Design options for sectoral carbon market mechanisms

CLIMA.B.3/SER/2011/0029

Final Report

Client: European Commission - DG Climate Action

Rotterdam, 31 August 2012

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

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Preface

This Final Report of the study: "***Design options for sectoral carbon market mechanisms***" includes an assessment of different elements and features for the design of the New Market Mechanism (NMM) under the United Nations Framework Convention on Climate Change (UNFCCC). Based on this assessment, three coherent packages of design elements have been compiled as proposals for the (potential) design of the NMM. These three design proposals have been analysed in five case studies, in which the emission reduction potential of the NMM has been assessed for several policy scenarios in certain country/section combinations. Next to the assessment of the emission reduction potential of the NMM, the project team has conducted interviews with carbon market observers and sector representatives to verify the feasibility of and to receive feedback on the design proposals. Each of the abovementioned elements will be discussed in different chapters (Chapter 3 – Chapter 6) within this Final Report.

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Executive Summary

The Executive Summary describes the approach taken in this project towards the design of New Market Mechanisms. For each of the tasks the main findings and results are listed.

Project Objectives and Set-up

At the Durban climate change conference in December 2011, Parties to the United Nations Framework Convention on Climate Change (UNFCCC) "defined" a New Market Mechanism (NMM).[1] The NMM is broadly understood as a UNFCCC-based mechanism that will scale-up greenhouse gas (GHG) emission reductions in broad segments of economies, such as sectors, in developing countries. In contrast to the existing carbon market mechanisms under the Kyoto Protocol, for instance the clean development mechanism (CDM), the NMM would go beyond pure offsetting. One of the principles agreed on by the Parties with regard to the NMM is that not all emission reductions would be used for offsetting, thus the NMM would deliver a net atmospheric benefit by itself.[2] Key design elements, however, such as the incentive structure, governance framework and measurement, reporting and verification (MRV) requirements remain to be defined by Parties before the NMM can come into operation.

The present project aims to provide information for decision-making on the different options for key design elements of the NMM, and to assess the impact that application of the NMM might have in specific sectors in developing countries. The latter element includes both an assessment of the readiness of such sectors to implement the NMM, as well as the abatement potential and consequent supply of credits which it could generate.

Identifying the key design elements of the NMM has been the first task of the project. Next, several options for each design element have been identified in Task 2, which have been assessed against a range of selected assessment criteria. Task 3 combines the most suitable design options into three coherent NMM design proposals. One of the three proposals, which entails a cap on the carbon intensity of production in a sector and *ex post* issuance of credits, is selected for further analysis in five case studies. Each case study involves a specific sector in a developing country. The case studies demonstrate the potential credit supply from a NMM in these sectors and the factors affecting this potential.

Task 1-2: Assessment of Options for Key Design Elements

Seventeen design features have been identified and grouped into nine design elements, each of which has been assessed against nine assessment criteria (figure 1). The following emerged as the most relevant elements for NMM design.

1 UNFCCC, Decision 2/CP.17, paragraph 83.
2 UNFCCC, Decision 1/CP.16, paragraph 80.

Type of Mechanism

The type of mechanism is a crucial factor in determining the operation of the NMM.

Sectoral trading involves the *ex-ante* issuance of tradable credits based on a cap. Up-front issuance sends a clear long-term signal to emitters and provides confidence to investors. However, setting absolute caps is technically difficult in developing countries where sectors may grow very quickly, but where growth rates are difficult to predict. It bears noting that 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. Nevertheless, as the target would be binding for the government, it might have to introduce very ambitious policies. Participants in the sector are therefore exposed to potentially high liabilities. This makes sectoral trading an option that for some hard is to accept, both for developing country governments and the local industries.

Sectoral crediting involves credits being issued *ex post* based on sectoral no-lose targets. It is more politically acceptable and the lower risk for host countries may lead to more ambitious targets; at the same time *ex post* issuance provides no capital flow for investments and crediting only provides proper incentives if the carbon price is sufficiently high.

Figure 1: Overview of the design categories as NMM building blocks and their assessment criteria.

Design Element	Explanation
1) Type of mechanism	Whether crediting or trading
2) Coverage	Sector boundaries; GHG coverage; Upstream versus downstream coverage
3) Sector target or crediting threshold	Nature of the target method for baseline setting; interaction with other policies/measures
4) Operational/ Incentive framework	Operation/Incentives of the scheme at government/installation level; Methodology for distributing trading units; currency and temporal flexibility
5) Requirements for Data Collection and MRV	Ensuring optimisation between accuracy and cost effectiveness; materiality and conservativeness
6) Compliance Framework and Penalties	Choosing a model based on the Kyoto Protocol, the Montreal Protocol or arbitration
7) Governance	National and international governance and accounting
8) Ways of Managing the Transition from CDM to the NMM	Options include: keep CDM outside NMM boundaries, phase-out CDM, continue CDM or integrate the CDM into the NMM
9) Financing of the Mechanism	Options include: host country, donors, multilateral organizations or share of proceeds

Assessment criteria

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

Sector Target or Crediting Threshold

The way the target or crediting threshold is defined determines the future supply of trading units from the NMM as well as the net atmospheric benefit. This makes this element key to the viability and environmental integrity of the mechanism. Absolute emission targets or thresholds are relatively easy to administer but lack the flexibility to respond to changes in emissions that are not attributable to mitigation action. Indexed baselines can make the emission target or threshold vary with changes in GDP or production, providing incentives to keep carbon intensity low and minimizing risks of over-crediting but reducing certainty on emission levels.

Thresholds, whether absolute or indexed, are based on baselines. The threshold level should balance incentives to participate with the level of environmental ambition. While the most straight-forward means is to express baselines as deviations from the emission levels in a business-as-usual (BAU) scenario, this entails the risk of BAU inflation to increase crediting potential.

Baselines can also be based on mitigation potential and costs. For these types of baselines more data is required. They can be used however as a basis to define a level of comparable effort between different sectors and even countries.

Baselines based on certain carbon intensity or benchmark like tCO_2/kWh of power generated provide the most objective option, but may only be feasible for sectors with very homogeneous technologies.

Governance framework

An effective governance framework is essential to ensuring smooth functioning of the NMM. Governance needs to take place at both national and international levels. At the national level a governmental body is likely to face the fewest political barriers and enjoy the lowest cost, but may create risks of perverse incentives to maximise credit generation. Designating an independent body avoids this risk, though entails high costs and potential barriers. At the international level an independent body is preferred due to the low risk of politicisation, though it is recognised that there may be political resistance to a non-political body taking decisions on sensitive issues such as crediting thresholds.

Task 3: Design Proposals for the New Market Mechanism

The options for design elements evaluated in the previous two tasks are brought together to form three distinct, coherent proposals for an NMM. The selection and combination of design options is based on a set of optimisation criteria that, while similar to the assessment criteria applied in Tasks 1 and 2, differ in terms of focus and importance. Environmental effectiveness and integrity, preparedness for evolution towards an EU ETS compatible cap-and-trade system and economic efficiency are chosen as the three top priority criteria.

The three proposals possess a degree of similarity on several design elements, reflecting some key conclusions that emerge from the application of the three priority criteria.

- Where adequate data and MRV capabilities are available, a coverage of all GHGs is optimal for environmental effectiveness and economic efficiency;
- Intensity targets minimise the risk of over-crediting and thus may - at least initially - be preferable to absolute targets;
- Existing policies and measures should be included in the baseline up to a cut-off date;
- Shorter crediting periods should be applied at the beginning to allow for adjustments based on early experience; longer periods can be applied thereafter;

- Both national and international governance should be undertaken by independent bodies to keep the oversight of the mechanism process apolitical;
- Early domestic implementation should be funded by start-up support from industrialized countries, while on-going implementation costs could be covered from funds generated by carbon revenues; the international infrastructure could be financed through participation fees and share of proceeds.

The three proposals chosen are the following:

Proposal 1: Government Crediting System

Under this proposal, the host country government adopts a sectoral crediting threshold and implements policies and measures to reduce emissions. All emission reduction credits accrue to the host country government, which may use them to (co-)finance policy implementation. The 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 entail high transaction costs, such as the transport sector.

Key strengths of the proposal include its minimal administrative requirements and its potentially broad coverage across sectors and economies, allowing for a broad range of mitigation options to be included in the system and enhancing economic efficiency. Weaknesses include its lower level of development toward a cap-and-trade system and the higher degree of uncertainty associated with aggregate-level accounting. Using conservative values can to some extent reduce this latter concern.

Proposal 2: Tradable Intensity Standard

As under proposal 1, a sectoral crediting threshold is agreed between the host country and an international regulatory body. Under proposal 2, the crediting threshold is further passed-on to individual installations, which receive international credits for reducing emissions or carbon intensities below their individual threshold. Host countries are recommended to make at least reaching the crediting threshold binding for each individual installations, and thereby avoid compromising the overall achievement of the target. This makes the proposal similar to a trading system at the national level. In contrast to a trading system, however, since the proposal provides for issuing international credits to installations and these are only received by the host country government after emission reductions have been verified, credits can only be issued *ex post*.

Making the achievement of thresholds binding constitutes a key strength of the proposal through ensuring a minimum abatement impact and reducing the risk for investors that credits will not be issued. If thresholds were not binding, non-performance of other installations could undermine the overall sectoral performance and thus the issuance of credits. Other strengths are the proposal's strong potential for evolution towards a cap-and-trade system and potentially broad coverage. Weaknesses associated with the inclusion of binding targets include the risk of leakage and potential political resistance at the domestic level. The proposal also entails high administrative costs, making it most suitable for sectors with large point sources like the power and industry sectors and for host countries with high administrative capacity.

Proposal 3: Installation-Based Emission Trading System

In this system, the host country government would adopt a sectoral "trading" target at the international level and be issued with trading units *ex ante*. Where emissions of the host country exceed its target, it would need to buy additional units to cover the difference. The host country would then introduce an installation-level emission trading system for the sector in order to achieve this target.

Table 1: Key differences between the proposals.

#	Design element	Government Crediting System	Tradable Intensity Standard	Installation-Based Emission Trading System
1	**Crediting or trading**	Crediting	Crediting	Trading
2	**Coverage of the mechanism**			
	a) Sector/activity boundaries	Entire sector	All emitters above certain threshold	All emitters above certain threshold
	c) Upstream versus downstream coverage	Not applicable	Downstream	Upstream or downstream, depending on sector
4	**Operational/incentive framework**			
	a) Operation/incentives at government/installation level	Government level	Mandatory participation at installation level	Mandatory participation at installation level
	b) Methodology for distributing credits	Not applicable as no credits are issued to individual emitters	Benchmarking if possible with available data	Auctioning, with benchmarking as second preference

The strengths and weaknesses of this proposal are very similar to proposal 2, given that under each proposal binding targets are devolved to individual installations. In addition, the proposal supports evolution towards a cap-and-trade system and potentially broad coverage, though the use of indexed targets means a certain conversion may be required for linking. As units are issued *ex ante*, private sector participation is facilitated and up-front capital made available for emission reduction investments. As the target is binding at the international as well as national level, political feasibility may be lower than other proposals. The proposal is most suitable for sectors with large point sources like the power and industry sectors and for host countries with high administrative capacity.

Task 4: Case Studies on Emission Reduction Potential of the New Market Mechanism

The case studies consisted of applying proposal 2 in five sectors in five developing countries, which provides insight into both abatement potential and the conditions under which the NMM could work.

The five countries and sectors were selected with the aim of including diverse sectors over a broad geographical spread, while also accounting for adequate data availability. The sectors and the abatement potential in different NMM scenarios are shown in table 2.

Table 2 Key information on selected sectors.

Case study	Estimated number of installations	Historic emissions ($MtCO_2e$/year)	Emission expectation in the BAU scenario ($MtCO_2e$/year)	Abatement potential in different NMM scenarios ($MtCO_2e$/year in 2020)	
				Absolute cap	Carbon intensity cap
Steel, Brazil	29	57.2 in 2007	126 in 2030	9	25
Power, Chile	100	14.2 in 2006	85 in 2030	14	18
Refineries , Indonesia	8	Estimated at 23 in 2005	Estimated at 30.6 in 2030	11	6
Power, South Africa	35	291 in 2000	1,640 $MtCO_2e$ by 2050 with unconstrained emissions	15	47
Cement, Vietnam	110	40 in 2010	55 in 2020	19	60

Note: these figures should be seen in the context of the sectors they refer to and the analysis from which they have been derived, as provided in and Annex I.

The key findings of the case studies are:

- The abatement potential depends heavily on growth and future carbon intensity of production and there is a large variation between different forecasts.
- The assumptions underlying BAU scenarios are very arbitrary and may even be subject to political influence when used as the basis for setting thresholds under the NMM.
- International standards are needed if thresholds for NMMs in different sectors and countries are to reflect comparable effort to generate credits.
- Consistent and reliable data on emissions from installations in a specific sector is crucial for the design and operation of the NMM. Unfortunately, such data is not always available. Some sectors already show a large economically viable abatement potential. In a well-functioning market, investments that represent financially viable options would be developed to reduce the costs of production. Research is needed to identify why these possibilities have not been developed. This is important to ensure that applying the NMM – and thereby providing financial incentives – can stimulate investments and have an impact on emissions.
- The risk that carbon constraints on domestic production in the target country will encourage production capacity to move to countries with less stringent climate policy appears low with the reasons for this varying between the case studies.

If successful implementation should occur, capacity building and developing institutions that can manage the NMM are important requirements.

In the power sector, for example, substantial abatement potential exists within the sector by improving energy efficiency and the deployment of renewable energy. However, significant abatement potential also rests with the end-users. The NMM should be designed to also create incentives to develop this potential.

In the short term, strengthening an existing and successful policy could be an effective approach to NMM development. If certain policies have demonstrated to have the intended effect, the NMM can support the policies' up scaling and help provide the necessary financial means.

1 Introduction

This chapter presents a short discussion on the aims and objectives of the project along with a brief description of the current international climate, negotiations and its relation to the development of a New Market Mechanism.

This Final Report on the study '***Design options for sectoral carbon market mechanisms***' aims at identifying the key design features and elements in developing (proposals for) the New Market Mechanism (NMM). Subsequently it aims at assessing the different options for key modalities and procedures for the establishment of an NMM and the impact of the NMM under different contextual and policy scenarios for potential sectors and/or countries.

The Parties to the United Nations Framework Convention on Climate Change (UNFCCC) have been discussing options for improving existing and/or introducing new market mechanisms for many years. These discussions have been partly inspired by the need for improvement and up scaling of the existing Clean Development Mechanism (CDM). The most recent development in this discussion is that involving a 'New Market Mechanism'.

The CDM has been a success in leveraging private sector finance for international cooperation on greenhouse gas mitigation. In parallel, it helped build capacity for monitoring, reporting and verification (MRV). However, critics have complained about lengthy and costly project registration and credit issuance procedures and the weak coverage of key sectors (such as demand-side energy efficiency and transport). Furthermore many have also been disappointed because CDM project activities have so far been concentrated in relatively few countries and regions while, for example, most of Africa has so far been bypassed. Due to its design as a project-based mechanism, some have also seen the CDM as fundamentally incapable of achieving essential structural changes as needed to effectively combat climate change (see e.g. Cosbey et al. 2005; Figueres et al. 2005; Michaelowa and Purohit 2007; Pearson 2004; Schneider 2007; Sterk 2006).

Even more fundamentally, several studies (e.g. Michaelowa and Purohit 2007; Schneider 2007; Lüttken 2012) have questioned the additionality of a large percentage of the CDM project portfolio. The atmospheric benefit of the CDM is at best zero as the emission reductions achieved by CDM projects are used to offset emissions in developed countries. If registered projects are actually not additional, this means that globally emissions will actually be higher than they would have been in the absence of the CDM.

In the context of this discussion, the concept of a "sectoral CDM" rapidly gained prominence in the beginning of the 2000s as one potential means to address some of these problems. The Parties decided that "project activities under a programme of activities" as well as bundles of large-scale project activities may be registered as single CDM project activities whereas policies or standards cannot. More recently, there has also been a strong effort to further scale up the CDM through the introduction of standardised baselines (see text box)

Scaling up the CDM through Programmes of Activities (PoAs) and Standardised Baselines

Under a PoA, an unlimited number of projects – CDM programme activities (CPAs) – can be implemented and added to the PoA at any time over the lifetime of the programme. The individual CPAs are not subject to the same lengthy CDM processes as individual CDM projects. These streamlined processes are intended to reduce transaction costs and promote dispersed small-scale activities such as renewable energy and energy efficiency projects at the level of households, communities or small enterprises.

In addition, PoAs may consist of concrete actions to implement policy goals, so to fill the gap between the project and the policy level. Governments themselves may be PoA coordinators and directly coordinate activities under their policy framework. The potential is illustrated by a government-led PoA in India which aims at large-scale distribution of compact fluorescent lamps. The PoA is coordinated by the Indian Bureau of Energy Efficiency, which has the task to accelerate market transformation towards energy-efficient appliances (Castro et al., 2011). However, the pace at which PoAs have been recognised under the CDM has been slow and hence practical experience with PoAs is still developing.

Another approach that is based on the existing CDM is to establish standardised baselines, this is sometimes also referred to as "sectoral CDM". For example, Amatayakul and Fenhann (2009) propose a scheme based on a national CO_2 emission intensity standard (gCO_2/kWh) for new power plants. The climate conference in Cancún authorised the further development of standardised baselines.

The 62nd Executive Board meeting of the CDM Board (EB 62) approved "Guidelines for the Establishment of Sector Specific Standardized Baselines", which were subsequently revised at EB 65. They are applicable to project at stationary sources with specific types of measures (fuel and feedstock switch; switch of technology with or without change of energy source (including energy efficiency improvement); methane destruction; methane formation avoidance).

Another topic where the CDM is being streamlined is on the demonstration of additionality by establishing positive lists of types of measures or technologies. What percentage of production should be chosen as cut-off threshold is sector-specific and to be determined by the Board sector by sector.

While standardisation has been present in CDM methodologies for some time already, for example in the form of grid and fuel emission factors, similar to PoAs it is still too early to see how far this approach can go. Butzengeiger-Geyer et al. (2010) note that standardised baselines are most feasible in homogeneous sectors with similar technologies. Even in sectors which are often seen as relatively homogeneous, such as cement, various technologies are in use and emissions are also influenced by factors such as the quality of raw materials. Nevertheless, the establishment of standardised baselines under the CDM may strongly contribute to the establishment of the necessary data basis for a sectoral new market mechanism.

In addition to these efforts to scale up the existing CDM, and partly to address the above mentioned weaknesses, the Parties to the UNFCCC have been discussing the introduction of new scaled-up mechanisms in the Ad-hoc Working Group on Long-Term Cooperative Action (AWG-LCA) for several years. After protracted discussions, the seventeenth Conference of the Parties (COP) to the UNFCCC in Durban decided to define a new market mechanism (NMM) that is to operate under the guidance and authority of the COP. In contrast to the CDM, the NMM is to stimulate the reduction of GHG emissions across "broad segments of the economy" and achieve a "net decrease and/or avoidance of greenhouse gas emissions", that is, go beyond offsetting. The COP mandated the AWG-LCA to develop modalities and procedures for this mechanism, to be considered at the COP in Doha end 2012.[3]

However, there are still some fundamental political differences between Parties. While many developed and developing country Parties subscribe to scaling up market mechanisms to the sectoral level, some argue that the new mechanism should still be project-based and similar to the

[3] In addition, the decision notes that Parties could individually or jointly develop and implement market mechanisms in accordance with their national circumstances and requests the AWG-LCA to conduct a work program to consider the establishment of a framework for treatment of various approaches to enhance the cost effectiveness of mitigation actions.

CDM. Some countries continue to be fundamentally opposed to any market-based mechanism. And finally, developing countries believe that market mechanisms should only be available to Annex I Parties that adopt an internationally legally binding emission target while the USA and the countries that have opted out of the second Kyoto commitment period insist on access to the carbon market as a means to fulfil their pledges.

In addition to some fundamental political differences between Parties there is also still a substantial need for discussion on how to conceptualize the NMM. Therefore, there is a need for developing and piloting sector-wide carbon market mechanisms in order to make clear and clarify the challenges and practicalities of implementation of these mechanisms: identifying appropriate sectors and countries, data gathering methodologies and appropriate administrative structures.

1.1 Purpose and Objectives of this Study

The EU is at the forefront with regards to international efforts to combat climate change. In that role, the EU is a driving force in international negotiations that have led to the agreements in the UN Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. DG Climate Action participates, on behalf of the EU, in the international climate negotiations and, amongst others, promotes the development of new instruments like NMM.. It is the vision of the EUto develop an international carbon market through linking a number of domestic/regional market based carbon reduction systems.. Therefore, DG Climate Action is, as an interim step, investigating the potential for the NMM in order to identify and articulate the challenges and practicalities of implementation of the NMM before integration with current project-based approaches, like the Clean Development Mechanism (CDM).

The overall objective of this study is to assist DG Climate Action in the preparation for the implementation of the provisions, in particular the Articles 11a(5) and 11a(6) of the EU ETS Directive 2009/29/EC and Article 5(2) of Decision No 406/2009/EC, in the EU climate and energy legislation. More specifically, the provisions mentioned allow for developing agreements (i.e. the NMM) with third countries on credits from emission reduction activities at sector level. Therefore, the activities and analysis have been undertaken with a view of improving the comprehension of different options regarding key design and features of sector-wide carbon market mechanisms. Moreover, this understanding is also of great importance as it relates to the EU ETS and to providing additional input for improved policies.

