Chamber of Mines of South Africa

Climate Change: Mining and the Clean Development Mechanism

An information pack on climate change and carbon finance for the South African mining industry

May 2007

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Preface

Climate change as opportunity and challenge:

What you need to know about the Clean Development Mechanism

'Uninformed decisions in government, industry and even in households could lock South Africa's next generation into even higher greenhouse-gas emissions, inefficient energy use, and wasteful patterns of production.... It is time to act, time to change behaviour and time to prepare our communities to deal with the social, economic and human impacts of climate change. It is also time for managers... to ensure that the planning decisions we take or influence today are environmentally sustainable.'

Hon. Martinus van Schalkwyk, Minister of Environment & Tourism, 29 August 2005.

'I believe we are past the point of no return (on global warming). What does the point of no return mean? To me, it means we've reached a point where we are seeing the impacts of global warming. The question is: How much worse is it going to get? That is a case in which we can control our destiny – if we act now.'

Stephen Schneider, co-director Stanford University Centre for Environmental Science Policy, quoted in The Sunday Independent, South Africa 2 April 2006.

Global warming and the mining industry

It is crucial for senior managers in South African mining sector companies to influence their companies' future positively by reducing the 'global warming footprint' of the company.

During the past few years, there has been a steady increase in reports warning of imminent climate change. Hardly a week goes by without the release of yet another study showing that global warming is at the tipping point, and that efforts to counter the human causes of climate change are more vital than ever. Most of these reports are based on the work of well-respected researchers and decision-makers. At the same time, critics of this view are shrinking in number, and both governments and the private sector are beginning to realise that aggressive actions to reduce greenhouse gas emissions must begin immediately.

The mining industry is a major focus of such efforts. Minerals beneficiation alone contributes more than 60% to South Africa's total industrial greenhouse gas emissions, a high percentage of which comes from the burning of fossil fuels or use of electricity to smelt or refine ore.[1] The largest single source of greenhouse gas emissions in the industry is methane emitted from coal mines[2], but significant amounts are also generated by other kinds of mining activities, for example, consumption of electricity to run motors for hoists, compressors, pumps and fans, and the electricity and liquid fuels used by transport equipment servicing the mines.

Electricity is a key contributor to greenhouse gas emissions since coal is used for approximately 90% of South Africa's total power generation. In simple terms, the country generates just under a kilogram of greenhouse gases for every kWh of electricity used. Similarly, the historic use of coal for the production of liquid fuels, when added to the use of coal for electricity

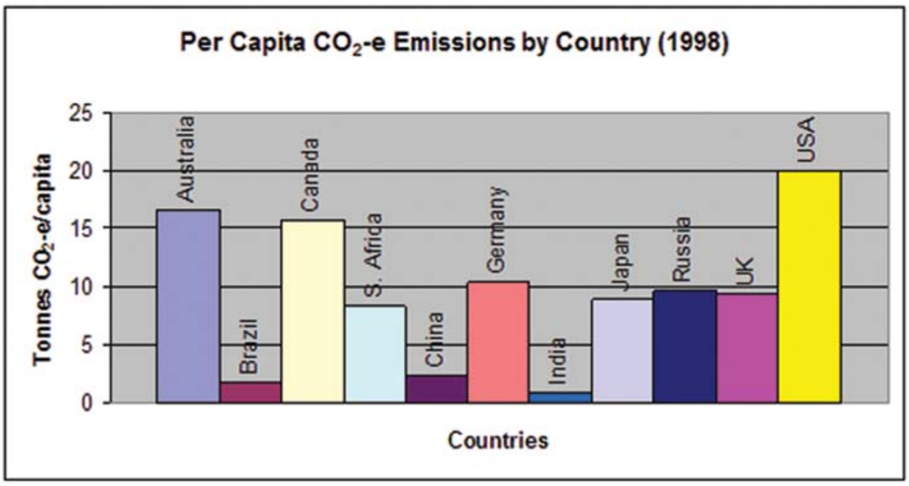


Figure 1: CO2-equivalent emissions per capita for selected OECD countries and South Africa

generation, means that the energy sector as a whole contributes around 90% of total carbon dioxide emissions and 78% of overall greenhouse gas emissions.

