under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement scenario	0 $MtCO_2e$/year
BAU scenario	15 $MtCO_2e$/year
NMM carbon intensity cap scenario	23 $MtCO_2e$/year
NMM carbon emissions cap scenario	41 $MtCO_2e$/year

No-abatement scenario

In the no-abatement scenario no abatement measures will be taken and emissions will keep pace with the forecast cement production capacity of the Master Plan. The same carbon intensity of 2010 (0.78 tCO_2e/t cement) will hold for the overall cement production until 2020. This is a hypothetical scenario which merely provides a reference for the following three scenarios.

BAU scenario

In the BAU scenario the planned policies and abatement measures, included in the Master Plan will be implemented. Emissions will grow from 44 $MtCO_2e$ in 2010 to 73 (2015) and 104 (2020) $MtCO_2e$. Since the emission levels increase more or less proportionally to the increase in the cement production capacity, the carbon intensity for the cement production installations in Vietnam will be rather stable around 0.78-0.82 tCO_2e/t cement between 2010-2020. That would be higher than the average carbon intensity of cement production installations within the EU-27 that fall under the EU ETS. Their carbon intensity is around 0.70 tCO_2e/t cement. This intensity level is based on the 2005 production (235 Mt cement) and verified emission (157 MtCO2e) levels[149].

Considering the abatement costs curves for the cement sector in Vietnam of IGES & Teri (2011), the BAU scenario could be achieved when:

- Between 2012-2015: the restructuring of the sector is realised and process-related emissions are reduced by blending and by substituting limestone with alternative raw material in the clinker production. In terms of abatement potential, the emissions in this phase can be reduced with 9.4 $MtCO_2e$/year compared to the reference scenario,
- Between 2016-2020: after the restructuring phase the reduction potential for the energy-related emissions should be realised by power cogeneration, energy efficiency measures and switching fuels. For 2016-2020 these improvements would reduce emissions from the cement production capacity with another 9.4 $MtCO_2e$/year.

In this scenario the emission reductions compared to the reference scenario in both existing and new capacity, will be on average 15 $MtCO_2e$/year throughout the period 2012-2020 when both the above measures are implemented.

NMM carbon intensity cap scenario

In the NMM carbon intensity cap scenario the Vietnamese government commits to a carbon intensity performance benchmark for the cement sector. The benchmark will be enforced via a tradable intensity standard along the line of Proposal 2. The performance benchmark will be similar to the carbon intensity level of 0.67 tCO_2e/t cement for installations under the EU ETS in 2005.

If the benchmarks are complied with, the sector's emissions will decrease to 86 $MtCO_2e$ by 2020 for the same cement production capacity, realising a reduction of 19 $MtCO_2e$/year compared to the BAU scenario of 104 $MtCO_2e$/year in 2020. On average, an abatement obligation of 23 $MtCO_2e$/year should be realised within this scenario for the period 2012-2020. Part of the additional abatement obligation, compared to the obligation in the BAU scenario, could be realised via abatement options that go beyond the abatement options listed in Section 5 (e.g. CCS deployment).

NMM carbon emissions cap scenario

In the NMM carbon emissions cap scenario the Vietnamese government implements an absolute cap on the emissions of 44 $MtCO_2e$/year, the emission level of the sector in 2010 and in line with