1.2 Structure of this Report

The remaining Chapters of this Final Report are organized as follows:
- Chapter 2 details the overall approach and methodology taken in carrying out this study;
- Chapter 3 presents the assessment of different options for key design elements and features that are important to develop the NMM (Task 1-2);
- Chapter 4 contains our packages of different combinations of design elements and features as design proposals for the NMM (Task 3);
- Chapter 5 presents a synthesis of the key messages and conclusions from the case studies that have been carried out to assess the emission reduction potential of the NMM (Task 4);
- Chapter 6 includes a ‘discussion paper’ based on the feedback and information received from the representative interviews with stakeholders and market observers (Task 5);

- Chapter 7 draws the main conclusions and recommendations regarding the development of the NMM that can be learned from the study;
- Annex A comprises the full assessment of pros and cons of the different options identified for the key design elements and features for the NMM;
- Annex B presents the full assessment of the key design elements and features in the construction of the three design proposals for the NMM;
- Annex C includes the full case studies that have been carried out under Task 4;
- Annex D lists the relevant literature and other documents that have been reviewed during the course of this project.

The Annexes are included in a separate supplement attached to this Final Report, and serve as background data and an information source for the main report.

2 Our Approach and Methodology

This chapter shortly presents the methodological framework and approach that has been chosen for the successful implementation of this project. Our overall project approach is explained and the relevant links between the different project tasks and activities are made clear for a coherent 'story line'.

For this study, the overall process has been carried out in different phases and tasks. Some tasks have been carried out in parallel so that all parties involved could benefit from synergies and feed-back received during the course of the project. Figure 1 illustrates our project approach and shows how the various components of the project approach fit together with the activities and outputs of the different project tasks. Each of these project tasks will be shortly described below, including the approach and methods.

Figure 1 Overview of Overall Project Approach

Task 1-2: Assessment of Options for Key Design Elements	
Activity: Reviewing existing literature	Output: Identification and assessment of options for key design elements for the New Market Mechanism (NMM)
Activity: Desk research and brainstorming	
Activity: Ranking design options	Output: Summary tables of ranked design options
Task 3: Design Proposals for the New Market Mechanism	
Activity: Define optimization criteria for design options	Output: List of optimization criteria for assessment
Activity: Select design options for distinct proposals	Output: Proposals for combinations of design options
Task 4: Case Studies on Emission Reduction Potential of the New Market Mechanism	
Activity: Selecting five combinations of sectors and countries	Output: Proposals for combinations of design options
Activity: Defining scenarios and key parameters credit supply	Output: Proposals for combinations of design options
Activity: Analyzing supply potential in different scenarios	Output: Proposals for combinations of design options
Task 5: Expert Opinion on the New Market Mechanism	
Activity: Prepare Questionnaire and Identify Expert	Output: Draft Questionnaire for Consultation
Activity: Interviewing 10-12 Relevant Experts	Output: Expert Opinion on the New Market Mechanism

Task 1-2: Assessment of Options for Key Design Elements

As a first step, the project team carried out a literature, information and data review to identify the different options for the key design elements and features in developing the NMM. A substantial amount of literature was reviewed, notably on existing and new market-based mechanisms for GHG mitigation, as well as literature on CDM experiences and proposals to move beyond current CDM practices.

Based on the extensive literature review, the project team conducted an in-depth qualitative assessment and analysis of the pros and cons of the different options for the important design elements and features. A generic template was developed for this assessment, which has been used as a reporting format for the option assessment in Annex A. Part of the assessment process was the identification of sectors and countries that would be relevant for the NMM. This selection of sectors and countries was based on (i) the sector's importance in overall GHG emissions and/or international commodity trading, (ii) the country's relative importance in terms of national GHG emissions and role in the international negotiations on the NMM, and (iii) the country's ability and willingness to implement and operate carbon market mechanisms.

The following sectors and countries were proposed as candidates for the NMM:

- **Sectors**: Cement, Steel, Paper, Fertiliser, Refineries, Chemicals, Electricity and Transport;
- **Countries**: Brazil, Chile, China, Columbia, India, Indonesia, Mexico, UAE, South Africa and Thailand.

Task 3: Design Proposals for the New Market Mechanism

After the in-depth assessment, the most feasible options and suitable combinations of design elements and features were collected to elaborate three distinct, but coherent, proposals for the design of the NMM. In other words, for each key design element and modality identified and assessed, one of the various available options was selected and combined into full-fledged blueprints for the NMM.

Selecting and combining design elements and features was done on the basis of optimisation criteria. The optimisation criteria were the same as the assessment criteria used in Task 2, but with higher weights attached to: i) **environmental effectiveness and integrity**, ii) **preparedness for evolution towards EU ETS compatible cap-and-trade system,** and iii) **economic efficiency**. The optimisation criteria were applied to the various options that were available for each design element in order to determine a policy-optimal combination of options. In addition, the project team took into account country- and sector-level considerations. Some designs are more suitable for some countries and sectors than for others. The full assessment of the design proposals can be found in Annex B.

Task 4: Case Studies on Emission Reduction Potential of the New Market Mechanism

Based on the developed packages of design elements and features for the NMM, the project team quantitatively estimated the potential supply of credits in five case studies. The case studies are combinations of the identified potential sectors and countries that are relevant for implementation of the NMM. In each case study, one proposal design was assessed for the selected country and sector combination (i.e. scenario for potential credit supply).

The most important criterion in the selection of sectors and countries was the **data availability in terms of emission sources, sectoral emission levels, abatement costs and national policies**. Other important criteria and parameters for assessing the credit supply potential in the case studies were: i) **clearly defined sector boundaries**, ii) **the way the reductions in emissions are quantified**, iii) **the market value of the credits used**, iv) **the sector's emissions and their**

development or trend, v) **the economic development of the sector**, and vi) **the carbon intensity of the sector compared to countries with a lower carbon intensity**.
Determining the credit supply potential was carried out in 8 steps that will be outlined in Chapter 5. The most important element in determining the credit supply potential was to define the future development of sector growth, carbon intensity and the related emission levels in the hypothetical no-abatement and BAU scenarios. The abatement potential of two different NMM scenarios was assessed against these reference levels of emissions.

Task 5: Expert Opinion on the New Market Mechanism

We conducted a consultation round among a representative group of: i) academia and researchers knowledgeable about the NMM worldwide, ii) (international) carbon market observers, and iii) sector stakeholders in relevant sectors that could be eligible for the NMM in developing countries and in Europe. This consultation round was designed **to verify and to receive feedback and reflections of the different stakeholders** on the proposed key elements and options of the EU for the NMM, including the three design packages proposed.

Thus, the project team prepared a (generic) questionnaire that aimed at receiving answers and feedback on the main objectives shown below for this expert consultation:

- What they regard as the main advantages and disadvantages of each of the three design proposals, taking specifically into account the identified optimisation criteria;
- How they see the political feasibility of each of the three design proposals in the multilateral UNFCCC context;
- How they see the political feasibility of each of the three design proposals in the national context of a developing country, with a focus on the country and sector combinations for which the case-studies have been carried out;
- How they see the aptness of each of the three models to be linked, in a later stage, with the EU ETS,
- What is, given their reflections above, the preference between the three models and why?

In the next chapters the different project tasks have been worked out in (short) summaries as follows, the full assessment of the design options, the full assessment for the design proposals and the case studies being taken up in the corresponding Annexes.

3 Selection and Assessment of Key Design Elements for the New Market Mechanism

In this chapter we present a summary assessment of different options for seventeen key design elements of the New Market Mechanism. For further detailed information, please consult the full assessment and references in Annex A.

This assessment has identified and evaluated different options to consider for seventeen **key design features** when developing the New Market Mechanism (NMM). These design features have been grouped into nine elements covered in Sections 3.1 to 3.9. Each of the design options has been evaluated against a set of nine **assessment criteria**, presented in Table 1. The details of the individual evaluations of each design option are outlined in Annex A.

A description of each of the design options and an overview of the associated merits and shortcomings of each option are presented below. It is intended that the evaluation of the various design elements can support policy makers in making informed decisions during the development process of a New Market Mechanism. The assessment is based both on the most recent literature available combined with expert judgement.

Table 1 Assessment criteria for evaluating design features for developing the NMM

#	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

3.1 Element 1: Type of Mechanism: Crediting or Trading

Sectoral trading involves setting a mandatory emissions target in a sector and ex-ante issuance of tradable units. A surplus of units can be sold on the carbon market, while in case of a shortfall the country would need to buy additional allowances. It is worth noting that 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. An advantage of this approach is that there is a clear and long-term political signal to emitters, leading to increased confidence among investors. 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 crediting approaches. However, much depends on the national implementation. The political feasibility with the host country may be low as it can be perceived as putting restrictions on growth and potentially be very costly. Setting an absolute cap on emissions may also be technically complex due to strong, but hard to predict economic growth rates and a lack of a reliable database to set the baseline.

In ***sectoral crediting*** a no-lose target would be set for a sector: credits are usually issued ex-post in case emissions are below a threshold, and can be traded on the carbon market. There is no penalty if emissions are above the threshold. Such an approach is likely to receive more political support from host countries as it does not place restrictions on economic growth and with no lose targets no sanctions are imposed if the target is not met. However, there is no certainty about the environmental effectiveness due to the non-binding nature of the target. The system only provides proper incentives if the international carbon price is sufficiently high (i.e. there needs to be demand for credits) and if the target is set at an appropriate emission level. Another drawback is the ex-post credit issuance, which provides no capital flow for investments, and entails a risk for investors given the possibility that the voluntary reductions are missed.

3.2 Element 2: Coverage of the System

3.2.1 Sector boundaries

Determining the sector boundary is mostly a matter of optimisation between environmental effectiveness and administrative burden. Increasing the scope of the sector boundaries exposes more emission points to the policy mechanism, however increased involvement will raise the administrative requirements such as monitoring and verification.

A first option is to include the ***entire sector***. Coverage of all emitters within the sector increases economic efficiency and abatement potential and reduces intra-sectoral leakage. Larger coverage enables the establishment of robust baselines. However data requirements are high especially in sectors with a large number of emitters.

A second option is to cover only a ***particular technology or process*** within a sector, for example coal-fired power stations or blast furnaces within the iron and steel sector. This allows for targeted policies focusing on specific technologies. Focusing on a single technology or process however will have a relatively lower abatement potential than an entire sector.

A third option is ***including a minimum threshold*** based on emissions or industrial output. The most important advantage of this approach is reduced transaction costs for government and small emitters. Robust MRV of the system may also be easier. However, narrowing the scope could reduce the effectiveness of the scheme, particularly in case there are many small emitters with a relatively large abatement potential outside the boundary. Leakage within sectors is also a risk if production and emission are transferred to smaller, less efficient installations outside the scope of the mechanism.

3.2.2 Types of GHGs to cover

Four options for GHG coverage have been identified:
- Carbon dioxide (CO_2) only
- CO_2, methane (CH_4) and nitrous oxide (N_2O) only

- All six Kyoto gases: CO_2, CH_4, N_2O, hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6)
- Selective GHG coverage based on the characteristics of the sector

CO_2 is the main source of GHG emissions in most sectors and data availability is higher compared to other gases. Methane is very important in agriculture, waste, land-use and fossil fuel production. N_2O is significant for a number of industrial processes and agriculture. Industrial HFCs, PFCs and SF_6 are small contributors to climate change but have a very long lifetime. Primarily, the selection of gases will be based on an optimisation between environmental effectiveness, administrative feasibility and transaction costs. The national inventories particularly for non-CO_2 gases are often less comprehensive in non-Annex I countries, so data availability and MRV robustness can be difficult.

3.2.3 Upstream versus downstream coverage.

An ***upstream*** system regulates the amount of GHG emissions through the suppliers or distributors of fossil fuels. In contrast, a ***downstream*** approach applies to the direct sources of GHG emissions such as end-users of fossil energy. A ***hybrid*** system, in which some sectors or entities are covered upstream and others downstream, is also possible.

An upstream approach may be able to address a larger number of entities or potential sources of emissions. In sectors with a very large number of very small emission point sources such as buildings and transport, the administrative feasibility of an upstream approach may be higher due to the lower number of entities involved. . A downstream system on the other hand, provides more direct incentives to the emitters which are generally also the ones that are able to implement most of the mitigation options. In case of a crediting system, this results in more effective price signals and higher environmental effectiveness (while an upstream approach would effectively result in a carbon tax for end-users). A hybrid system may combine the best elements of both the upstream and downstream approaches, but also makes the system more complex and double counting of emission reductions must be avoided.

3.3 Element 3: Sector Target or Crediting Threshold

3.3.1 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. These involve relatively large uncertainties due to the difficulty in predicting emission levels resulting in a significant risk of over- or under-crediting. They may also be politically unacceptable for host countries. However, it is simpler to administer and covers all emission reduction efforts.

Indexed baselines: the emission level is set at a function of one or several economic or physical variables such as GDP. These variables have the advantage of a lower uncertainty in establishing the baseline levels and could be politically more acceptable for host countries. 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. This, increases uncertainty for operators and the carbon market and provides incentives to increase output and emissions. There is also no incentive for demand side efficiency measures as changes in demand have no impact on achieving the target or indexed baseline (which is set relative to a certain input or output). Finally, measuring the index involves monitoring costs and can be technically challenging. All proposals discussed in Chapter 4 use indexed baselines, partly

because these baselines are easier to determine in the cases concerned and partly because indexed baselines are the preferred option for the host country.
As is done in the CDM, the reductions achieved in comparison to an indexed baseline can be expressed in terms of absolute tonnes of emissions. Indexed baselines are generally used in the CDM as otherwise credits could be earned simply by shifting production to other plants. Applied to a sectoral scheme, for example, if the power sector of a country has a baseline emissions intensity of 0.80tCO2e/MWh and manages to reduce its intensity to 0.70tCO2e/MWh while producing 100 million MWh of electricity, the emission reduction would be calculated as (0.80tCO2e/MWh - 0.70tCO2e/MWh) * 100,000,000MWh = 10,000,000tCO2e. Correspondingly, the sector would be issued 10 million emission credits, each worth 1tCO2e. Units from a system with indexed baselines are therefore fully fungible with those from a system with absolute targets.

Technology diffusion baselines: the crediting threshold is defined at a certain level of technology diffusion (e.g. MW installed capacity). Setting an appropriate baseline is challenging 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 establishing appropriate emission factors to calculate the emission savings. Another disadvantage is the relatively narrow scope. However it is relatively simple to administer and it has a higher political feasibility among host countries as it can support their interest to promote or develop certain technologies.

3.3.2 Technical method for target or baseline setting

To determine the target or baselines discussed in the previous section, the following options are identified, which can be used for both absolute and indexed baselines.

Baseline expressed as a deviation by X % from projected BAU emissions. This is rather common in the international climate negotiations and many countries have already set such targets. However, there is a risk that a country will inflate the baseline, thereby increasing the crediting potential of the NMM but reducing its environmental effectiveness. There is also an incentive to delay policy actions as it will result in setting a higher baseline, providing the potential to generate credits by implementing the policy actions at a later stage. These risks are also significant for the other options, particularly the next two. If the baseline is too conservative, the incentive to participate is reduced.

Mitigation potential and costs, a baseline is determined on the mitigation potential that should be achieved without using the crediting mechanism. This option is conceptually sound, however involves more complexities and data needs than a deviation from BAU.

Emission rate or benchmark per output produced, such as tCO_2/kWh of power generated. For indexed baselines this is a useful, objective and straightforward approach. However, determining an appropriate benchmark is complex, particularly for sectors with diverse products and technologies. A large variety of benchmarks may be required.

Policy objectives scenario*,* that takes for example energy efficiency improvements or the implementation of renewable power generation into account in deriving the crediting baseline. This approach could be promising in countries where related policy objectives have already been established in the past. However, a drawback is that early movers could be punished and laggards rewarded.

Technology penetration 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. In addition to the pros and cons for the previous option, this approach may be politically attractive for host countries that aim at stimulating certain technologies.

In addition, regardless of the technical method, the target or threshold can be either flat (i.e. fixed/static) or sloping (i.e. either upward or downward) over the crediting/trading period as a whole. The advantages of a sloping (or dynamic) 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.

3.3.3 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) that may be supported or credited by foreign donors. This type of policy interaction may lead to double counting. In addition carbon market mechanisms may interact with domestic PAMs that would have reduced GHG emissions (even) without these mechanisms. Therefore, for each instrument appropriate crediting baselines would need to be established. This can be done in the following two ways:

- ***Factor all PAMs into the baseline***, regardless when they have been agreed or implemented. This would reduce the emission level of the baseline and thereby increase the chance that reductions achieved under the carbon market scheme are in fact additional. However, this approach would also create a perverse incentive to the host government to delay domestic climate-friendly policies.
- ***Exclude PAMs after a certain date***, e.g. when the UNFCCC adopts the modalities and procedures of the NMM (i.e. analogous to the CDM). This avoids the risk of perverse incentives but increases the likelihood that non-additional credits are generated. This option may have higher political feasibility among host countries and a higher environmental effectiveness than the first option.

3.4 Element 4: Operational / Incentive Framework

3.4.1 Operation/Incentives of the scheme at government/installation level

Sectoral crediting and trading schemes can be operated at government or installation level. The following basic options can be conceived, including combinations of these options:

- The government receives credits/allowances and ***implements non-ETS policies and measures (PAMs)*** to reduce emissions. This option has the highest administrative and (probably) host-country political feasibility, potentially high dynamic economic efficiency, and medium security that the intended environmental effect will be reached. If the PAMs provide incentives ('carrots') this option could be attractive to companies, but also could affect EU competitiveness. Vice verse for mandatory regulation ('sticks').
- The government receives credits/allowances and ***defines binding installation-level emission targets***, possibly forming the basis for a national ETS. This option supports future evolution towards cap-and-trade, has low impact on EU competitiveness, and provides high environmental certainty. Political resistance from companies may be expected, which could be mitigated by introducing PAMs to promote emission reductions.

- The government ***breaks down a sectoral target to individual targets for the installations*** within the sector. Like with a no-loose target, if an installation achieves its target, it receives credits. If not, there are no penalties. If the international carbon price is high and targets sufficiently ambitious, this option may be economically efficient and provide incentives for domestic and foreign investors. However, the crediting of individual emitters needs to be decoupled from overall sector performance ('insurance'). Disadvantages include low political feasibility, high transaction costs and a negative impact on EU competitiveness.
- Installations ***receive credits directly from an international authority*** if they beat their installation-level crediting thresholds. Similar considerations as for the previous option apply.

3.4.2 Methodology for distributing trading units

Auctioning or selling of trading units yields a trading system with high economic efficiency and low transaction cost as it only needs an auctioning platform. It also creates a substantial source of government revenue. However, this option has low political feasibility among (industrial) stakeholders as entities have to invest significantly in buying allowances.

Grandfathering refers to the free distribution of emission allowances based on historic emissions. This is politically the most attractive option, but has some negative impacts: high transaction costs, low economic efficiency, windfall profits, favours existing emitters and needs complex rules regarding the updating of allowance allocation in subsequent trading periods in order to mitigate negative distributional effects and perverse incentives.

3.4.3 Currency

The most obvious trading unit or currency would be ***1 tonne of CO_2-eq. for an emission allowance or credit***. This option is the most commonly discussed and has clear advantages: it links directly to the objective of climate change mitigation, is easy to understand and is also used in other existing and future climate mechanisms.

However, other options can also be thought of for example: a ***unit of renewable energy*** (kWh, GJ), which is used in tradable green certificates (TGC), or a ***unit of energy savings*** (kWh, GJ) as used in tradable white certificates (TWC). Such units could facilitate schemes that may be politically attractive as these provide incentives for technology development that bring benefits to society. Clear drawbacks are the indirect link with climate objectives, the need for additional reporting, CO_2 accounting methodologies and potential for double counting. Linking with other schemes would be challenging.

Fungibility of Units Generated from Absolute and Indexed Baselines

As is done in the CDM and JI, the reductions achieved in comparison to an indexed baseline can be expressed in terms of absolute tonnes of emissions. Taking the example of grid-connected electricity generation CDM projects, it is usually assumed that the project displaces other electricity generation from the grid. Baseline emissions are hence calculated by multiplying the project's electricity generation with the average emission intensity of the relevant grid, the so-called grid emission factor. If, for example, a grid has an emission factor of 0.80tCO2e per MWh of electricity and a project expects to generate 100,000MWh per year, projected baseline emissions per year are 80,000tCO2e. The emission reduction is constituted by the difference between the baseline emissions and the actual project emissions. If, for example, the project is a wind power project with zero project emissions, this project could expect be issued 80,000 CERs per year, each worth 1tCO2e. However, while projects are required to provide an ex-ante projection of expected emission reductions, actual CER issuance is based on the actual production volume during the monitoring period. So if the project actually generates 110,000MWh, in the monitoring report baseline emissions are calculated at 88,000tCO2e and the project is issued 88,000 CERs.

For more complex project types such as aluminium production several baseline emission intensity factors need to be established to cover different emission sources such as emissions from electricity consumption and PFC emissions from anode effects. All emission factors are denominated in terms of emissions per tonne of aluminium produced. Baseline emissions are again calculated by multiplying the baseline emission factors with the amount of aluminium that is actually produced during the monitoring period, which are then compared with the actual emissions from electricity consumption, anode effects etc. as monitored.

Applied to a sectoral scheme, the baseline emissions intensity of the power sector of a country could for example again be set at 0.80tCO2e per MWh. If the sector is projected to generate 100 million MWh of electricity in one year, projected baseline emissions for that year are calculated as 0.80tCO2e/MWh * 100 million MWh = 80 million tCO2e. If in practice the sector generates 110 million MWh, baseline emissions are re-calculated at 88 million tCO2e. If the sector has only emitted 70 million tCO2e while producing these 110 million MWh, it has reduced emissions by 18 million tCO2e compared to the baseline. Correspondingly, the sector would be issued 18 million emission credits, each worth 1tCO2e.

Units from a system with indexed baselines can therefore be fungible with those from a system with absolute targets if there is agreement on the calculation method.