This heavy reliance on fossil fuels places South Africa in the same league as many developed countries in terms of greenhouse gas emissions per capita, and around 15th in total emissions. This is demonstrated graphically in Figure 1, which shows CO_2-equivalent emissions per capita for selected Organisation for Economic Co-operation and Development (OECD) countries and South Africa.

Mining also contributes indirectly to greenhouse gases by producing large amounts of bituminous and anthracite coal, used in a wide variety of applications from power generation through steam raising in industrial boilers to household heating and cooking. As coal is a major export earner for South Africa, with markets in both Europe and Asia, efforts to reduce the use of fossil fuels to stave off global warming will impact adversely on this sector. The exploitation of coal in South Africa produces one of the most powerful greenhouse gases: methane, which has 21 times the global warming impact of carbon dioxide. Coal mining alone produces about 97% of total fugitive methane emissions, according to the country's First National Communication.[3]

The problem

Clearly, South Africa's mining industries face an important dilemma – balancing the advantages of cheap energy and an expanding market for coal exports with the increasing burdens placed on industry by international and national limits on greenhouse gas emissions. The mere threat of global warming will substantially increase market risk for the mining sector as pressures increase to curtail the use of coal in power generation and industry worldwide. Managers of South African mining companies are at the centre of this dilemma.

The international response to the threat of global warming is called the Kyoto Protocol (signed in 1997), which sets out an overall framework and targets for reducing greenhouse gas emissions. Kyoto is a complex document that has spawned an even more complex set of procedures and sub-agreements that ideally will make it easier for industrialised countries to achieve their targets through the use of market mechanisms.

Balancing the threat of global warming and its potentially adverse impacts on the mining industry against the prospective advantages from reducing greenhouse gas emissions is no easy task. One solution to this is the so-called Clean Development Mechanism (CDM). CDM is only one of several Kyoto mechanisms by which carbon credits are created. It does so by encouraging the development of projects that reduce emissions through any of a number of mechanisms, including energy efficiency, improved process efficiency and fuel substitution.

This Information Pack is designed to help local mining companies deal with the opportunity side of this dilemma by investing in CDM projects. It also explains how to implement cost-effective actions to mitigate greenhouse gas emissions that will offset the negative carbon footprint of the sector's main product lines, particularly coal and metals.

Approach

The Information Pack is presented in a modular form to appeal to several different types or levels of management in the mining industry – chief executives and other executive managers, financial managers, engineering managers, and environment managers. Each module identifies the important information and issues that managers at that particular level need to understand if the company is to develop a successful CDM project. The Executive Summary provides a useful overview of the problem for busy executives. The main section is followed, in the annexures, by a series of case studies, examples of approved methodologies and further reading.

Executive summary

What is CDM?

CDM is a project-based mechanism under the Kyoto Protocol, which is itself a key part of the international response to the threat of global warming. CDM enables companies in developing countries like South Africa to sell credits from reductions in greenhouse gas emissions to entities in developed countries at a market-determined price. In so doing, South Africa is both improving its own performance as an emitter of greenhouse gases and helping to reduce the global impact of these gases at a lower cost than would be possible in developed countries.

The South African mining sector is a major source of greenhouse gases, both directly through mining and minerals beneficiation activities, and indirectly through the production of coal, a major source of greenhouse gas emissions internationally.

For managers in the South African mining industry, CDM offers a new and challenging way to reduce greenhouse gas emissions and simultaneously reduce the cost of improving corporate environmental performance. In most cases it also provides secondary benefits such as lower energy costs and improved overall emissions performance.

For the corporate balance sheet, CDM is a way of turning a potential liability into a significant asset.

Implementing CDM

A comprehensive approach involving sectional managers at three different levels – engineering, financial and environmental – is needed to implement a CDM project, because CDM is a technical issue that requires substantial knowledge of how to measure current emissions and calculate reductions from a project as well as a potential source of foreign direct investment for a company. It is also implicitly an environmental project, and will almost certainly require an environmental impact assessment to ensure that it meets national standards.