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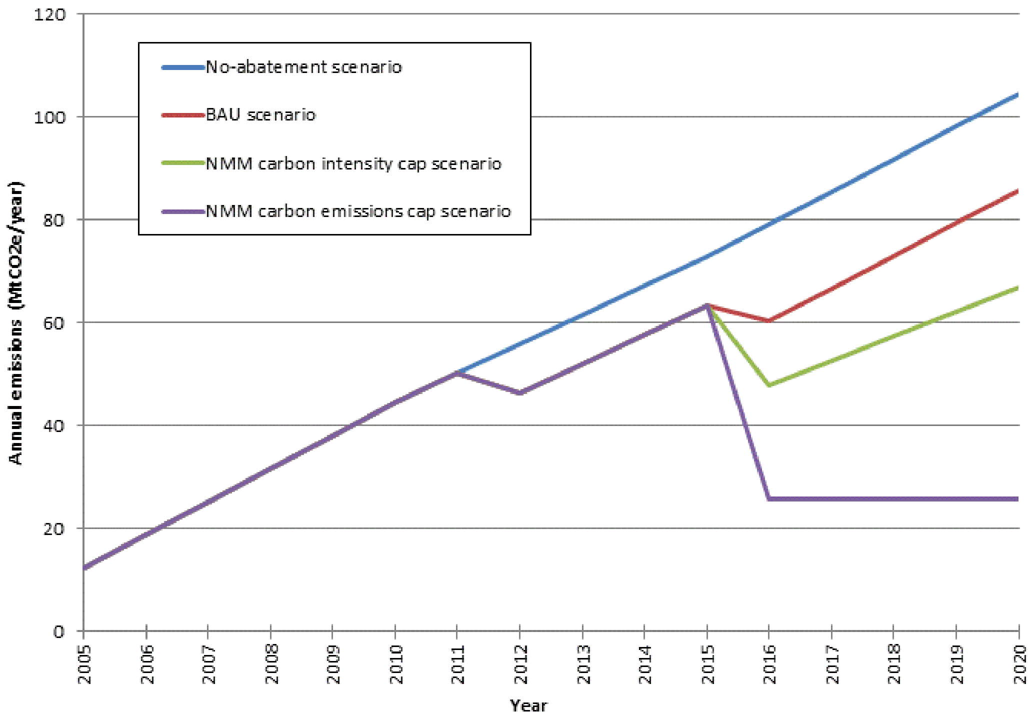
149 SETIS Energy Efficiency and CO2 reduction in the Cement industry, Ecofys BM study and CEMBUREAU

the national pledge to the UNFCCC. Since production capacity will expand, the carbon intensity of the refineries will have to improve to comply with this absolute target. The carbon intensity will need to decrease from 0.78 tCO_2e/t cement in 2010 to 0.35 tCO_2e/t cement in 2020 in order to achieve emission target and as such also here significant improvements to the sector's efficiency would be needed (e.g. CCS deployment). The abatement obligation that should be realised would be 41 $MtCO_2e$/year for the period 2012-2020.

Figure 22 below presents the trends in emissions for the cement sector in Vietnam over time for the different scenarios. The vertical axis represents the level of emissions in $MtCO_2e$, where the horizontal axis represents the timescale for the scenarios.

Figure 22 Analysis of emission trends for the Vietnam cement sector in different scenarios



In the above scenarios we have analysed the impact of emission caps and carbon intensity performance benchmarks for the Vietnamese cement sector. However, there are other parameters as well that significantly impact the emission reduction potential of the sector.

Parameter	Impact on emission reductions
Energy (i.e. electricity prices)	Increasing global energy prices (i.e. electricity prices) will put upward pressure on the operational costs for the sector. Depending on the sector's price elasticity, the cost increase can or cannot be passed-through to consumers directly. However, cement is a local market due to the high transport costs. Therefore, the cement sector overall has an inelastic price effect such that the impact of mark-ups (i.e. additional costs for abatement options to reduce emissions) in the cement price will have a less significant impact on the sector's demand than for sectors with an elastic price effect.
International clinker price	The cement sector in Vietnam is a state regulated market that aims to become more market-oriented. Therefore, political and/or other economic factors could impactthe sector's transition to a privatised market set-up (i.e. sector competition from other South-East Asian economies) and the operational costs of the production process. Moreover, the sector has become depended on the international clinker price and will need to adjust accordingly.

Parameter	Impact on emission reductions
EU ETS price	If in the period up to 2020 the EU ETS price increases, a larger part of the abatement potential becomes financially attractive. However, in the case of the MACC for cement in Vietnam, the abatement options identified seem to be all financially feasible (so within the NMM). The abatement option with the lowest marginal benefits is switching fuels (i.e. from coal to gas) at 4.7 EUR/tonne emissions reduced. However, a (additional) carbon price might incentivise the adoption of more efficient new capacity rather than investing in the efficiency of old installations.

4 Annex D: Literature References

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ECORYS

P.O. Box 4175
3006 AD Rotterdam
The Netherlands

Watermanweg 44
3067 GG Rotterdam
The Netherlands

T +31 (0)10 453 88 00
F +31 (0)10 453 07 68
E netherlands@ecorys.com

W www.ecorys.nl

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