3.4.4 Temporal flexibility and other timing issues

Choices have to be made regarding four main issues:

1. First of all, the ***length of the crediting/trading period***. Investors generally prefer a long period as it provides more certainty, whereas regulators consider the possibility to adapt the system as being very important in order to reduce any risk of design flaws. Harmonization of the crediting/trading period with the GHG commitment period of a country reduces the number of transitional arrangements when a new commitment period starts. However, this may lead to cyclical investment patterns by covered emitters. Renewal of the baseline period offers the possibility to improve and update baselines, while still providing some long-term certainty. This may also be an impediment to more ambitious, integrated mitigation approaches.
2. ***Credit issuance for no-lose crediting*** can be done once at the end of a period to increase the system's environmental effectiveness, but will also increase investor uncertainty and generate fewer credits. An intermediate option would be to start crediting from the year that emissions are below the baseline.
3. Compliance flexibility can be enhanced by the ***option of saving credits/allowances*** to future periods (*banking*) and *borrowing* from future periods for use in the current period. These options enhance cost-effectiveness and foster carbon price stability. In addition, banking provides incentives for early action, but also involves increasing risks of over-allocation of allowances/credits in subsequent periods. Borrowing provides an incentive to delay mitigation actions and thereby potentially weakens future targets.
4. Ex ante or ex post crediting. Ex ante crediting, i.e. issuing credits at the beginning of a crediting period, relieves the ex-ante financing problems of investments in GHG mitigation, but introduces the risk that at the end of the crediting period the emission reductions actually achieved (i.e. ex post) turn out to be less than the credits issued at ex ante. On the other hand, ex post crediting – i.e., issuing credits at the end of the crediting period – avoids this risk but enhances the uncertainty and financing problems of an investment and hence, may result in less investments and fewer GHG reductions.

3.5 Element 5: Requirements for Data Collection and MRV

MRV systems are based on the optimisation between several principles and criteria, such as accuracy and cost effectiveness, but also completeness, conservativeness, materiality, consistency, adjustability and transparency. These principles will play out differently in various contexts and scopes, such as sectors and countries. Often it will be needed to introduce flexibility into 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 the data and capacity building for MRV also need to be considered.

3.6 Element 6: Compliance Framework and Penalties

Three non-mutually exclusive options for a compliance framework for emission targets and reporting are outlined below.

A ***Kyoto based approach*** includes a Compliance Committee (with facilitation and enforcement branches) that manages compliance. Proceedings can be triggered by any Party or automatically, where a mandated expert review team finds a 'question of implementation', resulting in an 'apolitical' process. Consequences are automatically applied and penalties are thought to be relatively stringent. A disadvantage of this approach is its inflexibility. The political feasibility of this option, however, is likely to be rather low.

A ***Montreal Protocol*** (on ozone depleting substances) based approach also combines elements of facilitation and enforcement, but with a stronger role for the Meeting of the Parties in managing compliance. There is an Implementation Committee (which seeks solutions and makes recommendations) and parties or the Secretariat can trigger proceedings. However, substantive decisions are taken by the MOP. Advantages include the flexibility and the link of compliance to financial support, which makes this option politically attractive to host countries. On the other hand, there is a lack of certainty regarding consequences and a risk of host countries blocking or mitigation punitive actions against them.

Arbitration consists of the submission to an independent judicial body of a dispute to be decided based on principles of law. It thereby closely resembles a court of law, with the Parties shaping to a large degree the arbitral proceedings. This is an apolitical process and can imply relatively strong and binding consequences. The drawbacks include a bilateral rather than multilateral process, absence of facilitation, ex-post application and its costs and time requirement.

3.7 Element 7: Governance

3.7.1 National governance and accounting framework

Depending on the further design of the carbon scheme, national institutions need to fulfil several functions, including setup of the scheme and its international submission, trading regulation, issuance of trading units, verification and stakeholder involvement. We identify three broad options for governing institutions:

5. ***Governmental:*** This option is likely to entail fewer political barriers, medium transaction costs, it is compatible with the EU ETS and, compared to self regulation, it mitigates the impact of

powerful business interests. However, as host country governments have an incentive to maximise credit generation there are significant risks of baseline inflation, weak targets, weak monitoring, competitive distortions and some perverse outcomes.

6. ***Self-regulation by the actors from the sector:*** Although transaction costs could be lower, the drawbacks related to governmental oversight are most likely larger here. In addition this is an option that is likely faced with political opposition from buyer countries.
7. Governance by an ***independent agency*** beyond government control could avoid the drawbacks mentioned above. However, there are high transaction costs and possibly political barriers with the host countries and covered emitters.

3.7.2 International governance and accounting framework

The central issue for international governance is the competence for approval of national proposals and issuance of credits:

- 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 given by a ***new supervisory body***, 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 a **national level** subject to the respect of all participation requirements and modalities for setting baselines and targets, with only a technical review undertaken at an international level by some sort of International Expert Team designated by the COP.

Technically, the first two options are basically the same. This option could lead to a largely depoliticised process that may lead to a relatively high environmental ambition with decisions being taken fast. However, target or threshold setting is a rather political question and might not be appropriate for a technical body. Therefore, another option is approval by the COP, based on an assessment by the regulatory body, which has a higher political legitimacy, but also runs the risk of having a lower environmental effectiveness due to a more politicised process. The final option 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 that of other options.

The new regulatory body could be composed of full-time professionals or follow a CDM EB model (political candidates nominated by the UNFCCC's regional groups). The latter has higher political acceptability but with politicised decisions. The former does not have these drawbacks, but may face political opposition and involves more transaction costs.

For the assessment of sectoral proposals, the CDM model based on auditing companies could be followed, or a process similar to the Annex I inventory review model: assessment by independent experts coordinated by the Secretariat. The latter appears to have less potential for conflicts of interest, lower administrative costs and higher political acceptability.

3.8 Element 8: Ways of Managing the Transition from CDM to the NMM

In order to prevent or reduce double counting in the reduction of emissions by the CDM and the NMM there are four main options (with sub-options, see Annex A):

- ***Carve out CDM projects from sectoral boundary***. This option will be acceptable to project participants and is easy to administer. It however results in significant risk of intra-sectoral leakage, particularly if new CDM projects continue to be allowed. In addition, there is potential for double counting from indirect overlaps and the option is less compatible with the EU ETS.
- ***Phase-out CDM projects immediately, after their current crediting period or after their last crediting period*** and until the phase-out, deduct CERs from sectoral performance. This option addresses double counting adequately and is easy to administer. While phase-out after project's last crediting period would be acceptable to project participants, they would probably strongly resist the other two options. There is some potential for leakage within the sector to small installations outside the NMM boundaries. The phase-out could be limited to those CDM projects which are subject to direct or indirect double-counting.
- ***Continue CDM*** and deduct CERs from the sectoral performance. This option is the most acceptable to project participants, is easy to administer and addresses double counting well. On the other hand, there are strong risks of 'system shopping' for investors and intra-sectoral leakage. It is also less compatible with the EU ETS and may complicate mitigation planning.
- ***Integrate existing CDM projects*** into a sectoral scheme, e.g. by adapting a CDM benchmark to the benchmark for the sectoral scheme. This option minimises intra-sectoral leakage, addresses double counting, has high environmental effectiveness and is compatible with the EU ETS. Its acceptability to project participants and administrative feasibility may be lower than the other options and depends on each specific case.

3.9 Element 9: Financing of the Mechanism

The upfront cost of capacity building and setting up of the sectoral mechanism may be financed by:
- ***The host country***. This could be an economically efficient option; however the costs could be a barrier for host countries, and may lead to lower environmental integrity.
- ***Donor countries.*** This option would be more attractive to host countries; however an additional process for accountancy of the funds is required.
- ***Multilateral donors***. Similar considerations to donor countries, with the additional note that there is already ample experience with financing capacity building.

The costs of operating the system are assumed to be relatively small and can best be financed through an administrative fee or a small share of the NMM proceeds. This so-called 'Share of Proceeds' (SoP) for NMM credits may be more or less similar to the level of the SoP for CDM credits which is between US$ 0.10-0.20 per tonne of CO_2 equivalent reduced, depending on the amount of credits issued . 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 issued, the specific international governance structure of the NMM and the resulting costs of this structure in particular.

Finally, the extra (upfront) costs on investing in the GHG mitigation options may be substantial and could be financed in the following ways:
- ***Through host government (budget) accounts.*** A major advantage of this option is that no external or private finance is needed. It implies, however, that finance risks are born solely by the host government and may result in underinvestment or even a barrier to participation.
- ***Through private (installation level) capital.*** Private installations in developing countries, however, may lack access to upfront capital funding, while the risks of a crediting/trading scheme may be considered too high.
- ***Through credits from compliance buyers, including carbon investment funds.*** The main pro of this option is that no – or less – finance from host governments or domestic (private)

installations is needed. Credits, however, may be sold at below market value – due to the high risk premium – or a guarantee from the host government or third party may be required.

4 Proposals for Designing the New Market Mechanism

In this chapter 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.

Chapters 3 delivered a list of possible options and features for the design elements and modalities of a New Market Mechanism (NMM), including an assessment of their respective strengths and weaknesses. This chapter combines these design elements and modalities towards three distinct, but coherent, proposals for the NMM. For each design element and modality, one of the available options is selected and combined into full-fledged proposals.

The selection and combination of design options has been made on the basis of a list of optimisation criteria. The optimisation criteria are similar to the assessment criteria in Chapter 3, 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 2.

Table 2 Assessment Criteria for Optimising and Evaluating Design Proposals

Top Priority
Environmental effectiveness and integrity
Preparedness for evolution towards an 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 have taken into account country- and sector-level considerations. Some design options are more suitable for some country-sector combinations 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 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.

Therefore, accounting for emissions is 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. 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 its emission intensity 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 hardly be any incentive to invest. Therefore, we propose that the host country government should introduce mandatory installation-level targets. If the targets are intensity-based, as is proposed here, such a system is referred to as a "tradable intensity standard".

Proposal 3: Installation-Based Emission Trading System

In this system, the host country government would adopt a sectoral "trading" target and introduce an installation-level emission trading system for the sector.

The following sections elaborate the three proposals in more detail. During the elaboration it became apparent that the three priority criteria for the assessment point in very similar directions for many of the design options. The table below summarises the design choices that are the same for all three proposals and the basic rationales, rather than repeating them three times for each individual proposal. A detailed discussion of the design choices for each design element is contained in Annex B.

Table 3 Common Design Elements of All Three Proposals

#	Design element	Selection
	Types of GHGs to cover	Potentially all GHGs if data availability allows. Broad coverage enhances environmental effectiveness and economic efficiency if reliable MRV is ensured.
3	**Sector target or crediting threshold**	
	a) Nature of target/threshold	Intensity targets to minimize potential for over-crediting by factoring key emission drivers such as production growth into the baseline.
	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.
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 the process.
	c) Composition of international regulatory body	Full-time professionals to minimize politicization of the process.
	d) Registry	National or international.

#	Design element	Selection
7	**Compliance framework and penalties**	Kyoto accounting system has most sophisticated assessment of monitoring and reporting obligations, add increased facilitation as under Montreal Protocol.
8	**Ways of managing the transition from CDM to new market mechanisms**	Phase out CDM projects after their current crediting period (i.e. the period that is ongoing when the new mechanism starts operation) to minimize potential for double counting and inter-sectoral leakage, 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.

4.1 Proposal 1: Government Crediting System

4.1.1 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 many very small emission sources, the transaction costs of accounting for each individual source would probably be prohibitive.

Therefore, we propose a government-level system that facilitates participation of such sectors and 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 proposal needs to include at least a definition of the system boundary, a baseline projection, the proposed target and modalities for MRV. The design could require further elements, such as details on measures the government intends to take to reduce emissions. The level of detail will increase transparency; it also makes it easier for policy-makers to validate the impact of specific policy measures.
- 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 implementation reports at regular intervals.
- The international body reviews the implementation report and approves it, requests changes or rejects it. In case of rejection, countries may be given the option to resubmit the report if the outstanding issues are addressed.
- If the report is approved and emissions are below the crediting threshold, the host country government receives credits. If emissions are above the threshold, there are no further consequences.

Figure 2 Overview of Basic Steps in the Mechanism's Cycle of Proposal 1

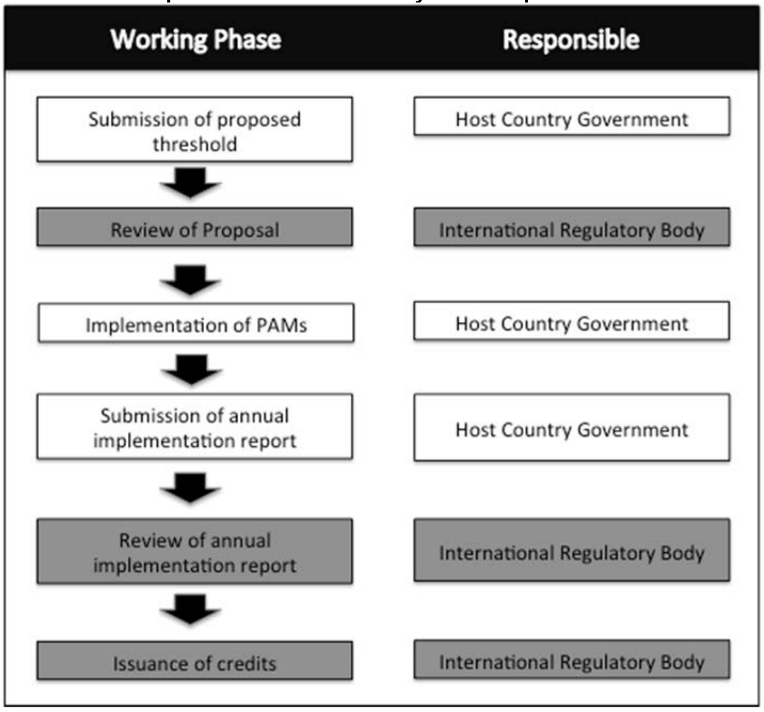


Table 4 summarises the specific design choices that differ from the other two proposals and the main rationales. Annex B discusses in more detail why a respective option was chosen in order to maximise the design towards the three priority criteria.

Table 4 Specific Design Elements of 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.
	c) Upstream versus downstream coverage	Not applicable as no emission units are issued to individual emitters.
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.

4.1.2 Main Strengths and Weaknesses of the Proposal

The system envisages coverage of entire sectors, maximising the potential for environmental effectiveness and eliminating risks of intra-sectoral leakage. The broad coverage implies that a broad range of mitigation options is included in the system, enhancing economic efficiency.

However, whether the reduction potential is actually realised depends on the host country government's willingness and ability to introduce appropriate policies and measures to reduce emissions. This willingness would partly depend on a sufficiently high international carbon price to provide a meaningful incentive. A caveat is that credits only accrue ex-post, so the government would need to pre-finance the policies and measures. The discussion of design element 9 in Annex B discusses options for pre-financing in detail.

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 mobilising investments and inducing emission reductions. In addition, the system could be particularly suitable for state-owned sectors, such as the power sector in many countries, where the host country government has direct control over emission sources.

Accounting for emissions on the basis of aggregate data generally has a higher level of uncertainty than installation-level accounting. It should in general be rigorous, for example by using conservative values for all relevant parameters such as fuel emission factors.

The system requires establishment of a robust sectoral emission inventory, providing some evolution towards a domestic cap-and-trade system. Moreover, the system would require strengthened domestic MRV capacity and installation-level data. Technical cooperation between international partners could deliver significant exchange of expertise and efficiency gains in this area.

Intensity targets have been chosen to minimize the risk of baseline inflation by factoring key emission drivers such as production growth into the target. However, intensity targets entail an implicit incentive to increase production in order to maximise credit generation. Short crediting periods give the opportunity of frequent adjustment to minimize perverse outcomes.

The use of indexed targets also enhances political feasibility for developing countries, which fear that absolute emission targets might cap their domestic (economic) growth. The political feasibility of national implementation will very much depend on the policies and measures that the host country government will introduce. If the government mainly uses voluntary “carrots”, domestic political resistance can be expected to be much lower than if it uses mandatory “sticks”.

Overall, administrative requirements would be relatively modest. As individual installations would not participate in the carbon market, administrative costs would be lower than for 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 selected. Some policies, such as banning outdated technology, can achieve considerable emission reductions at low transaction costs.

4.1.3 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 and to implement and enforce robust emission reduction policies. Therefore, the design principally should 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.

4.2 Proposal 2: Tradable Intensity Standard

4.2.1 Basic Design, Rationale and Mechanism Cycle

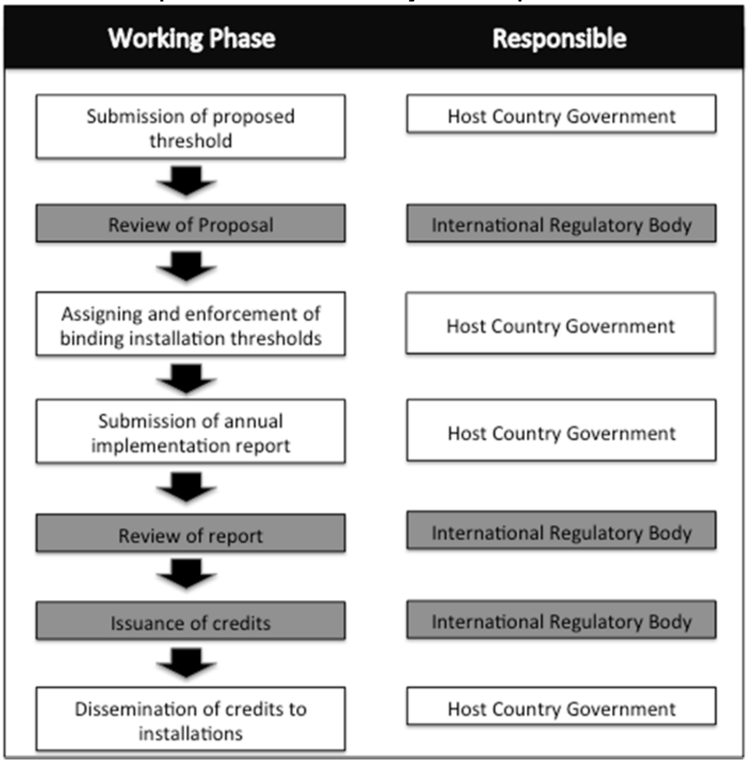
As opposed to Proposal 1, in this system, the sectoral crediting threshold would be devolved to the individual emission sources. Each emission source in the sector would be assigned an individual target and would receive credits if it reduced its emission intensity below the target.

To avoid the problem that the reductions at one installation may be offset by emission increases at another installation, it is proposed that the host country government should make the installation-level targets mandatory.

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

- The host country government submits a proposed crediting threshold to the international regulatory body. This proposal 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 host country government imposes binding targets on the sector's individual installations. Installations whose annual emission intensity is above the target will need to buy emission 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 implementation reports to the international regulatory body.
- The international body reviews the report and approves it, requests changes or rejects it. In case of rejection, countries may be given the option to resubmit the report if the outstanding issues are addressed.
- If the report is approved and the emission intensity is below the crediting threshold, the host country government receives credits. If the emission intensity is above the threshold, 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.

Figure 3 Overview of Basic Steps in the Mechanism's Cycle of Proposal 2



The proposed system is rather similar to a fully-fledged cap-and-trade system. However, to implement a cap-and-trade system the host country would need to either adopt a "trading" 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 only take place after the host country government has received credits from the international regulatory body. Practically, this means that there would be a time lag, but it is assumed that investors prefer internationally fungible units over a domestic currency. In addition, if a domestic currency was used, the domestic market should have a minimum size in order to ensure sufficient liquidity, whereas the use of international units would connect the system to the international carbon market.

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

Table 5 summarises the specific choices that were made for each individual design element and the main rationales. Annex B contains more detail on each individual design element and why a respective option was chosen in order to maximise the design towards the three priority criteria.

Table 5 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

#	Design element	Selection
	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 credits	Benchmarking if possible with available data
	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 the scheme has been proven Year-on-year no-lose to create proper incentives.

4.2.2 Main Strengths and Weaknesses of the Proposal

The system would cover all installations in a sector above a certain size, using for example similar inclusion thresholds as in the EU ETS, providing substantial coverage and sufficient potential for significant emission reductions. Environmental effectiveness would 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.

However, since only installation above a certain size threshold would be covered, there may be some risk of intra-sectoral leakage: Installations would be subject to binding targets and would therefore have an incentive to reduce emissions by reallocating 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. To what extent installations would be incentivized to relocate production would depend on the level of the carbon price and the overall cost structure 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 relocating production, whereas installations with low intensity and/or low abatement costs would have an incentive to increase production in order to maximise credit generation.

The system would support a strong evolution towards an EU ETS-compatible system. 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 for installations with low emission intensity and/or low abatement costs. The net effect on companies' competitive position would depend on the stringency of the targets.

The relatively broad coverage means that a diverse range of mitigation options would be available, which promotes economic efficiency. In addition, emitters would be directly exposed to the carbon price signal with the aim to stimulate economic efficiency and private sector participation. 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 for political feasibility, the proposal envisages imposing binding targets on the individual emitters which would probably result in substantial domestic political resistance. 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".

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 *de minimis* threshold tries to strike a balance between environmental effectiveness on the one hand and administrative costs on the other.

4.2.3 Applicability to Sectors and Countries

Installation-based crediting implies substantial transaction costs. Therefore, it is most suitable for sectors with large point sources like the power and industry sectors. Most developing countries will probably have substantial capacity constraints in implementing installation-level emissions accounting.