Developing a successful CDM project will, therefore, require careful co-ordination among all three of these elements and will reward an integrated approach.

The CDM cycle

Once managers have selected a project and undertaken basic feasibility work, they will need to move forward through the CDM cycle, which involves a series of local and international approvals and will ultimately lead to its registration with the CDM Executive Board. This process takes time – up to two years in some cases – but the delays can be offset by the pre-sale of some of the potential carbon credits and by utilising one of the many approved methodologies for CDM that are now available. Expert assistance is available both in South Africa and internationally. This Information Pack provides basic information to guide managers through the process.

Selling carbon credits

Once a CDM project has been identified and initial steps taken to develop it, potential buyers of the carbon credits can be sought. The credits are denominated in a common unit – tons of carbon dioxide or its equivalent avoided, also called carbon emission reductions (CERS). CERs can be sold for anywhere from €5 each to upwards of €10, depending on the risks associated with a project as perceived by the potential buyer. For a project that yields 100 000 CERs per annum (not unusual in the industrial and mining sectors), this could provide an additional cashflow of between €500 000 – €1 000 000 a year that can be used to reduce the cost of the project.

Selling carbon credits is a very complex business and the market for credits is currently quite volatile. The situation is improving every day as buyers and sellers grow more confident in the Kyoto process and gain a better understanding of the true value of carbon credits and how they are generated. Getting into this market early, and developing projects now that will begin to produce credits by 2008 – the beginning of the Kyoto First Commitment Period – makes good economic sense for a company.

Section 1

CDM for the executive manager

Why CDM?

The Clean Development Mechanism (CDM) is first and foremost an investment tool. CDM presents executive managers and other senior mining company officials with a unique opportunity to create value for their company by developing projects that improve its environmental footprint and attract foreign investment, which would otherwise not be available.

What is CDM?

CDM is a programme that allows a company to sell the credits it receives for reducing its greenhouse gas emissions to a growing international market of companies and countries that need these credits. Since the emission of greenhouse gases is not regulated in South Africa – at least not yet – the CDM allows value to be created from something that currently has no value, or perhaps even negative value, to a company.

CDM is one of three mechanisms[4] created by the Kyoto Protocol on climate change to stimulate the creation of a market-based approach to reducing greenhouse gas emissions. However, CDM is the only one of the mechanisms available to companies and organisations in developing countries such as South Africa.

The most important attribute of CDM is that it is project-based. A project that reduces greenhouse gases must be developed prior to claiming credits. It must be shown that the project was developed at least in part because of the opportunity to claim credits. In other words, merely demonstrating that a company is avoiding the generation of greenhouse gases through existing or planned activities will not be enough – proof must be given that the project would not have occurred without the incentive of increased revenue from carbon credits.

What are carbon credits?

The credits generated by CDM projects are based on the tons of greenhouse gases a company saves – i.e. avoids producing – a year. These credits are called carbon emission reductions (CERs) and all such reductions are denominated in terms of carbon dioxide, the major greenhouse gas. Details of how CERs are calculated are covered in Section 2.

It is important to note that CERs can be sold internationally to help offset the caps or limits that many industrial countries have placed on their own greenhouse gas emissions. All carbon credits traded internationally (not just CDM credits) are measured by the same standard of value as are CERs: one credit is equal to a ton of carbon dioxide or its equivalent in other greenhouse gases saved.

Depending on the kind of project developed, its risk profile, the buyer of the credits, and whether they are sold now or later, each credit or avoided ton can be sold at prices that range anywhere from €2 to €10 or more per ton. These prices will rise further in the future, subject to negotiations underway for an extension of the Kyoto Protocol. Current prices are likely to remain volatile and somewhat unpredictable.

The price of carbon

Because the price of carbon emission credits is market driven, it is likely to fluctuate owing to changes in both supply and demand. As an example, the price of carbon emissions credits on the European compliance market recently dropped from €28 to €12 per ton in a single day, when it became obvious that some key European countries were emitting less than had been forecast, and would therefore not need to purchase as many credits as expected to meet their caps. This and other financial issues important in developing CDM projects are covered in more detail in Section 3.