4.3 Proposal 3: Installation-Based Emission Trading System

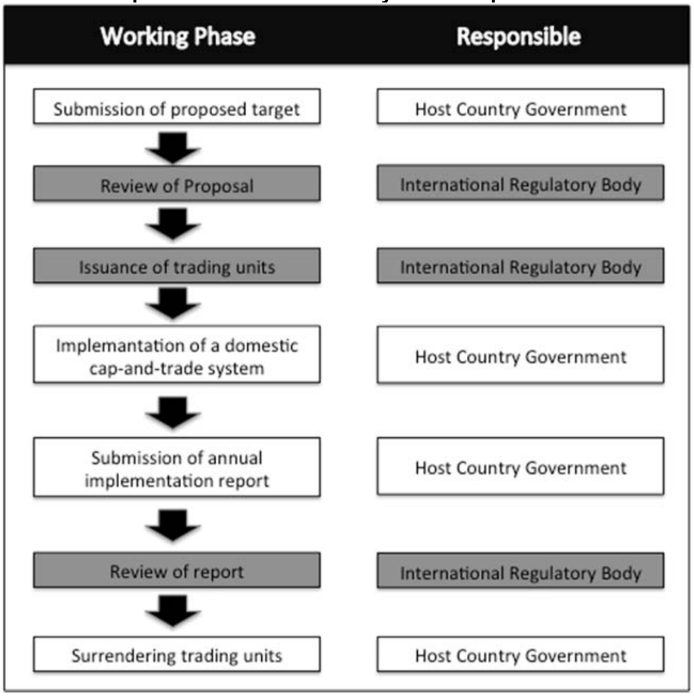
4.3.1 Basic Design, Rationale and Mechanism Cycle

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 be as follows:

- The host country government submits a proposed target to the international regulatory body. This proposal 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 implementation reports to the international regulatory body.
- The international body reviews the report and approves it, requests changes or rejects it. In case of rejection, countries may be given the option to resubmit the report if the outstanding issues are addressed.
- Once the report is approved, the host country government needs to surrender trading units corresponding to the total sectoral emissions.

Figure 4 Overview of Basic Steps in the Mechanism's Cycle of Proposal 3



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

Table 6 summarises the specific choices that were made for each individual design element and the main rationales. Annex B entails more detail on each individual design element and why a respective option was chosen in order to maximise the design towards the three priority criteria.

Table 6 Specific Design Elements of Proposal 3: Installation-Based Emission Trading System

#	Design element	Selection
1	**Crediting or trading**	Trading to explore a range of options as other proposals are based on crediting
2	**Coverage of the mechanism**	
	a) Sector/activity boundaries	All emitters above a 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
	c) Temporal flexibility	One or two short trading periods in the beginning, especially up to 2020, to allow quick changes to scheme if problems occur; longer ones thereafter if robustness of the scheme has been proven Annual compliance.

4.3.2 *Main Strengths and Weaknesses of the Proposal*

The strengths and weaknesses are very similar to those of Proposal 2, as in both systems binding targets would be imposed on emitters. Covering all installations in a sector above a certain size provides for substantial coverage and potential for a significant reduction in emissions . Environmental effectiveness would depend on the stringency of the target. As both the sectoral and the installation-level targets would be binding, the environmental outcome would be assured unless the national or the international compliance system fails or the country choses not to fulfil its international obligation to offset excess sectoral emissions. However, since the entire sector would not be covered, there might be some risk of intra-sectoral leakage, depending on the level of the carbon price and the overall cost structure covered compared to non-covered installations.

Establishing a domestic emission trading system would support a strong evolution towards an EU ETS-compatible system. However, the use of indexed targets might not be compatible as they provide an implicit production subsidy for installations with low emission intensity and/or low abatement costs. The net effect on a company's competitive position would depend on the stringency of the targets. Another issue in this context, even more crucial, could be the fungibility to other countries and sectors.

The relatively broad coverage means that a diverse range of mitigation options would be available, which promotes economic efficiency. In addition, emitters would be directly exposed to the carbon price signal with the aim of stimulating economic efficiency and private sector participation. 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. The issuance of emission units ex ante further facilitates private sector participation. Units could be traded under standardised contracts, which would probably result in exchange-based trading and further facilitate operation of the mechanism. Entities could manage their allowances as assets and sell them whenever they like, rather than having to wait for the ex-post assessment of their performance.

As for political feasibility, 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 that of Proposal 2. In addition, imposing binding targets on the individual emitters would probably result in substantial domestic political resistance. 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".

Administrative requirements would be high due to the need for installation-level emission accounting. The *de minimis* threshold tries to strike a balance between environmental effectiveness on the one hand and administrative costs on the other.

4.3.3 *Applicability to Sectors and Countries*

The applicability is similar to Proposal 2: As installation-based trading implies substantial transaction costs, Proposal 3 is most suitable for sectors with large point sources, that is, the power and industry sectors. With upstream coverage it would also be applicable to buildings and transport. However, it may be doubtful whether carbon pricing alone is a sufficient means at tackling emissions from transport and buildings. Most developing countries will probably have substantial capacity constraints in implementing installation-level emissions accounting.

5 Emission Reduction Potential of the New Market Mechanism

5.1 Approach

This chapter provides insights on the possible impacts of implementing the selected design proposal 2 in five case studies. The cases involve five different sectors in five developing countries. In each case the impact of the New Market Mechanism (NMM) is assessed in four policy relevant scenarios. The scenarios provide insight in the development of the sector's emissions without an NMM and whether and to what extent these emissions could be reduced when an NMM is implemented. There are two different types of NMM scenarios examined in these case studies: one in which a cap is set on the carbon intensity of production in a sector and one in which an absolute cap is set on the emissions from the sector.

The five sectors in developing countries analysed in this section were selected on their annual emissions and sufficient availability of data. In addition the objective was to include different kinds of sectors in a geographically representative selection of countries.

5.1.1 Four Scenarios

The four scenarios are:

1. **No-abatement**: Implementing currently planned sector expansion without changes in the current carbon intensity. This is a hypothetical scenario in which emissions grow proportional to the forecasted increase in production. This scenario is based on the current carbon intensity combined with expansion plans from sector or governmental organisations. Although hypothetical, it reflects the emissions of the sector without abatement measures. Thereby providing a reference for the other three scenarios in which national policies, either with or without an NMM stimulate emission reductions.
2. **BAU**: A Business-as-Usual (BAU) scenario derived from government publications on targets or planned policies. While in the no-abatement scenario no abatement measures are taken, this scenario reflects likely development of emissions from installations in this sector, affected by technological and economic developments and the policies or governmental targets which are currently planned.
3. **NMM carbon intensity cap**: Implementing an installation-based tradable intensity standard (Proposal 2). This proposal involves a voluntary governmental commitment to an emission target at the sector level which is imposed on installations as a mandatory intensity target. Carbon credits are rewarded at the end of the trading period if an installation emitted less than it was allowed to according to the intensity target. The reduction in emissions encouraged by the NMM go beyond the reduction effort foreseen by government policies in the BAU scenario.
4. **NMM carbon emissions cap**: Implementing an absolute GHG emission cap on the sector. The cap is defined by an annual allocation of emission allowances at the beginning of the year. The allowances can be freely traded within the scheme, can get a daily price if the market has sufficient liquidity, and can potentially serve as collateral in the financing of investments in the reduction of emissions. In general the level of ambition in the NMM carbon emission cap scenario exceeds the level of ambition of the NMM carbon intensity cap scenario.

The case studies involved gathering information on historic and future emissions and production, and on current and future policies aimed at reducing emissions. Furthermore, the characteristics of the sectors were thus examined, including the number of installations, the number of companies involved and whether they are government owned or privatised. Finally, information on the abatement costs was gathered to gain an insight into the costs of the possible measures.

5.1.2 Five Sectors

Five countries and sectors were selected, with the aim of having a geographical spread over different continents, including different sectors in the assessment and data availability. The sectors selected were: steel in Brazil, power in Chile, refineries in Indonesia, power in South Africa and cement in Vietnam. Individual case studies are elaborated in Annex C. Table 7 provides an overview of the sectors.

Table 7 Key information on selected sectors

Case study	Estimated number of installations	Historic emissions ($MtCO_2e$/year)	Emission expectation in the BAU scenario ($MtCO_2e$/year)	Carbon intensity	
				Case study	EU
Steel in Brazil	29	57.2 in 2007	126 in 2030	1.17 tCO_2e/t steel in 2011	Less than 1.0 tCO_2e/t of steel
Power in Chile	100	14.2 in 2006	85 in 2030	0.26 tCO_2e/MWh in 2005	0.37 tCO_2e/MWh
Refineries in Indonesia	8	Estimated at 23 in 2005	Estimated at 30.6 in 2030	Estimated at 0.4 in 2005	0.21 tCO_2e/t crude oil
Power in South-Africa	35	291 in 2000	1,640 $MtCO_2e$ by 2050 with unconstrained emissions	0.80 tCO_2e/MWh in 2010	0.37 tCO_2e/MWh
Cement in Vietnam	110	40 in 2010	55 in 2020	0.8 tCO_2e/tonne cement in 2009	0.67 tCO_2e/tonne cement

Note: The emission forecasts have different timelines, as in the studies from which they originate. In table 8 all forecasts are presented for the period till 2020.
The emission expectation for the South African power sector in the BAU scenario is without emission constraining policies. For the other countries the BAU scenarios does include mitigation policies. In addition, emission data for Indonesian refineries varied between different sources. Therefore, rough estimates of the sector emissions had to be used.

5.2 Defining the BAU Scenario and the Use of a No-Abatement Scenario

The BAU scenario can provide a basis for setting an emission target or carbon intensity target under the NMM or emission cap. As such, it defines both the mitigation effort needed for industries to meet the targets of the additional abatement obligation and, indirectly the number of credits that can be generated if additional mitigation action is taken.

In all five case studies production from the selected sectors is expected to increase dramatically up to 2020, 2030 or 2050, with the exception of the cement sector in Vietnam. Likely drivers behind a decrease in carbon intensity as the sector expands are a) technological development, b) potential increase in energy prices and national commitments and c) policies aimed at reducing emissions.

These factors are included in the BAU scenario, allowing the NMM to provide incentives for reductions that go beyond what would otherwise occur. As a consequence, the BAU scenario defines the potential for crediting under the NMM, making its definition subject to national interests and political motives.

The BAU scenarios and emission forecasts in the case studies are based on studies from scientific institutions and/or government agencies. In the absence of an internationally agreed standard to define the BAU emissions of a certain sector, the different BAU scenarios will inevitably reflect different calculation methods and assumptions on how to determine the impact of policies on GHG emissions, thus making the scenarios difficult to compare.

As a more objective standard, the case studies also included a no-abatement scenario. This scenario shows the emission level if the carbon intensity of the sector is maintained while its production is expanded as forecasted in the BAU scenario.

Particularly interesting is the Chilean case. According to the University of Chile, power production will potentially grow 5.4% annually. The sector is dominated by gas-fired power plants and hydropower but expected to expand with increased use of coal-fired power. As a result, the country's emissions are expected to increase nearly six-fold in the next 23 years. Whereas, for the other cases the no-abatement scenario assumes no decrease (nor increase) in carbon intensity, the emission levels in this scenario for Chile actually increases.

5.3 Abatement Potential

The basis of the two NMM scenarios is an emission target. The emission targets are based on national commitments or ambitions, historic emission levels of the sector or international references. Considering these five cases, the differences in abatement potential between four scenarios is examined. In addition, the likelihood these emission targets are able to be complied with is assessed. This is essentially a comparison of the abatement requirement, defined by the sector's emission target, and the abatement potential. Finally, the sensitivity of the emissions and the abatement potential in the NMM scenarios to factors such as changes in fuel prices or carbon prices has been assessed. The full analysis can be found in Annex C.

Table 8 provides an overview of the abatement potential of the BAU, NMM and carbon emissions cap scenarios compared to the no-abatement scenario. A finding which stands out is that the difference in the abatement potential of the NMM carbon intensity cap and the NMM carbon emissions cap in the Chilean scenarios is relatively small. This is because the no-abatement scenario foresees both an increase in carbon intensity and production levels. Therefore, significant reductions are necessary to keep emissions below carbon intensity targets in the NMM carbon intensity cap scenario or absolute emission targets in the NMM carbon emissions cap scenario.

The difference between the abatement potential in the BAU and NMM carbon intensity cap scenario based in the South African power sector is significantly larger, partly due to the larger size of the sector. Although, domestic action in the BAU scenario prevents an increase in the carbon intensity of South African power, its intensity remains well above EU levels. On the other hand, the carbon-intensive power production in South Africa also makes the impact of renewable energy on the sector's emissions higher than, for example, in Chile.

Table 8 Emission levels and abatement potentials compared to the no-abatement scenario, annual average for the period 2012-2020 in $MtCO_2e$/year

Case study	Emissions in 2020 (in $MtCO_2e$)					
	No-abatement Scenario	BAU scenario	NMM carbon intensity cap scenario Target		NMM carbon emissions cap scenario Target	
Steel in Brazil	96	73	*Carbon intensity at the level of installations under the EU ETS in 2005*	64	*Cap on sector emissions of 71 $MtCO_2e$/year by 2020, corresponding to the national emission pledge of 36% below the BAU emission level in 2020*	48
Power in Chile	46	26	*Carbon intensity at the level in Chile in 2005*	12	*Cap on sector emissions of 31 $MtCO_2e$/year by 2020, corresponding to the national emission pledge of 20% below the BAU emission level in 2020*	8
Refineries in Indonesia	28	24	*Carbon intensity at the EU level*	13	*Cap on sector emissions at its 2005 level (no international commitment available).*	18
Power in South-Africa	306	261	*Carbon intensity level as the average of that in the EU-27 in 2005 and the carbon intensity level in the respective year in the BAU scenario of the South African power sector*	246	*Cap on sector emissions of 228 MtCO2e/year by 2020, corresponding to the announced national pledge of 34% below the BAU emission level in 2020*	214
Cement in Vietnam	104	86	*Carbon intensity at the EU level in 2005*	67	*Cap on sector emissions of 44 $MtCO_2e$/year, the emission level of the sector in 2010 (no international commitment available).*	26

Note: The emission levels in the different scenarios are achieved only if the policies, NMM or carbon emission cap indeed stimulates abatement measures. As discussed in this chapter, in some sectors barriers to abatement measures have been identified which may affect the impact of policies and emission targets on emissions.

Table 8 shows the abatement potential in the different sectors. It shows that in the Brazilian steel sector annual emissions in 2020 are expected to reach 96 $MtCO_2e$/year by 2020 if no abatement measures are taken. In the NMM carbon intensity scenario emissions would be capped using a carbon intensity reference level from the EU ETS. If this target is met, this would reduce emissions in 2020 by 22 $MtCO_2e$/year to 64 $MtCO_2e$/year. Most abatement ambition is reflected in the NMM carbon emissions cap scenario, potentially bringing emissions down to 48 $MtCO_2e$/year.

In Chile emissions from the power sector could be reduced in the NMM carbon intensity cap scenario by 14 $MtCO_2e$/year in 2020 compared to the BAU scenario. The NMM carbon emissions cap scenario can bring emissions down by an additional 4 $MtCO_2e$/year in 2020. The abatement ambitions in the NMM scenarios compared to the BAU scenarios for Indonesian refineries which decreases emissions by 11 $MtCO_2e$/year and 6 $MtCO_2e$/year, The abatement potential in the South African power sector and the Vietnamese cement sector may be determined in a similar manner. These figures represent the potential supply of credits from these sectors. Annex C provides more background on the likelihood that this estimated supply of credits in the NMM scenarios could actually be delivered.

5.4 Findings from the Case Studies

5.4.1 *Data Availability and Consistency*

Consistent and reliable data on emissions from installations in a specific sector is crucial for the design and operation of the NMM. Unfortunately, such data is not always available. This became evident when identifying sectors for the case studies and analysing the case studies. In some cases data revealed inconsistencies. In the Chilean case, for example, different sources presented different figures on historic emissions and in the Indonesian case emission data was not compatible with production figures. In all cases, targeted and detailed sector-specific studies are needed before an NMM can be successfully implemented.

The case studies were built on publicly available reports for the chosen sectors. The national communications of developing countries do not always provide information on emissions at the sector level, which is the level discussed in these five case studies. In previously existing cases, the data is not current and is available up until 2000 or 2005, at the latest. Unless there is more information available than is reflected in the UNFCCC reporting, capacity building is needed to help improve data availability and quality.

5.4.2 *Carbon Leakage*

The risk that carbon constraints on domestic production in the target country will encourage production capacity to move to countries with less stringent climate policy appears low with the reasons for this varying between the case studies. For example, in Chile the lack of grid connection with neighbouring countries makes it currently technically impossible to move generation capacity abroad and then import electricity into Chile. This could change in the future. On the one hand, in the case of South Africa such connections are available. However, in South Africa, the NMM is expected to have a low impact on the electricity price.

Both the Indonesian refinery sector and the Vietnamese cement sector have large financially viable abatement potentials. For installations in these sectors, developing their abatement potential will most likely enhance their competitiveness compared to foreign competitors and reduce the incentive to move capacity abroad. However, the large financially viable abatement potential also indicates these sectors are facing barriers to investments in energy efficiency which carbon markets may not be able to overcome. These need to be removed in order for the NMM to have the intended effect.

5.4.3 *Receptiveness to Market Forces*

The large financially viable abatement potential in Indonesian refineries and Vietnamese cement plants points to market imperfections. In a well-functioning market, investments that represent financially viable options would be developed to reduce the costs of production. Research is needed to identify why these possibilities have not been developed. This is important to ensure that applying the NMM – and thereby providing financial incentives – can stimulate investments and have an impact on emissions.

For example, in Indonesia the refineries are state-owned and the country's product is heavily subsidised. As a result, the subsidies might protect the refineries from the market exposure that may stimulate investments in cost reductions through improved energy efficiency. This issue needs to be resolved in order for an NMM to have an impact.

5.4.4 The Costs of Abatement compared to the Carbon Price

The NMM will expose the sectors to a carbon price which creates a financial incentive for investments in emission reductions. At a carbon market price of EUR 10, only a few abatement options are made financially feasible in addition to what is already feasible without a carbon market.

As discussed above, the Vietnam and Indonesia studies found most abatement potential in the sectors concerned to be feasible even without a carbon price. In South Africa, significant potential comes at a cost below 10 EUR/tCO_2e which could develop if the carbon credit price reaches or exceeds that level. In the Brazilian steel sector some potential is financially viable but the vast majority of the abatement potential comes at a price of over 20 EUR/tCO_2e. A similar situation holds for Chile, where more than half the abatement potential costs more than 10 EUR/tCO_2e.

5.4.5 Abatement Options outside the Sector

In the power sector, substantial abatement potential exists within the sector by improving energy efficiency and the deployment of renewable energy. However significant abatement potential also rests with the end-users. Reducing power consumption is an effective way to reduce emissions from the power sector. Using South Africa as an example, improved lighting, efficient hot water use, heat pumps, efficient heating, cooling and air conditioning are all available at negative abatement costs.[4] The NMM can also be designed to create incentives to develop this potential.

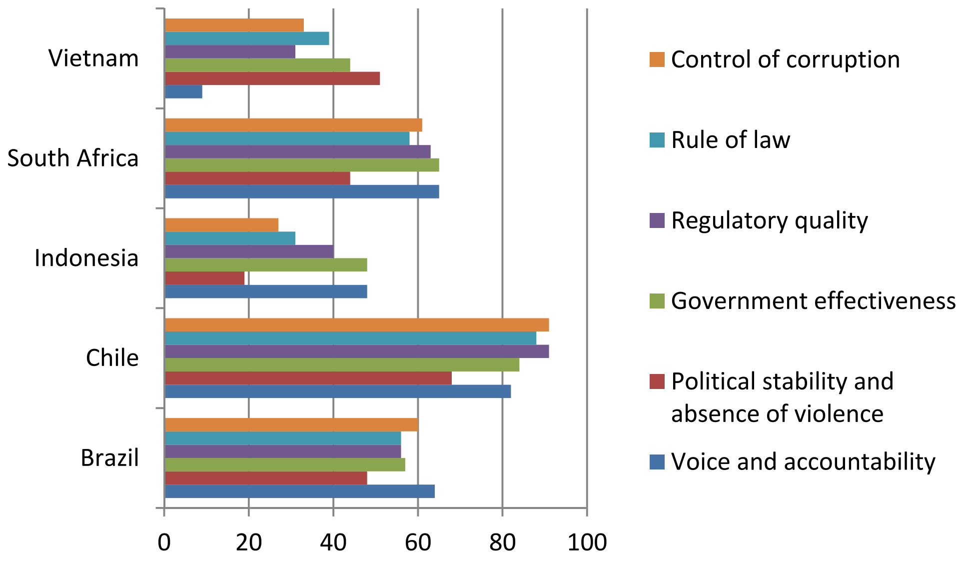
5.4.6 Governance

The NMM carbon intensity cap scenario foresees that the tradable intensity standard will be operated by the government of the host country. However, few developing countries have experience with undertaking these activities and capacity building is needed to erect the necessary institutions. Private sector participants in the NMM may also need training and support.

Figure 5 shows the differences in government capacity and regulatory effectiveness in the countries of the five case studies according to the World Bank. Amongst the case studies examined, Chile has the highest score and thereby the Chilean government may be the most suitable partner to pilot the NMM, however further analysis is currently needed.

[4] World Bank (2002), *South African national strategy study on Clean Development Mechanism,* Program of national CDM/JI strategy studies (NSS program), Washington DC CDM/JI strategy studies (NSS program), Washington DC.

Figure 5 Governance indicators from the World Bank[5]



5.5 Conclusions

Countries and sectors vary in the quantity and quality of data available. Capacity building and developing institutions that can manage the NMM are important requirements for successful implementation.

In addition, the sector may not be ready for the NMM at the moment. Some sectors are highly controlled and/or owned by the government. This may limit the ability of installation operators to make commercial choices and react to the market incentives to improve efficiency which the NMM aims to provide. State intervention like fuel subsidies could further reduce the receptiveness of the sector. In some cases, either the incentives to improve the carbon efficiency or the means to do so are lacking. This is confirmed by the existence of large commercially viable abatement potential that is left untouched. The barriers to the development of this potential must first be addressed before an NMM can have the intended impact.

The timeline for implementing the NMM is relatively long. The NMM will be an innovative market instrument and a great deal of data is needed to assess the possible impact of the NMM, determine a target level for the sector which requires a reasonable abatement effort and to divide the target between installations. Also, an assumption in this analysis is that the NMM will start operating in 2016. Targets could be defined well before the start of the NMM so that installations can take preparatory action and may already begin taking abatement measures. However, most of the impact of the NMM will be experienced after 2020.

In the short term, strengthening an existing and successful policy could be an effective approach. If certain policies have demonstrated to have the intended effect, the NMM can support the policies up scaling. For example, if a government has a successful preferential feed-in tariff for power generated with renewables, the NMM can help provide the financial means to increase the price differential with power from fossil sources. The abatement impact of the NMM could be determined

5 Data obtained from the World bank: http://info.worldbank.org/governance/wgi/index.asp

through the grid emission factor of the country. Such a system would require less preparation because the institutional capacity is already largely in place.

Determining the impact of policies and measures and the likelihood that government targets are met is difficult. Also the assumptions on which these targets are based should be assessed which did not fall within the scope of this analysis. As a result, this should be a subject of further analysis if NMMs are to be implemented.

6 Expert Opinions on the New Market Mechanism

This chapter includes a 'discussion paper' in which the views and opinions are represented by the interviews that the project team has carried out among academia, analysts and sector experts in relation to the New Market Mechanism.

In this Final Report, options for the technical design of the New Market Mechanism (NMM) are discussed. However, the technical option realised will strongly depend on the political context of the international climate under the UNFCCC in which these options are debated. Therefore, the political context of the options has been analysed in more detail in this chapter. This will be done based on interviews with several experts from various backgrounds.

The interviews were held with experts representing academia, researchers knowledgeable about the NMM discussion worldwide, stakeholders in developing countries and European stakeholders in certain sectors that could be strongly affected by the NMM. Table 9 gives an overview of the experts interviewed for this study.

Table 9 Overview of Experts and Stakeholders Interviewed

Expert	Organisation
1. Rob Versfeld	Tata Steel (Netherlands)
2. Rodrigo Cespedes	Carbon Management Consulting Group (Chile)
3. Andrei Marku	Centre for European Policy Studies (Belgium)
4. Maria Netto	Inter-American Development Bank (United States)
5. Jeff Swartz	International Emissions Trading Association (Switzerland)
6. Wenjia Cai	Tsinghua University (China)
7. Björn Dransfeld	Perspectives (Germany)
8. Nicola Rega	Eurelectric (Belgium)

The aim of the interviews was to gather expert views on the NMM concept in general and more specifically on the three design proposals for the NMM that are presented in chapter 4 of this study. These proposals were formulated in such a way to describe the full width of potential technical solutions for a NMM, without providing too much detail to the interviewees that would restrict them in their answers to technicalities only.

The following sections will first discuss the views of the experts on the debate about the NMM within the overall context of the UNFCCC negotiations, then turn in more detail to their view on the three design proposals for the NMM.

6.1 Negotiations about the New Market Mechanism

Expert views on the general negotiation of the NMM is centred around three key issues in the interviews: the need for, and the added value of a new market mechanism, the political feasibility of such a mechanism and the potential consequences of such a mechanism for the EU ETS. These issues are outlined below.

6.1.1 Need for, and Value-Added of the New Market Mechanism in the UNFCCC Climate Negotiations

The experts consulted are divided based on the need for the NMM. On one hand they state that the NMM is necessary in order to stimulate the reductions in emissions in developing countries on a much larger scale, for instance in the energy sector: According to one interviewee, 'the scale of the need for change, $15 trillion additional investment needed in the energy sector between now and 2035 demands a significant new market mechanism to stimulate investment'. Also, they point to several shortcomings in the current CDM system. On the other hand, they doubt if the current discussion is really 'new'. As one expert states it: '*It is unclear what is exactly new. Sectoral mechanisms have already been discussed for a long time*'. Furthermore, the old system should not be given up before it is clear what the merits of the new system are exactly. Lack of robust information and the insecurity about economic and environmental impacts are given as main reasons for this position. From a developing country point of view, it should also be made clear first that the NMM is fair and in line with the Common but Differentiated Responsibilities which are stated as one of they key principles at the outset of the international climate negotiations.

6.1.2 Political Feasibility of the New Market Mechanism in the UNFCCC Climate Negotiations

Overall, the experts regard the political feasibility of the NMM as low. One interviewee outlines that technically, three positions have emerged regarding the NMM discussion. One is a top-down approach proposed by EU and an Umbrella group, which basically proposes strict criteria that have to be met in order for a linking with the other mechanisms to become effective. The second, proposed by Ecuador, Bolivia, India, is a bottom-up approach that sees the emergence of NMM as a bottom-up process that is basically country driven and the third position, advocated by China, proposes a continuation of the CDM.

Another interviewee sees mainly a conflict between developing countries and industrialised countries behind the discussion about the NMM: '*Main political problem is the divergence of views between developing countries and industrialised countries. Whereas the first don't want to discuss technical design mechanisms until a broader framework of responsibilities for the different groups of countries is worked out, the latter want to move forward. This stalemate is hard to overcome'*. Therefore, the latest UNFCCC meeting in Bonn did not show much progress in his view. A third expert warns the EU and the Umbrella group not to push too hard towards progress in technical issues regarding the NMM discussion, as '*this might be counterproductive and antagonising to G77/China, as the political motive behind the aim for technical progress is clearly visible'*.

Therefore, progress might instead be found outside the UNFCCC negotiation than within this circuit according to one of the experts: '*The most exciting issue going on right now is the World Bank Partnership for Market Readiness. Funds in this partnership will not be released if not complying with strict criteria for a market based mechanism. Hence, with less countries, in this coalition-of-the-willing, the same discussion is taking place as under the UNFCCC, partly also with the same people, but far less politicized'*.

6.1.3 *Potential Consequences of a New Market Mechanism for the EU ETS*

The EU Emission Trading System (EU ETS) is seen by experts as not properly working yet even without credits from a new market mechanism feeding into the system. Extremely low prices and distortions caused by an auctioning system in are pointed to as important reasons for this. '*The free allocation of emission rights in the ETS is the second best system. From a worldwide macroeconomic optimization point of view, emission rights should be auctioned. But, as this leads to a reduced competitiveness of, for instance, the European steel sector, border adjustments will be needed making it hard to determine the right level'*.

The NMM would create even more supply of credits, for which it would be very hard to find demand in the current situation of the EU ETS: '*Knowing the current and future supply of EUAs and CERs it can be doubted whether there will be (sufficient) demand for more credits'*. The only way to create more demand within the EU would be to increase the current emission reduction targets.

6.2 Design Proposals for the New Market Mechanism

Regarding the three design proposals presented to the interviewees, discussions focused on the following issues: the pros and cons of crediting versus trading, the role of government versus that of business, the aptness of the proposals for a developing country context and finally other conditions for success. These are subsequently described.

6.2.1 *Crediting versus Trading*

A cap-and-trade system to the experts would appeal in theory, and be the preferred system for some. However, implementing such a system in developing countries in the near future does not seem probable to most interviewees. As one expert states it: '*Trading systems would be theoretically interesting, but will not be implemented in the coming ten years'*. Some experts point to the liquidity problem that might arise with sectoral trading: '*Regarding trading, for many sectors overall liquidity will be a problem, as in many cases there will be too few installations to trade. Therefore, in many cases sectoral trading systems will need to be converted into economy wide trading systems. Alternatively, supranational regional sectoral systems would have to develop, e.g. in South America, for which the current regional cooperation bodies could be used'*. However, implementation of such systems is far away (for the time-being).

Regarding crediting, the actual way of implementation of such a system is crucial to the interviewees. According to the experts, some of the key questions regarding the implementation of such a system are: Will there be sufficient financial incentives for installations to take part in the system? What happens when targets are not met, will there be sanctions? How would the overall administrative and execution burden of such a system be shared with a host government?

Baseline-setting is another key issue for the experts to avoid 'free lunches' in a crediting system. If baselines would be set too low, then competitors in emerging markets would gain so-called windfall profits, which would undermine overall credibility of the system. Lack of data in many developing countries could compound this problem. Even more important, if participation in the crediting system would be voluntary, there should be sufficient incentives for investors to participate. The fact that investors would receive the financial gains from the credits only long after the investment has been made, risks of an oversupply of credits and hence very low gains of participation in the system, and the potentially high transaction costs involved are main drawbacks to a crediting system seen.

Given the diversity of political preferences around crediting, one expert proposes that the NMM could offer countries a framework with three choices:

1. Benchmark crediting – credit at project level based on a common standard (per unit of output)
2. Policy crediting – Credit awarded at national or regional level, based on country-specific methodologies.
3. Aggregate crediting – credit at pre-defined sectoral or sub-sectoral level.

Other experts are more sceptical about crediting. With the existing implementation problems around 'sectoral options', an interviewee thinks that very soon such a system might tend towards a system that will look at an individual project level mainly. In that case, differences with CDM would become marginal. Another interviewee sees more merits of a bottom-up system, with tailor-made and simple indicators such as a set of pre-defined technologies to be installed that take account of the specific characteristics of each sector. Such a technology-based approach could even be valuable on a global level, argues yet another expert: '*For the steel sector, a sectoral, technology based agreement with an intensity target (CO_2 emissions per tonne of steel produced) would be a good alternative. Technology transfer could be part of such a system, as most (90%) of the reduction in emissions in the steel sector could be achieved by implementing generally known existing technologies anyway'*.

6.2.2 Government versus Business

Roles of government versus business are another topic debated by the experts interviewed. One interviewee sees a leading role for government not only in initiating, but also in implementing a sectoral crediting system. '*The fact that the system can be used to co-finance national policies can contribute to the political acceptability of such a system design'*.

Others see an executive role for government only in dispersed sectors, such as transport. They warn against a too active role of government, as this might shy away private investors: 'If NAMAs are too publicly oriented they will not attract sufficient interest by the private sector, who in the end has to be the main sector responsible for creating credits'.

However, the Government has to have an involvement in any system. As one interviewee puts it: '*In all three proposals, the Government will play a crucial role. Whereas in business-based proposals the Government only sets the rules as a referee and actions in relation to reductions are left to the installation level - in the first proposal the Government will also be the main actor initiating activities relating to reduction'*. For that, a good governance structure in the host country will be required.

6.2.3 Aptness of the Proposals for a Developing Country Context

A third main issue for the experts interviewed regarding the implementation of the NMM in developing countries is the degree to which these countries are prepared for such a mechanism. According to the experts, a government that has the necessary structures in place to cope with administration and regulation of a sectoral carbon mechanism would be necessary. There should not be a double role of government as a regulator and as owner of the industry involved at the same time.

For all proposals for a new market mechanism, data availability for the sectors involved is a key prerequisite for a well-functioning system with a good baseline. Uncertain growth figures and a large number companies of varying size in some sectors and an overall lack of preparedness of industry are sometimes hurdles here, as was stated by one interviewee for the case of China: '*Within the Chinese borders quite some climate-friendly initiatives are being explored or* *implemented. For example, there are several pilot projects of carbon trading in preparation within various provinces. The designing and preparatory processes are not as smooth as was hoped for, and sometimes the effectiveness and realism can be doubted. For instance, for Beijing quite some information and data is available, but these are lacking for provinces in the country side. Also, exchange agencies are set up to stimulate interprovincial trade. Experiences with these pilots so far are that authorities in general are enthusiastic, but industry is often not ready yet – although, the 'more developed' industry does recognize the business opportunities that a NMM or carbon trading system can realize*'.

One particular problem mentioned by the interviewees is that in some sectors in developing countries, prices are subsidized in order to make the products produced accessible to all. This is for instance the case in electricity sectors in several developing countries. One expert states that: '*Electricity sectors are not easily accessible for a new market mechanism. Often in developing countries' electricity prices, they are kept artificially low, which makes it difficult to establish good baselines'*. The relevance of this argument is for instance seen in China, where '*the difference between the coal prices that are regulated based on a near-market system, and the strictly state-controlled electricity prices makes that many electricity companies presently are making losses. Additional emission reduction efforts in this situation will not be easy'*.

6.2.4 Other Conditions for Success

Finally, by some experts other conditions for success of the NMM were mentioned. One person for instance stated that '*continuity from the old crediting mechanisms to the NMM is essential for building business confidence. Therefore, the best approach would be to create a single new GHG commodity*'. Other points to the framework structures needed on a UN level to handle a new market mechanism: 'Improved emissions data management requirements would require a central registration and issuance facility at UN level, using CDM infrastructure, or an international credit conversion mechanism if disparate systems evolve'.
Specific characteristics would make some sectors more suitable for pilots than others: 'If a pilot with a sectoral system would be considered internationally, probably the steel or even better the cement sector would be a good candidate. A relatively simple product and a limited number of companies would make conditions much easier than in the case that the electricity sector would be chosen for a pilot'.

Finally, any system should be examined integrally on its impact in developing countries, thereby not only looking at the effects on climate policies. For most investors involved, climate aspects involved are only a side-issue: '*It has to be realised that generally it is not the carbon value alone that will make a project run. Rather, the carbon value is a by-product of another asset that will provide the main benefits to an investor. Therefore, the whole production chain has to be examined in order to find where these benefits are'*.

6.3 Conclusions

The perspectives of the NMM according to the interviewees have to be called dim at least. On top of the many uncertainties regarding practical and technical design of sectoral market-based mechanisms that were identified by the experts, they also point to many political differences of opinion between countries about these mechanisms which will make the chances for implementation of a new market mechanism in the near future very small.

However, whereas a short-term implementation of the NMM does not seem likely, the experts also realise the value of having a discussion about such a mechanism right now. As one expert puts it: '*It is good that a NMM is being designed and developed at this point in time, although for the actual implementation and operationalization we would need some patience. It could be a good moment to discuss this further, or to implement a system, at the time the developing countries are presenting their new emission reduction pledges in 2020'*.

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7 Conclusions and Recommendations

Having analysed the possible design options for the New Market Mechanism (NMM) and the possible design packages for such an NMM, the consortium has identified a wide range of relevant aspects, from political to practical and from economic to environmental. In this chapter, we present the conclusions of our analysis. Subsequently, we will provide our recommendations for the future development of the NMM debate.

7.1 Design Options

There is a wide variety of options for the design of a new market mechanism. We have analysed options for 9 design elements, each against nine different assessment criteria. The design elements do include, amongst others, the boundaries of a system, whether to use a crediting or a trading system, where excess emissions above the target would need to be offset by the host country, which greenhouse gases to be included, etc. Examples of assessment criteria are environmental effectiveness, economic efficiency or political feasibility. The design elements provide a thorough and complete overview of the issues at hand, although practice (cf. chapter 5) shows that every sector per country has its own individual characteristics that can be crucial for the success of an NMM.

At the same time, it is complicated to define the right level of detail for such an analysis and it is difficult to assess the design elements of an NMM individually, as they are all inter-related. It is not always possible to single out the impact of one design element as it depends on the other design elements as well as on the institutional design. The level and geographical distribution of the demand for carbon credits is just one obvious example that has a large impact on the design options and which can only be seen in the context of an international climate agreement. The ownership structure and/or government involvement in a sector (or group of companies) is on the national level and is of great impact to the effectiveness of an NMM.

7.2 Three Proposals for the New Market Mechanism

Based on the analysis of possible design options, specific options were selected and combined into three coherent design proposals for an NMM. The selection process was especially focussed to optimise the NMM's environmental effectiveness and integrity, economic efficiency, and its ability to open up ways for it to evolve towards an EU ETS-compatible system. The three proposals are:

- **Proposal 1 - Government Crediting System**: The host country government adopts a sectoral crediting threshold and implements policies and measures to reduce emissions. All emission reduction credits accrue to the host country government, which can sell the credits on the international market to (co-)finance policy implementation. Accounting for emissions is proposed to take place at an aggregated level rather than source-based.

- **Proposal 2 - Tradable Intensity Standard**: In this system, the host country government adopts a sectoral crediting system and devolves it to the individual emission sources. That is, each emission source in the sector would be assigned a mandatory individual crediting threshold. An individual installation would receive credits from the host country government if it reduces emissions below its threshold and be subject to penalties if emissions exceed the threshold. The credits that would be issued to the installations would be the same internationally fungible (tradable, exchangeable) credits that would be issued to the host country government for the overall sectoral performance.
- **Proposal 3 - Installation-Based Emission Trading System**: In this system, the host country government would adopt a sectoral "trading" target, which means that it would be allocated allowances ex ante and would have to purchase emission units if actual emissions in the sector exceeded the target, and introduce an installation-level emission trading system for the sector. The sectoral trading system would be based on the allowances that were issued to the host country government.

All three proposals are based on intensity-based targets/crediting thresholds. Absolute targets give higher environmental certainty and provide for stronger evolution towards an EU ETS-compatible cap-and-trade system. However, it is very difficult to predict future economic trends in rapidly growing economies, there are many examples where actual economic activity has diverged substantially from what had been projected. Intensity-based systems therefore pose a lower risk of over-crediting because key emission drivers such as output growth can be factored into the baseline.

While all described systems can become operational in theory, they have very different levels of complexity. The efforts required for Proposal 1 are comparatively low. It aims at facilitating participation of countries that do not have the technical capacity to implement installation-level emissions accounting and to facilitate participation of sectors where installation-level emission accounting would involve very high transaction costs, such as the transport sector. The relative ease for implementation comes at a price: lower certainty on environmental effectiveness and the dependency on the host country government to implement effective policies and measures, such as fees and taxes, performance standards or financial incentives. The system could be particularly suitable for state-owned sectors, such as the power sector in some countries, as in these cases the host country government has direct control over emission sources. Despite the relatively low complexity of accounting many developing countries may still require capacity building to establish robust sectoral inventories.

Proposals 2 and 3 are installation-based and would thus expose emitters directly to the carbon price signal. Imposing mandatory targets on emitters means that the environmental outcome would be assured (unless the national compliance system would not operate adequately). It would also provide for a strong evolution towards an EU ETS-compatible system. However, the proposals would require considerable capacity to implement installation-level targets and robust MRV systems, which is probably currently beyond the capacity of most developing countries.

The imposition of binding targets on emitters may also be expected to generate substantial political resistance domestically. The Installation-Based Emission Trading System is probably the least likely to occur in the years to come due to the reluctance of developing countries to adopt "trading" targets. Though it should be noted that if a "trading" target is implemented through a cap-and-trade system, the obligation to offset excess emissions is passed on to the individual emitters. The host country government therefore does not face compliance risks, unless it does not enforce proper domestic compliance.

The 'Tradable Intensity Standard' (proposal 2) ' with a strong role for government (setting installation targets, issuing credits) was therefore judged the most interesting for further development of an NMM in the future as it has the best balance between political feasibility, environmental impact and has a good potential for gradual growth to more global cooperation.

7.3 Case Studies and Interviews

Despite the high political attention to NMM systems, it is clear that more negotiations and more time (probably at least 5 to 10 years) is needed before an effective NMM system with a form of global governance is in place. Practical constraints (e.g. role of government, size of sector, etc.) need to be addressed before an NMM can become an effective strategy for carbon mitigation (see chapter 5, case studies). The table below shows the constraints and the opportunities found in the case studies:

Constraints:	Opportunities:
Data availability	Cost-efficiency
Institutional capacity	Large abatement potential
Government involvement in sector	Growing international co-operation
Size of sector / number of actors	

The interviews showed still hesitations or even substantial doubts by experts as to whether the international community is ready to take the necessary steps towards a global framework for NMM system. Nevertheless, those of whom were interviewed refer also to specific cases (e.g. Brazil, South Africa) where the preparedness and enthusiasm for an NMM is increasing and where it is expected that NMM will have added value in an efficient carbon mitigation effort. Political support for active NMM approaches, sometimes also outside the UNFCCC context (e.g. World Bank PMR project), is continued in most developed countries.

7.4 Recommendations for the Future Development of the New Market Mechanism

7.4.1 From theory to practice

This report has outlined the spectrum of design options for elements of an NMM as well as their main pros and cons. Three coherent options for NMM design were formulated and these options have been checked for their practical implications in 5 case studies and as well with a group of experts to comment on the options and the overall findings. Next to this more theoretical exercise, options should be further explored through more pilot programmes.

7.4.2 Timing

Having gone through most arguments and issues concerning NMMs, we can still not predict the outcome of the NMM debate and if, when or how this will be implemented. At this moment, the actual demand for credits is low and some might argue that developing an NMM system is not opportune yet. But as the UNFCCC clearly indicates that our reduction efforts must be significantly scaled up in the near future, we will hopefully face an increased demand for credits. The right balance between developing demand and supply is crucial for any market-based system. It is now that we have to prepare for that period and thus prepare towards further NMM-readiness.

We recommend carrying out one or more pilot studies for implementing an NMM, in countries that are willing (and have the capacity) to participate in such a practical pilot. The report outlines several basic conditions a pilot country and sector have to fulfil, such as data availability, a stable government, clear public / private separation in order to prevent confusion of roles, etc.

Ideally, such pilots should generate tradable emission credits in order to fully simulate the real-life conditions of an NMM. The generation of compliance tools would also be necessary to achieve participation by private companies, as was the case in the World Bank's Prototype Carbon Fund. The EU could consider creating a special demand window for credits from NMM pilots in the EU ETS. However, actual demand for additional credits is currently very low. Pilots could therefore alternatively be developed as supported NAMAs, but with ETS-level MRV and the perspective to translate the supported NAMA into a market-based approach in the mid-term.

The interviews showed that expectations for implementation of an NMM system in the short term (up to 2015) are low. The relatively slow pace in the UNFCCC process as well as the economic crisis in Europe (reducing demand strongly) make a rapid implementation (within 5 years) unlikely. However, it is good to be prepared, and efforts such as those of the EU and World Bank to develop thinking on NMMs are therefore necessary. We expect that, if well prepared, within 10 years we will see that some form of NMM will be operational, although maybe not at the scale as sometimes discussed today.

7.4.3 International context:

The possibilities to make progress regarding an NMM outside the UNFCCC context should not be neglected. For example the World Bank's PMR initiative, in close cooperation with the EU, has shown encouraging progress in a number of the participating countries.

But the EU should take care that further technical steps towards the realisation of an NMM can also be misunderstood by other countries as a political manoeuvre meant to establish 'facts on the ground', whereas the political modalities of an NMM have not yet been clearly agreed about. The report, and in particular the interviews, have shown the political sensitivities of some countries regarding this aspect.

Overall, it is clear that more needs to be done to further develop the theoretical knowledge and practical experience in the world for market based carbon reduction mechanisms. Fortunately there are many initiatives to develop new market mechanisms; cooperative action with a view to sharing best practices, developing compatible designs and eventually linking these schemes. All of which will greatly enhance the effectiveness for carbon reduction through a global carbon market. The carbon market is not the goal it is an instrument; a well designed and interlinked global carbon market can be a very important instrument for major carbon reductions.

Annex I: Emission Reduction Potential of the NMM in diverse Case Studies

This Annex presents case studies in which the emission reduction potential of a New Market Mechanism is assessed in five sectors in five countries.

This Annex provides insights on the impact a sector-wide market mechanism could have in developing countries. This is demonstrated in five case studies based on the following: combinations of countries and sectors in which the impact of the New Market Mechanism (NMM) is assessed in a number of scenarios, which define emission targets in a variety of ways.

We consulted different sources to obtain forecasts on production and emission growth rates, information on emissions in each sector and production figures. Within the scope of these case studies we were not able to independently verify the figures obtained and found that sources were not always consistent and at times even contradictory. The case studies therefore highlight the difficulties in obtaining accurate information for operation of the NMM, the differences in 'readiness' of specific sectors to participate in an NMM and the uncertainty with respect to the reduction potential. Further research is needed to determine the emission reduction potential more accurately, to define a reasonable emission cap level and to present an equitable or fair business as usual emission scenario.

The selection of the following five countries and sectors (see table 27) by the consultants and DG Climate Action was based on key criteria including geographical spread and variety of sectors. Data availability was also considered.. The sectors chosen are: steel in Brazil, power in Chile, refineries in Indonesia, power in South-Africa and cement in Vietnam.

In the subsequent sections, the five case studies are presented. A summary of the cases (Chapter 5) is included in the main report.

Table 10 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.
Chile	Power	• 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.
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.[10] • Most of the abatement potential in the oil and gas sector is in processing.	• Abatement costs available for Indonesia's downstream oil and gas processing.[8] • Indonesia has one CDM project in an LPG plant.
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.[11] • 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[12] • Vietnam has one CDM waste heat recovery project in the cement sector.

6 McKinsey & Company (2010) Pathways to a low carbon economy for Brazil; World Bank (2010) ENERGIA: Low Carbon Emissions Scenario in Brazil
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 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).
11 ECN (2007) GHG Marginal Abatement Cost curves for the Non-Annex I region
12 Tatrallyay & Stadelmann (2011). *Country Case Study Vietnam – Removing barriers for climate change mitigation*. University of Zürich.

i. 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 until 2030
Emissions reduction potential	Up to 26 $MtCO_2e$/year in 2012-2020	**Emissions intensity in 2011**	1.17 tCO_2e/t of 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 of 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

a. 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 of crude steel, which makes it the largest steel producer in Latin America[13]. The total quantity of steel produced in Brazil has 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.

b. 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

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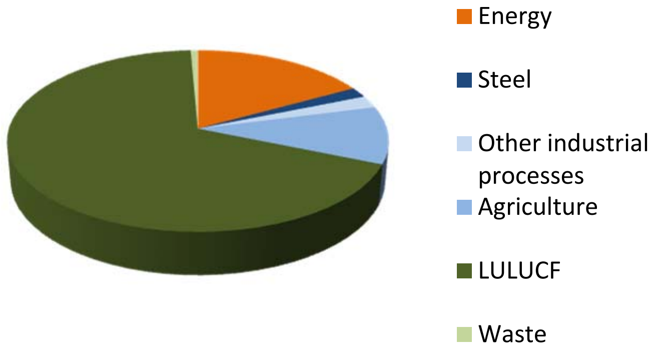
13 Brazil Steel Institute, <http://www.acobrasil.org.br>, accessed 9 May 2012.

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 6).

Figure 6 Brazil's national emissions

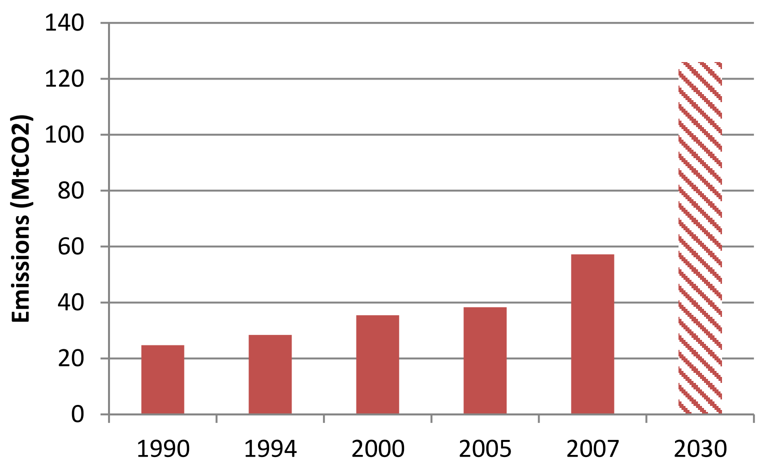


The iron and steel sector in Brazil accounted for 45% of the total CO_2 emissions in the industrial processes sector, or 57.2 $MtCO_2$ in 2007.[16] These emissions are the result of high consumption levels of both fossils fuels and non-renewable biomass. Brazilian steel mills obtain around 60% of their 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 7 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

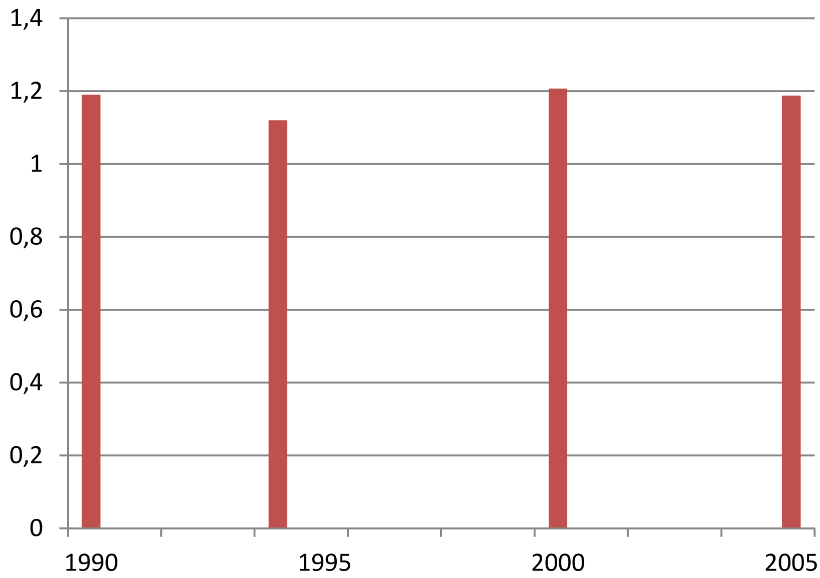
The production capacity is expected to reach some 95 Mt (a tripling from today's capacity) by 2030, driven by Brazil's own development and the export of semi-finished goods following the 'Pathways to a Low-Carbon Economy in Brazil' study of McKinsey & Company (hereafter "McKinsey"). Overall, McKinsey estimates that the production of steel will increase by 4.6% per year between 2005-2030.[18] Moreover, the sector's emissions would reach approximately 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 increase 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 came 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 production capacity in the near term.[20] According to the BSI, near future investments are expected to be lower than in previous years[21].

c. 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 7). 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 tonne of steel produced (Figure 8)[23].

Figure 8 Amount of CO_2 produced per unit of steel



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[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]

d. 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, as a result of reducing deforestation in the Amazon, Brazil estimates that voluntary mitigation action can reduce emissions by 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.

e. 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 on a wide scale before 2020.

Table 11 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 require less coal. All these measures (listed in Table 11 but excluding CCS) would cost EUR 4 on average per tonne CO_2e 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 $MtCO_2e$. The total abatement potential of 50 $MtCO_2e$ 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 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]:

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31 McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*. P. 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.

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.*

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

f. Application of a Tradable Intensity Standard

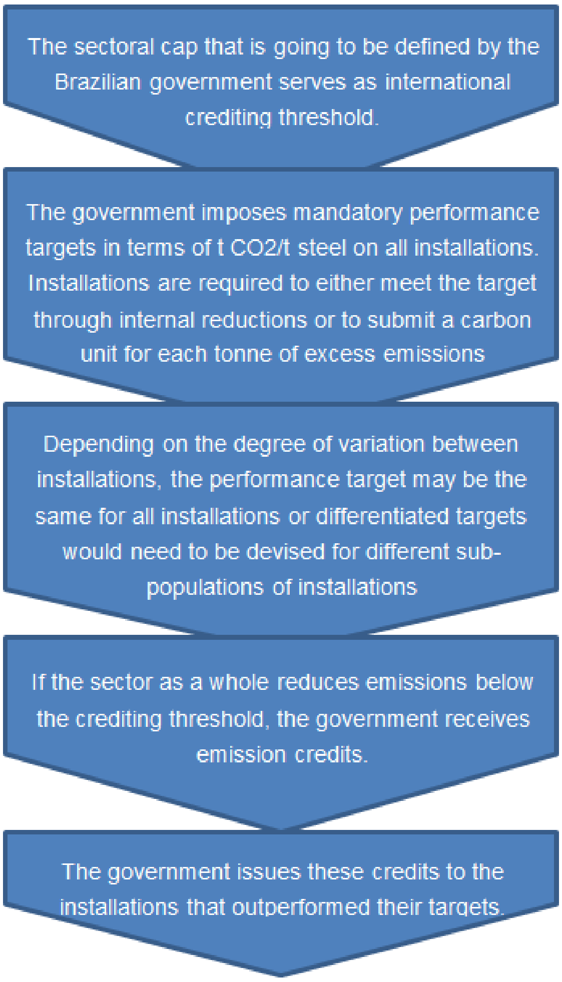
A tradable intensity standard for the Brazilian steel sector could build on the initiatives that are already in place. Brazil's pledge to the UNFCCC includes sector targets. In addition, the government may soon announce sector caps. A tradable performance standard could hence work as indicated above. 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 in which the tradable intensity standard could be applied.

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 their CO_2 emissions since 2009. However, the sector is highly concentrated. Companies are aggregated under eleven industrial and financial groups with three of these groups responsible for 61% of the nation's steel production in 2009. If the system operated in isolation from other carbon markets, there might not be as much liquidity. Without liquidity, the system cannot provide flexibility for companies to choose whether to reduce their own emissions or instead purchase emission units from others. Companies with a shortage of credits might not find sellers, which would put strong upward pressure on prices. First, this may result because installations that outperform their targets may not generate enough credits to supply those that do not meet their targets. A second reason is that credits would only be issued after the international regulatory body has assessed the overall sectoral performance. Given

38 Mt of oil equivalent
39 World Bank, *Energy: low carbon emissions scenarios in Brazil (synthesis report), 2010, p. 81.*
40 bid., p. 99.

these supply constraints, there might be substantial fluctuation in the availability and price of credits within the system. Therefore, it would 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 develop more quickly 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, with other states possibly following suite in the near future. As a result, instead of Proposal 2 Brazil may instead go for Proposal 3 but as a bottom-up initiative rather than through a top-down UNFCCC framework. As a result, the EU may have 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 comparable[41]. Nevertheless, a study by de Bruyn et al[42] found steel producers in the EU have probably been able to fully pass through the EU ETS carbon price, which indicates that at least thus far, the EU ETS probably has not had major negative implications for steel makers.

As it is suggested, the crediting threshold should include all abatement potential up to 20€/tCO_2e. Based on the suggestion, 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, therefore, may be minimal. A more definite statement would require a detailed analysis of relative production costs, impacts of carbon pricing and trade intensities.

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.

Table 12 **Barriers to implementation of a sectoral mechanism and suggested solutions**

Barriers	Solutions
High sector concentration leading to low carbon market liquidity	Link to international carbon market
Domestic cap-and-trade may come faster than establishment of UNFCCC mechanism	Explore possibility to link possible Brazilian and EU ETS

g. 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 the steel sector's capacity and emission projections in Brazil[43]. The emission reduction which can be obtained under other scenarios, 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 coming to an agreement on the New Market Mechanism.

Table 13 **Abatement potential in the Steel sector in Brazil under different emissions scenarios**

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

No-abatement

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

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

tCO_2e/t of 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.

BAU

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 of steel in 2010 to around 1.5 tCO_2e/t of 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 of 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

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 of 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.

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

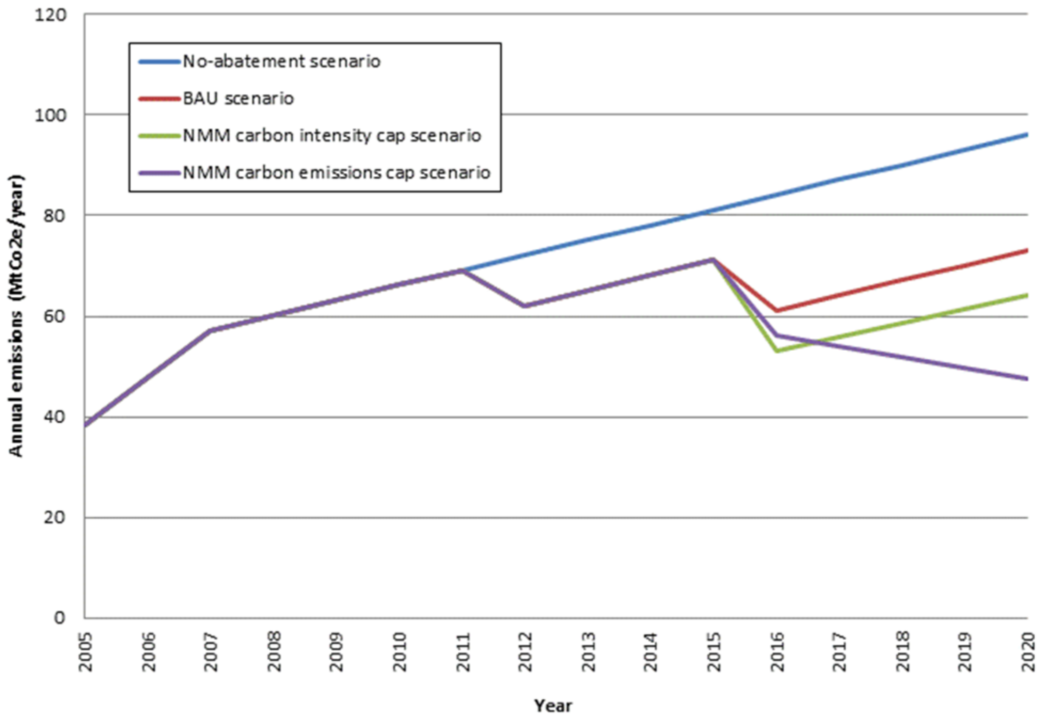
[46] McKinsey & Company (2010) *Pathways to a low carbon economy for Brazil*

NMM carbon emissions cap

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 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 of steel in 2010 to 1.1 tCO_2e/t of 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 9 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 $MtCO_2e$ and the horizontal axis represents the timescale for the scenarios.

Figure 9 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 was only privatised in 1993 with large conglomerate steel companies representing part of a limited number of industrial and/or financial groups. Therefore, the Brazilian steel sector has an oligopolistic setting such that economic and

Parameter	Impact on emission reductions
	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 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 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."

ii. 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

a. Description of the Sector

Traditionally, the Chilean electricity market has administered resources based on their economic efficiency, which created a heavy focus on low-cost and traditional (coal-fired) generation technologies. Rising energy prices, an increase in national power demand and the rapid depletion of national fossil fuel sources in the country have created more political support for the development of renewable energy policies.

The majority of the power sector in Chile is 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 14 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 Northern Chile with three separate systems.
Magallanes	98 MW$_e$	Generates electricity for theSouthernmost part 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>.

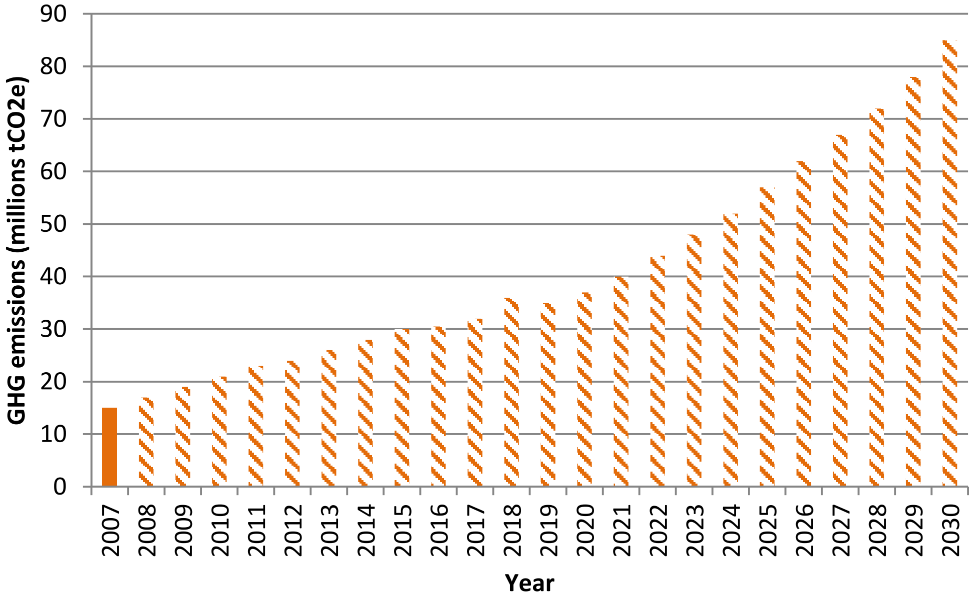
Colbun. The same holds for the SING system where three (AES Gener, Gas Atacama and Suez/CODELCO) out of the six companies own almost 95% of the generation capacity[48].

b. Trends in Production and Emissions

The energy consumption per capita in Chile has nearly doubled between 1990 and 2006, increasing the emissions per capita by 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%, the majority (79%) of the emissions originated from electricity production.

Until 2030, the energy consumption in Chile is expected to increase at an annual rate of 5.4%. For the electricity generation sector to keep up with the pace of increased 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 may increase to 52% coal in 2030 with most of the increase taking place during 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 10 Historical emissions and projected growth in the Chilean power sector



[48] Ibid., p. 142.

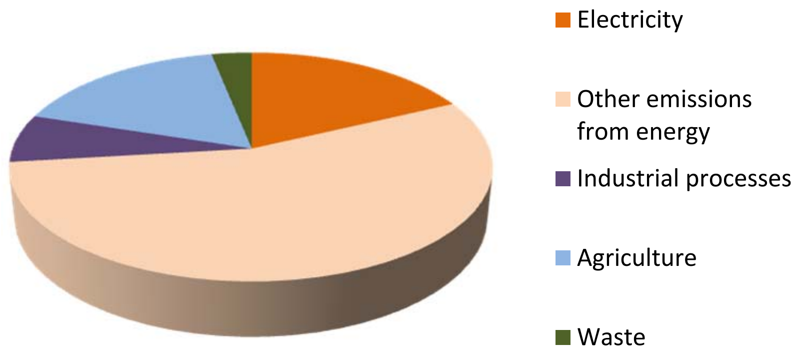
[49] O'Ryan, R.; Diaz, M. and Clerc, J., *Energy Consumption, Greenhouse Gas Emissions and Mitigation Options for Chile – 2007-2030,* PROGEA, University of Chile, 2010.

[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 11 Chile's national emissions in 2007

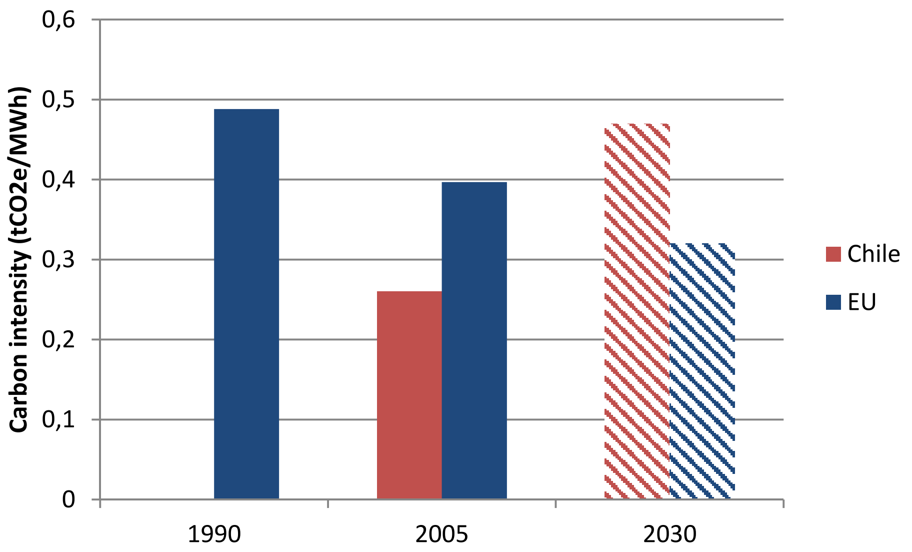


Note: the data presented in the national inventory deviates from the data presented by O'Ryan.

c. Carbon Intensity

In 2005 the Chilean carbon intensity was 0.26 tCO_2e/MWh. However, with the expected increase in use of coal, this figure will reach 0.47 in 2030.[53]

Figure 12 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. It is important to note the re-emergence of coal and the national policies of most EU Member States, whicht replace controversial nuclear capacity will make it difficult for the EU to meet its ambitions[55].

d. 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

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>.

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. Beginning in 2014, this percentage will gradually increase by 0.5% annually to reach 10% NCRE in 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]

e. Abatement Potential

The sector's carbon intensity is expected to increase significantly up to 2030 due to a 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 15 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
Installation of hydroelectric power plants with 1 GW capacity by 2025	-25	4
Implementation of a stricter NCRE law (1% increase	22	23

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)
after 2014, up from 0.5%)		
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 16 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 has the lowest investment costs, followed by hydropower and wind.

Table 16 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, which already provides a significant portion of Chile's total energy supply, there are multiple opportunities for various other NCRE sources, which are abundant 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 which can be used to generate geothermal power. Table 17 indicates the estimated potential for all NCRE sources. Although the potential is high, there are still many obstacles and barriers in Chile which inhibit the optimal use of the potential i.e. the electricity market framework and the lack of investment conditions.[65]

Table 17 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

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.

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.

f. 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 a shift like this 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 also, possibly, 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. Some parts of the plant are dedicated to SING while other parts are reserved for Argentina. As a result, there is no connection between the two systems.[67] Accordingly, Chile only has very limited imports and exports.[68] Consequently, there is no risk of leakage.

Table 18 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

g. 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 capacity and emission projections of the University of Chile. Emission levels are calculated, including the impact of potential abatement measures under different scenarios and 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

[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.

current Chilean power sector situation, in which we take into account the large potential for coal-fired electricity generation 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 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 19 Abatement potential for Electricity generation in Chile under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement	0 MtCO_2e/year
BAU	11.5 MtCO_2e/year
NMM carbon intensity cap	20.5 MtCO_2e/year
NMM carbon emissions cap	22.5 MtCO_2e/year

No-abatement

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 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.

[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.

BAU

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 electricity generation 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. The EU-27's 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 by 11.5 $MtCO_2e$/year throughout the period 2012-2020.

NMM carbon intensity cap

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 17), 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

In the NMM carbon emissions cap scenario, the Chilean government implements installation-based crediting mechanisms with an absolute cap on emissions of 31 $MtCO_2e$/year by 2020, 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. Nevertheless, it is 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.As such, only minor improvements to the sector's efficiency would be needed. However,t major efforts would be needed

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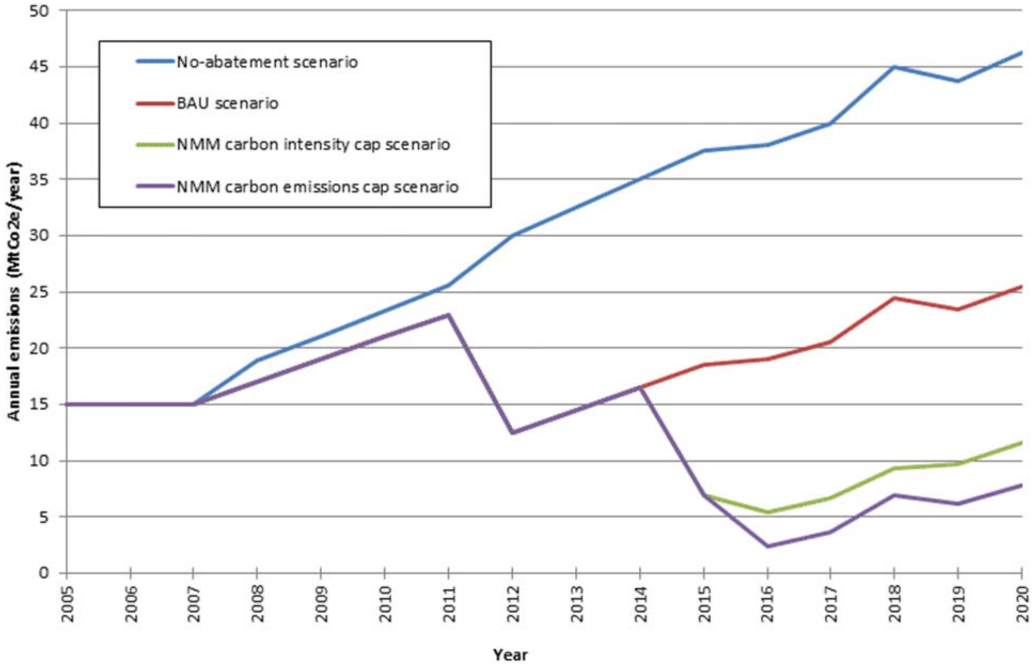
70 Source: Eurelectric, Power Choices study "Pathways to Carbon Neutral Electricity in Europe by 2050"

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 13 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 $MtCO_2e$ and the horizontal axis represents the timescale for the scenarios.

Figure 13 Analysis of emission trends for the Chilean power sector in different scenarios



iii. 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/t of 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.

a. 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 eight refineries. Sources differ on the number of refineries that are actually operational in Indonesia. Some sources state seven refineries, others state nine 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 may be lifted in 2014.[73] The company purchases its crude oil against world prices. Whereas, it supplies 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 raising cash by selling shares.

The Indonesian oil and gas industry is a vital source of state revenues of approximately EUR 7 billion in 2009.[75] However, the Indonesian government spends significantly more on fuel subsidies, up to EUR 14 billion in 2011, of which EUR 6 billion was spent on gasoline.[76]

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[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).

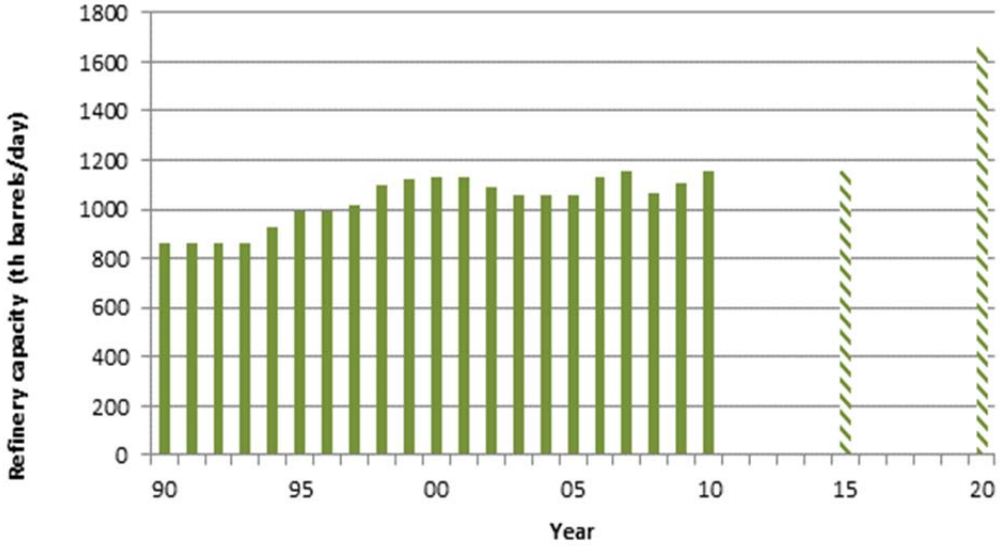
[74] IEA, Energy Policy Review of Indonesia, 2008.

[75] PriceWaterhouseCoopers, Oil and gas in Indonesia, 2010.

b. Trends in Production and Emissions

Indonesia is producing around 1.1 million barrels of crude oil per day, which is expected to remain relatively constant. The country's refining capacity is currently 1 million barrels per day, with the country relying partly on imported refined products. To reduce the dependence on imports (Figure 14), Pertamina announced plans to expand the capacity to 1.5 million barrels per day by 2020.[77] If its financial position allows, Pertamina may decide to increase its capacity by replacing some of its old refineries with larger, more efficient refineries.[78]

Figure 14 Development of past refinery capacity and future capacity forecast



Indonesia's latest National Communication estimates the country's 2005 greenhouse gas emissions (hereafter "emissions") at 1.8 Gt. The majority (63%) of these emissions are from land use, forestry and peat fires . Indonesias total GHG emissions for the energy sector was 280 Mt in 1990, increasing to 370 in 2005. However, only 84 Mton is from electricity, heat, oil & gas refining, increasing to 130-135 Mton in 1990-2005.[79] When comparing this withfigures froma 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 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. When comparing thewith emissions from refineries in other countries and with the fuel production in Indonesia, this figure is more realistic.

However, it must be noted a study is planned by the Center for Data and Information for Energy and Mineral Resources (DCIEMR) for the refineries for 2013, which may shed additional light on 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

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76 IISD, Indonesia's Fuel Subsidies: Action plan for reform, (Geneva, 2012), values converted from USD at a rate of 0.8 EUR/USD.

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 by 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.

c. Carbon Intensity

Comparing the carbon intensity of Indonesian refineries with those in the EU provides insight into technical abatement potential.

The EU has 110 refineries under the EU ETS whose aggregated GHG emissions are just over 150 Mt CO_2e during 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 provide a carbon intensity for refineries in the EU of around 0.21 tCO_2e/t of crude oil.

Total emissions from refineries in the US were 214 Mt CO_2e in 2005.[83] In the same year the sector processed around 758 Mt crude oil.[84] This gives a carbon intensity of around 0.28 tCO_2e/t of crude oil.

The reported 2005 emissions from Indonesian refineries of 91 $MtCO_2e$, including indirect emissions,[85] would provide an exceptionally high emission factor. The installed capacity in the year was around 52 Mt/year in crude oil.[86] If the refineries operated at full capacity the carbon intensity would be around 1.80 tCO_2e/t of crude oil. If they operated below full capacity the carbon intensity would be even higher. Experts from ECN in Indonesia provided estimates that the refinery emissions are closer to the range of 15-30 $MtCO_2e$/year. This would indicate a carbon intensity somewhere between 0.29 and 0.58 tCO2e/t of crude oil. For this analysis we used the average of the two estimates, resulting in 0.43 tCO_2e/t of crude oil. **Error! Reference source not found.** provides an overview.

Table 20 Indicative estimates of the carbon intensity of refineries in the EU, US and Indonesia

Country/region	Carbon intensity of refineries (tCO_2e/t of crude oil)
Refineries under the EU ETS	0.21
Refineries in the US	0.28
Refineries in Indonesia	1.80 (based on BP and Dewan data)
Refineries in Indonesia	0.43 (assumption based on the performance in surrounding countries)

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.

Nevertheless, emissions data from European refineries cannot be directly compared with emissions from Indonesian refineries, partly because the data on Indonesian refineries includes indirect emissions while the figures from the US and EU ETS installations may not. Furthermore, many European refineries also generate electricity and different products.

d. Policies and Measures

The government of Indonesia ranks similarly to Vietnam, well below Chile and Brazil, on the World Bank Governance Indicators ranking.[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] also quote weak enforcement of environmental legislation and corruption as key challenges to the country's climate policy.

Fuels in Indonesia are subsidised and the country implemented laws for equal regulatory and legal treatment of private investors in the oil sector. Despite this removal of legal barriers, there has been minimal private investment in Indonesian oil refineries to date.[89]

Currently, Indonesia does not have incentive schemes or penalties in place to stimulate energy efficiency measures. National energy policies from 2006 describe a need to conserve energy and defines 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]

e. Abatement Potential

For the abatement potential the relative rather than the absolute figures from the Dewan Nasional Perubahan Iklim report have been applied. This avoided the discrepancy with the national communication and production figures in the absolute emission date. The abatement potential of Indonesia's refineries is estimated at 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]

Based on the overall abatement potential, 46% is available at negative abatement costs (see Table 21). 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

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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).

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]

Table 21 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%

The growth forecast of emissions from refineries, based on the report by Dewan Nasional Perubahan Iklim, assumesemissions in 2005 were approximately 23 MtCO_2e/year and will increase to 31 MtCO_2e/year in 2030. Based on these numbers, 30% mitigation potential would constitute an abatement potential of around nine MtCO_2e/year. This potential is available against a net cost 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 measure 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 which sells at fixed prices while purchasing from the international market which has continuously fluctuating oil prices.[95]

f. 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 are able to put a price on carbon emissions, thereby incentivising emission reductions. However, 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. Because the refineries are 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.

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

93 IntercontinentalExchange, 14 July 2012, available at: www.theice.com/emissions.jhtml.
94 Dewan Nasional Perubahan Iklim, Indonesia's greenhouse gas abatement cost curve (2010).
95 IEA, Energy Policy Review of Indonesia, (2008).

system. The high level of governmental influence on the sector may help overcome concerns on the weak enforcement of environmental regulations in Indonesia.

The system would consist of approximately eight installations and, if small refineries are replaced with a few larger ones, in the future potentially fewer. If the system operated in isolation of the international carbon market, there would 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 also possibly other internationally fungible units to comply with their targets.

Given the high level of governmental regulation in the sector, reforms are needed before a carbon crediting mechanism would be able to 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 the credits to (co-)finance implementation costs. Comparably, NAMAs that are supported can lay the foundations for establishing a more market-based approach in the long term.

Before providing any type of international support to reduce emissions of Indonesian refineries it should be clear what barriers currently exist to improve efficiency and reduce emissions. If this barrier, for example, is a lack of investment capital, a financing scheme might be more effective in 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 subsequently reduce fuel prices and thereby be able to 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. Therefore, an appropriate crediting threshold might be to set an intensity target that would be equivalent to stabilising emissions at approximately 25 Mt/year and then reduce emissions to approximately 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 is due to mandatory carbon constraints on Indonesian refining capacity, which will be moved abroad and is low because:

- Indonesian refining capacity is currently state–owned,
- To date, Indonesia is not self-sufficient in refined products and domestic demand is projected to increase substantially,
- Indonesian refineries have a financially substantial and feasible abatement potential. Imposing and enforcing a carbon constraint may therefore actually enhance competitiveness because it would force operators to mobilise this potential and thereby lower production costs.

A more definite statement would require a detailed analysis of relative production costs, impacts of carbon pricing and trade intensities.

[96] Dröge, S. and S. Cooper (2010): Tackling Leakage in a World of Unequal Carbon Prices. Cambridge: Climate Strategies.

Table 22 Barriers to implementation of a sectoral mechanism and suggested solutions

Barriers	Solutions
Insufficient data	Capacity building and research, potentially through 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, which are most likely 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 the international carbon market
Weak government enforcement, capacity and corruption	Capacity building and trainings

g. 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. Based on the state of the Indonesian refinery sector and knowledge of 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 23 Abatement potential for Indonesian refineries under different scenarios

Scenario	Emission reductions (average 2012-2020)
No-abatement	0 $MtCO_2e$/year
BAU	3 $MtCO_2e$/year
NMM carbon intensity cap	10 $MtCO_2e$/year
NMM carbon emissions cap	6 $MtCO_2e$/year

No-abatement

In the no-abatement scenario no abatement measures will be taken and emissions will continue to increase 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 of 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

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 of crude oil in 2005 to 0.35 tCO_2e/t of 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 of crude oil) but is above the average emission level of installations under the EU ETS (0.21 tCO_2e/t of crude oil).

Considering the abatement cost curves for Indonesian refineries, the BAU scenario could be achieved:

- 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 by 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

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 of 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 even up to potentially replacing existing refineries with 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.

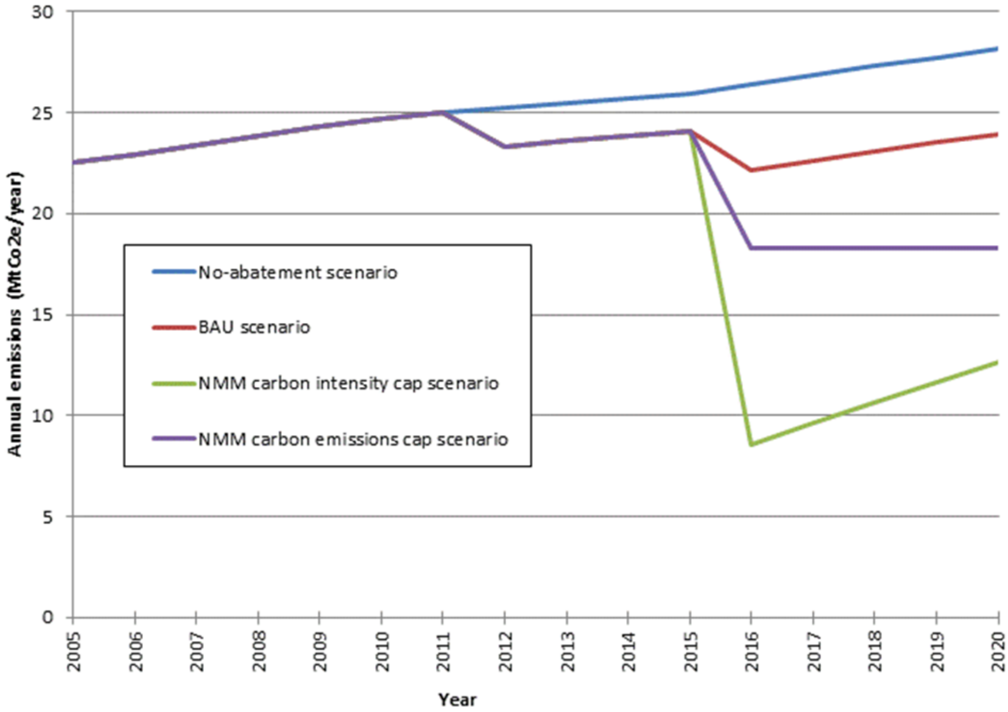
If the benchmarks are complied with, the sector's emissions will decrease to 17 MtCO_2e by 2020 for the same refinery capacity, realising a reduction of 11 MtCO_2e/year compared to the BAU scenario of 28 MtCO_2e/year in 2020. On average, an abatement potential of 10 MtCO_2e/year could be realised within this scenario for the period 2012-2020.

NMM carbon emissions cap

In the NMM carbon emissions cap scenario the Indonesian government implements installation-based crediting mechanisms with an absolute cap on emissions of 22.5 MtCO_2e/year, the emission level of the sector in 2005. Given that 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 of crude oil in 2005 to 0.28 tCO_2e/t of 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 15 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 and the horizontal axis represents the timescale of the scenarios (2005-2020).

Figure 15 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 24 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 on directly to consumers because 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 leading up to 2020 EU ETS prices increase, 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. The option would be viable even at the current allowance price level under the EU ETS of approximately EUR 6. For new refineries a higher carbon price might incentivise the adoption of more efficient installations than those that 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 for the 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.

iv. Case Study 4: South Africa – Power Sector

South Africa's power sector at a Glance			
Number of installations	~35 power stations of which 19 are 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

a. 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 will become a 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 from 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 approximately 45% of Africa's electricity. According to the South African Ministry of Energy, South Africa is one of the four cheapest electricity producers in the world. [103] The largest

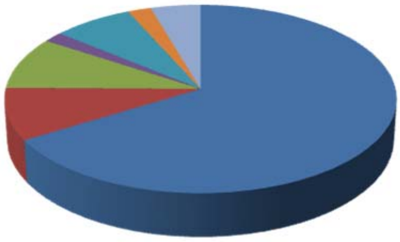
97 South Africa (2010), *PMR Template for Organizing Framework for Scoping PMR Activities.*
98 Hartnady, C.J.H., South Africa's diminishing coal reserves, South African Journal of Science, Article #369.
99 U.S. Department of State, available on: <http://www.state.gov/r/pa/ei/bgn/2898.htm>. The industry 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 >

power company is Eskom and produces about 96% of South Africa's electricity. In 2002, Eskom became a public, limited liability company, wholly owned by the government. Next to Eskom, a small number of international and national energy companies are active in the market, such as BHP Billiton and Exxaro. These are typically mining companies in which power generation supports their mining activities. Besides Eskom, private generators are responsible for about 3% of generation and municipalities for 1%[104] of generation.

b. 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 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 annually.

Figure 16 South Africa's national emissions in 2000



As part of the country's strategy to curb emissions, a 2006 report on Long Term Mitigation Scenarios (LTMS) was developed for the South African Department of Environmental Affairs and Tourism. 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:

5. "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.
6. "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 17).

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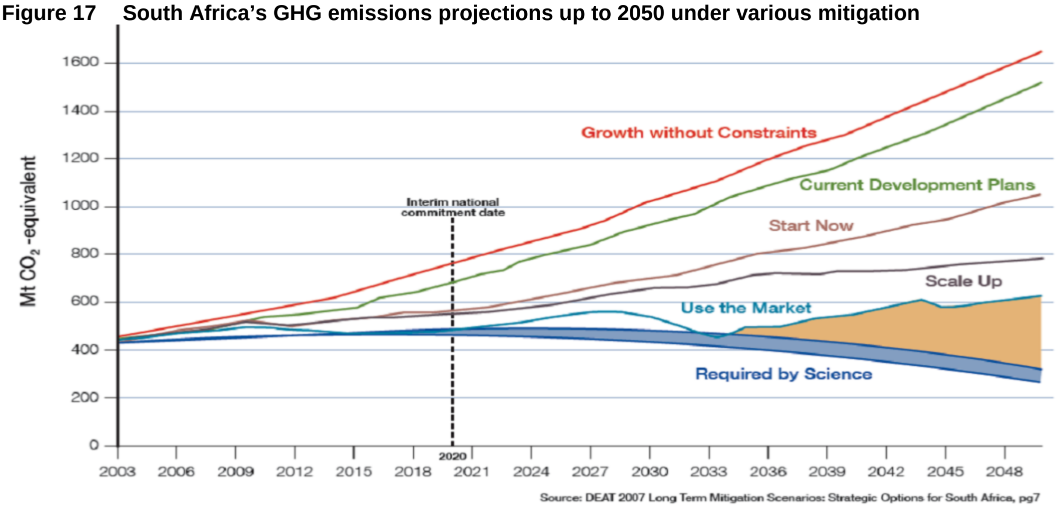
[104] South Africa (2011), *South Africa's Second National Communication under the UNFCCC,* Department of Environmental Affairs, Pretoria, p. 14.

[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 17 South Africa's GHG emissions projections up to 2050 under various mitigation

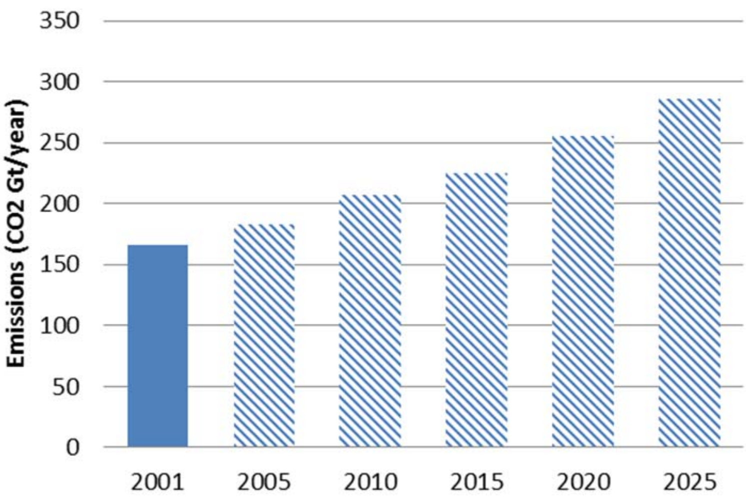


Total emissions from energy production in 2000 were 291 $MtCO_2e$, accounting for 66% of national emissions[107]. The energy production saw the largest emissions growth between 1990 and 2000 of 37%. Capacity expansion is likely to come from coal, as it is the least expensive option. Therefore, renewable energy sources would need support to compete with fossil fuel generated electricity.

c. 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 versus 0.80 tCO_2e/MWh in 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 18 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.

d. Policies and Measures

In the March 2011 South African Integrated Resources Plan for Electricity (IRPE), the government decided to improve the electricity distribution network and fast-track projects by independent power producers[111]. This policy also aims at reducing the market share of the state owned power company Eskom in order to benefit 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]. Eskom's standard tariffs of Eskom have increased by 24.8% between 2010-2011 and will be increased further by 25.8% between 2011-2012 and another 25.9% between 2012-2013. As a result, the average electricity tariff will double over the next three years[113].

The market potential 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 only one has been registered. The majority 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.

e. 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 by 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 25 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$_2$e /year**

The mitigation potential at the power demand side exceeds the potential at the power generation installations. This potential is 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 coal supply side, abatement potential of 6.5 Mt/year exists at a negative cost of EUR 10. The demand side measures

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.

and mitigation action in coal supply could potentially be supported with a domestic offset scheme operating in parallel to targets for the power sector.

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/year and for solar water heating (SWH) at 47 TWh/year. So far, this potential has been explored only to a limited extent. 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 no large solar power plants were operational in South Africa.[115] If South Africa wants to meet its target of having 42% of all new electricity generation capacity by 2030 to come 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 26 Potential energy supply from different renewable energy technologies 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

f. Application of a Tradable Intensity Standard

Electricity production is basically a state-owned monopoly, with Eskom producing approximately 96 % of South Africa's electricity. Hence, a tradable performance standard would need to be established as an intra-company trading system. Given the current high reliance on coal, this threshold would most likely be correspondingly high initially, e.g. at about the current grid intensity of 800g CO_2/kWh. For example, an inclusion threshold could be defined at the same level as 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 previously 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 also possibly 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 limited effectiveness. Analysts 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

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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.

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 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 due to the resulting price increase of power from fossil fuels. 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, the main producer, could increase the import of electricity potentially, together with expanding capacity in the countries from which South Africa imports. This would avoid increasing capacity in South Africa and payment 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 may be relatively modest. Therefore, the risk of leakage is most likely low. Another indication of this is literature on the possibility of introducing emissions trading in South Africa appears to discuss leakage only in respect to industry.[119]

Table 27 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

g. 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 and are compared to the emission projections of the IRPE for 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. Based on the state of the South African power sector, in which we take into

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

account the large potential for coal-fired electricity generation 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 '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 no-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 its IRPE 2010-2030. The emissions projection in the 'Emissions-1' scenario is in line with the emission growth of the sector, which is reported on 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 include the use of carbon market incentives or emission caps and will commence after 2015. This is in line with the foreseen time framework for concluding an agreement for the New Market Mechanism

Table 28 Abatement potential for Electricity generation in South Africa under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement	0 $MtCO_2e$/year
BAU	14 $MtCO_2e$/year
NMM carbon intensity cap	23 $MtCO_2e$/year
NMM carbon emissions cap	31 $MtCO_2e$/year

No-abatement

In the no-abatement scenario no abatement measures will be taken and emissions will keep pace with the forecasted electricity generation capacity of the IRPE 2010-2030. The same 2005 carbon intensity (0.82 tCO_2e/MWh) will hold for overall electricity generation until 2020. This is a hypothetical scenario which merely provides a reference for the following three scenarios.

BAU

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 $MtCO_2e$ in 2015 and will be capped at 275 $MtCO_2e$ after 2017. The capacity of coal-fired electricity generation 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

[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.

average carbon intensity of the power sector within the EU-27 of around 0.36 tCO_2e/MWh in 2005[121].

Considering the abatement options for the South African power sector, the BAU scenario could be achieved when the abatement options for the power sector are implemented. In terms of abatement potential, the emissions can be reduced by14 $MtCO_2e$/year compared to the reference scenario for the same electricity generation capacity. Moreover, next to the abatement potential in the sector, many demand-side abatement opportunities exist. However, these opportunities would require investments from the power sector consumers.

NMM carbon intensity cap

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.

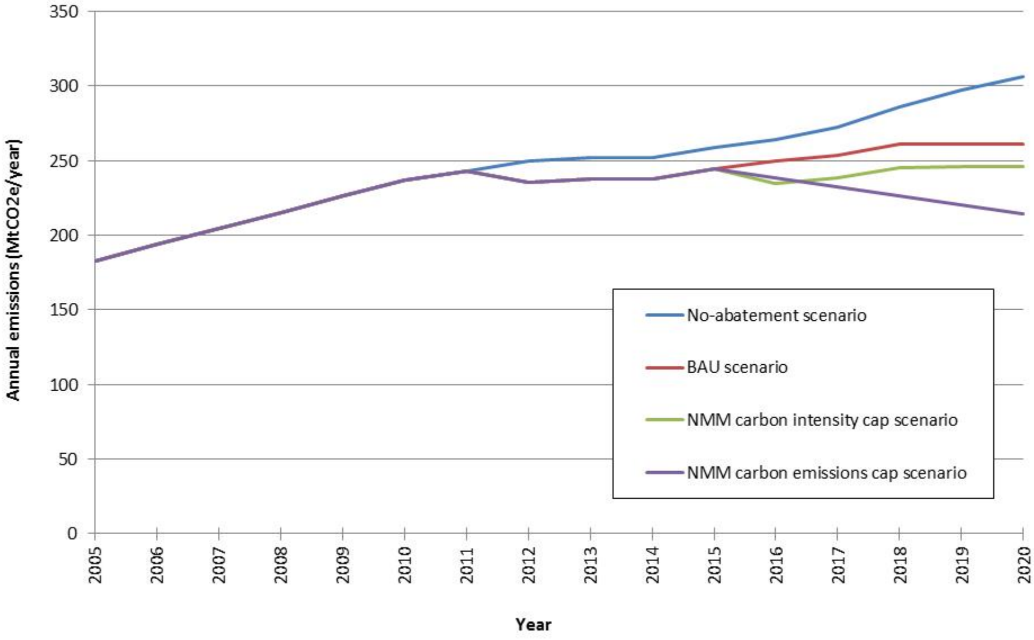
NMM carbon emissions cap

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 the emission target and as such significant improvements to the sector's efficiency would also be needed. The abatement potential that could be realised within this scenario would be 31 $MtCO_2e$/year for the period 2012-2020.

Figure 19 below presents the trends in emissions for the power sector in South Africa over time for the different scenarios. The vertical axis represents the emissions level in $MtCO_2e$ and the horizontal axis represents the timescale for the scenarios.

[121] Source: Eurelectric, Power Choices study "Pathways to Carbon Neutral Electricity in Europe by 2050"

Figure 19 Analysis of emission trends for the South African power sector in different scenarios



v. 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 of cement
Carbon leakage potential	Probably low due to high no-regret potential	**Emission intensity of cement sector in the EU**	0.7 tCO2/t of 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

a. Description of the Sector

Vietnam is the eighth largest cement producer in the world, after China, India, Russia, the United States, Russia, Japan and South Korea. In 2012, there were 51 integrated cement plants in Vietnam, with another eight plants expected to begin producing 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 capacity.[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

[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)

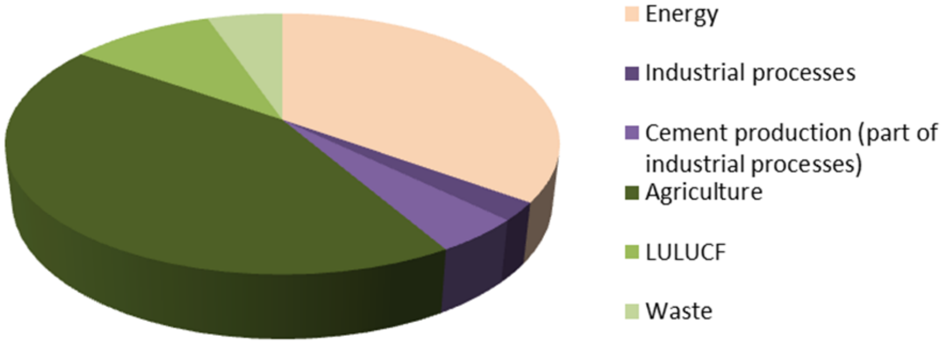
Industry Corporation (VICEM) still majorly controls the industry. The VICEM has a 34% market share in the sector through the ownership of 12 plants. Moreover, VICEM has decision-making power in the majority of Vietnam's other cement plants.[126] The Vietnam National Cement Association (VNCA) represents 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. The reason, despite these efforts, no CDM projects were developed might be because cement projects under the CDM have proven challenging.[128] To date, only 19 projects have been registered while 46 projects have been rejected at registration or have had validation terminated. [129] Significant issues with CDM projects in the cement industry are related to methodology, complexity and additionality.[130]

b. Trends in Production and Emissions

The 2nd National Communication of Vietnam to the UNFCCC estimates the country's GHG emission levels were 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 a part, emitted 10 $MtCO_2e$ (Figure 20). The share of emissions from cement production within industrial processes has increased since 2000.[131]

Figure 20 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 fuels 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-

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*

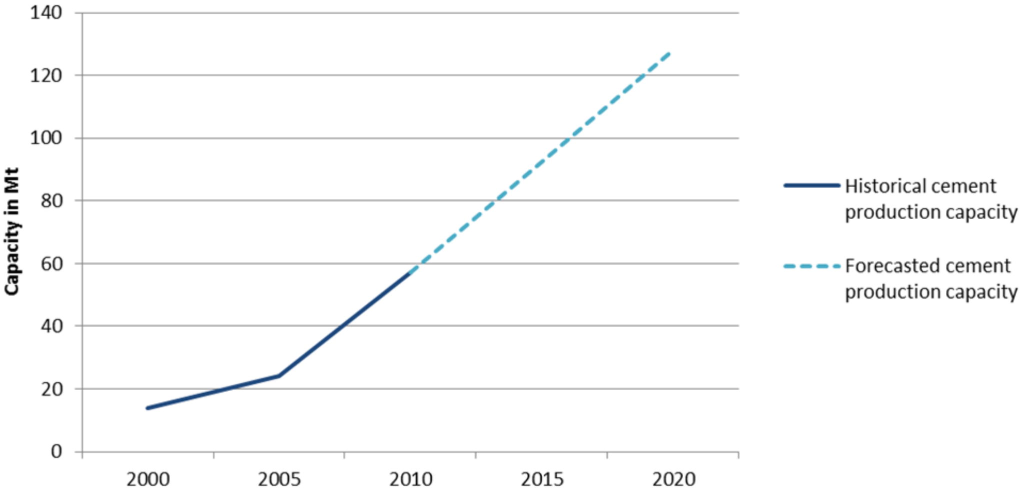
131 MONRE (2010).*Vietnam's Second National Communication to the UNFCCC.*

132 MONRE (2010).*Vietnam's Second National Communication to the UNFCCC.*

related 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]

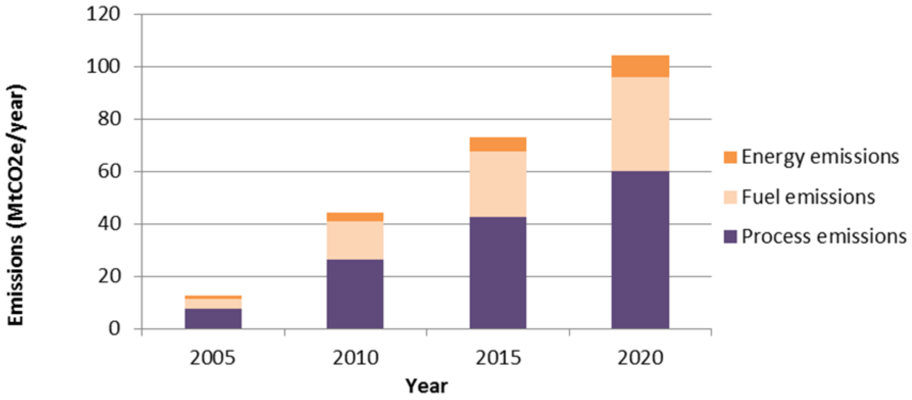
Demand for cement is projected to increase to 105 Mt/year by 2020 and 126 Mt/year by 2030 according to the draft Master Plan for the cement industry developed by the Vietnamese Ministry of Construction.[135] In a separate statement, the Ministry of Construction also indicated that between 2011 and 2020 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 21 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 22 illustrates the evolution in capacity development and indicative forecasted capacity until 2020.[137]

Figure 22 Historical emissions in the cement sector and projected growth



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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 of the 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 the Vietnamese Ministry of Construction's February 2012 announcement 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 of the 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 22).

c. Carbon Intensity

Vietnam's current emission factor for cement of roughly 0.8 tCO_2/t of cement is above the 2009 average of 0.653 tCO_2/t of cement based on over 900 cement installations that report emissions data under the Cement Sustainability Initiative (CSI) of the World Business Council for Sustainable Development (WBCSD).[140] The average CO_2 intensity of the European cement industry is about 0.7 tCO_2/t of 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.

d. Policies and Measures

The Vietnamese governmentrankssimilarly to Indonesia, well below Chile and Brazil, on governance based 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 free media.

Most environmental aspects of the 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 the following 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 export when necessary.

The Ministry of Construction 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]

e. 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 29:

Table 29 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 the primary source of 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.

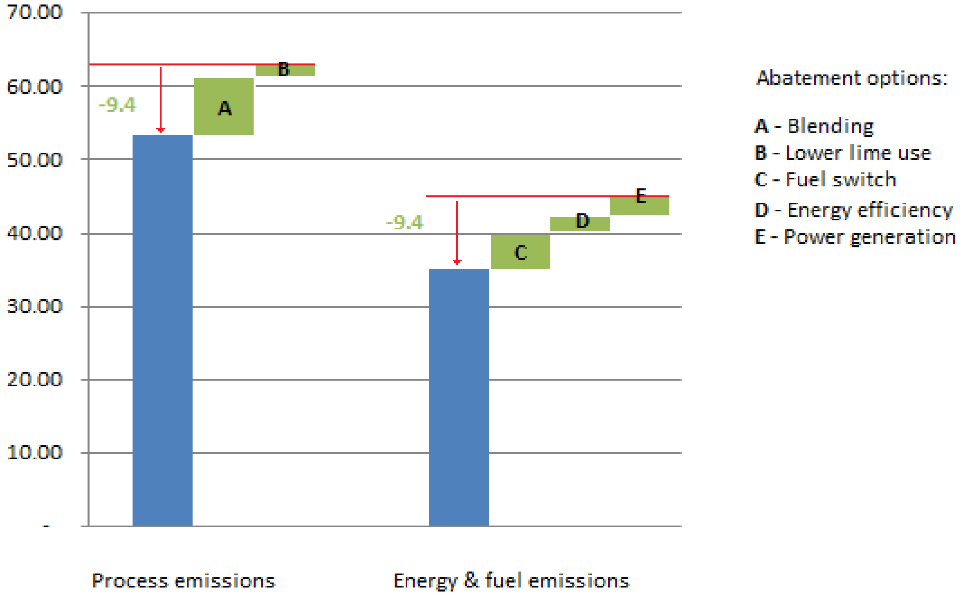
[143] Vietnam Chamber of Commerce and Industry (2011). *Vietnam Cement Industry: Energy-Efficient Technology Needed,* also: http://www.worldcement.com/sectors/materials-handling/articles/Less_Rejection_Less_Waste_in_the_cement_industry.aspx

[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 23 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 23 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 abatement options described above (see Table 30).[147] These projects are the results of a preliminary market survey conducted by VICEM and the Vietnam Association of Building Material (VABM).

Table 30 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	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)
	cogeneration		
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	

f. Application of a Tradable Intensity Standard

A tradable intensity standard could be defined in terms of CO_2/t of cement. Given the rapid production growth and wide range of projections, e.g. production forecasts for 2020 ranging between 105 and 130 Mt of cement. The use of absolute targets is not recommendable.

An inclusion threshold could be defined similarly 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.

Hence, Proposal 1 might be 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

[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.

lower their production costs. Furthermore, in the proposed system, emission units would only need 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 31 Barriers to implementation of a sectoral mechanism and suggested solutions

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

g. Emissions Reduction Potential under Different Scenarios

In this section we define the emission reduction potential of the Vietnamese cement sector 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. Based on the current state of the Vietnamese cement sector and knowledge of 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 mentioned in the Master Plan;
- In all scenarios, we assume that 2010 is the preferred reference year for the sector's caps on carbon emissions and carbon intensity. For 2010 there is reported data on the scenario parameters. However, there appears to be some data bias because reported emissions data for 2005-2007 are not realistic when compared with the production capacity;
- It is assumed that the sector's restructuring process started in 2010 with the first results achieved beginning in 2012 and continuing thereafter. 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 32 Abatement potential in the Cement sector in Vietnam under different emissions scenarios

Scenario	Abatement potential (average 2012-2020)
No-abatement	0 $MtCO_2e$/year
BAU	15 $MtCO_2e$/year
NMM carbon intensity cap	23 $MtCO_2e$/year
NMM carbon emissions cap	41 $MtCO_2e$/year

No-abatement

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 of 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

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 $MtCO_2e$ in 2015 and 104 $MtCO_2e$ in2020. 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 relatively stable around 0.78-0.82 tCO_2e/t of cement between 2010-2020. This would be higher than the average carbon intensity of cement production installations within the EU-27 that fall under the EU ETS. The installations' carbon intensity is approximately 0.70 tCO_2e/t of cement. This intensity level is based on the 2005 production (235 Mt of cement) and verified emission (157 MtCO2e) levels[149].

Considering IGES and Teri's (2011) abatement cost curves for the Vietnamese cement sector, 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 by 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. Between 2016-2020 these improvements would reduce emissions from the cement production capacity by an additional 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

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 lines of Proposal 2. The performance benchmark will be similar to the carbon intensity level of 0.67 tCO_2e/t of 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).

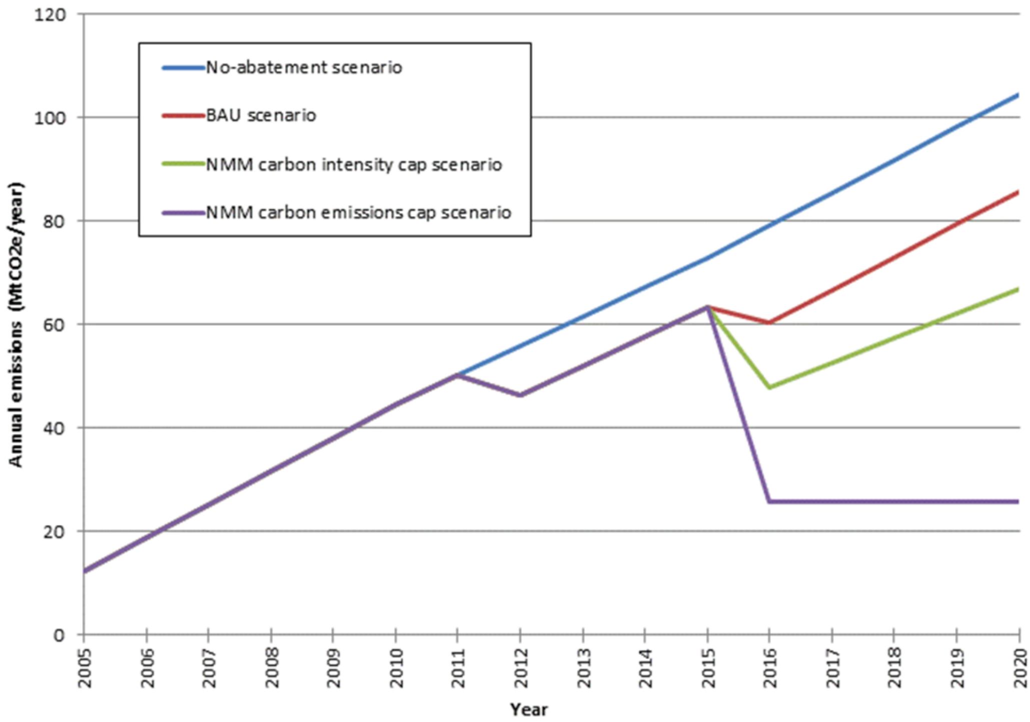
[149] SETIS Energy Efficiency and CO2 reduction in the Cement industry, Ecofys BM study and CEMBUREAU

NMM carbon emissions cap

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 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 of cement in 2010 to 0.35 tCO_2e/t of cement in 2020 in order to achieve the emission target. As such, significant improvements to the sector's efficiency also 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 24 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 $MtCO_2e$ and the horizontal axis represents the timescale for the scenarios.

Figure 24 Analysis of emission trends for the Vietnamese 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 most often bound to the local market due to high transport costs. Therefore, overall, the cement sector 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 sectors with an elastic price effect.
International clinker price	The Vietnamese cement sector is a state regulated market that aims to become more market-oriented. Therefore, political and/or other economic factors could impact the

Parameter	Impact on emission reductions
	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 dependent on the international clinker price and will need to adjust accordingly.
EU ETS price	If in the period leading 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 all be 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 of 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.

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