Why develop a CDM project?

As the above discussion suggests, CDM provides an important opportunity to improve a company's cash flow and its overall return on investment for capital projects. If a CDM project can be developed, approved by the designated national authority, and registered by the CDM Executive Board, a company is then free to sell the credits to an entity in any industrialised country that has ratified the Kyoto Protocol. This means all the European Union countries, plus Japan and Canada.[5] This could result in an increased revenue flow to a company of anywhere from a few thousand rand a year to several million rand a year, depending on the size of the project.

In addition to its tangible financial value, CDM provides evidence to the business community, including shareholders, that a company is doing its best to counter the effects of climate change. For the South African mining sector, this has special importance because it demonstrates that even industries with a fairly large carbon footprint are doing something to improve the global environment.

What types of projects are eligible for CDM?

Most potential CDM projects in the mining industry will fall into a few basic categories:

- Projects that reduce the emission of methane gas, either directly from coal seams, or indirectly from industrial processes. Projects that reduce methane are major sources of carbon credits, because methane has 21 times the impact of carbon dioxide on global warming. In other words, for every ton of methane reduced each year, 21 carbon credits can be claimed.
- Projects that reduce the consumption of fossil fuels. This can include efficiency improvements to furnaces and boilers that reduce energy consumption, substitution of fuels, such as natural gas or biomass for coal or oil, or the use of renewable sources of energy, such as wind or solar. In this case, it is primarily emissions of carbon dioxide that are reduced, although some fossil fuels also emit small amounts of methane and nitrous oxide (another major greenhouse gas).
- Projects that reduce the use of electricity. In South Africa, reducing electricity use indirectly reduces fossil fuel consumption since 90% of South Africa's electricity production comes from coal. Improvements such as the introduction of more efficient motors for lifts and other equipment, conversion to energy-efficient lighting, replacing drills and other pneumatically-powered equipment with electrically-powered equipment, or even generating electricity privately from waste gases or alternative energy sources such as methane, can all reduce greenhouse gas emissions. The credits generated by these projects belong to the company implementing them.
- Projects that improve the efficiency of mineral extraction or processing. In some cases, production processes themselves may emit greenhouse gases directly, rather than by burning fossil fuels. If these emissions can be reduced by a modification to the process (for example introducing a catalyst) or by changing the process itself, carbon credits can, in principle, be claimed for doing this. In aluminium smelting, for example, reducing emissions of perfluorocarbons – a major group of greenhouse gases – could theoretically provide substantial benefits since these gases have a global warming potential 5 000 – 10 000 times that of carbon dioxide. (In practice this may be difficult to do without major and expensive process changes.)

There are many different kinds of CDM projects that mining companies can develop. Descriptions of a few of the most important of these can be found in Annexure1, along with a number of detailed case studies.

How to identify a CDM project for a company

There are a number of mandatory steps in developing a CDM project and getting it approved or registered. Because these steps involve significant costs, which either a company or a project developer must bear, it is important first to screen and prioritise projects that may have CDM potential before embarking on a programme to develop a particular project. The following steps should be followed:

Step 1: Ask the engineering manager or his/her staff to prepare a list of planned capital projects that involve energy efficiency improvement, fuel switching or process changes

Include in this list any project that is planned within the next five years, since the length of time over which carbon credits can be claimed is limited (see below). Ideally, the list should show the capital cost and potential energy savings of the project, as well as any savings from greenhouse gas emissions, both from energy and non-energy sources, for example reduced methane release or reduced CO_2 emissions from process changes or from reduced use of coal or electricity. The savings in greenhouse gas emissions can be approximate at this point. In a later section of this Information Pack, we provide more information for engineering managers on how to develop a detailed project design document.

Step 2: Ask the financial manager or his/her staff to assess each of these projects based on the company's hurdle rate for its return-on-investment (ROI) or internal rate of return (IRR)

Projects that are marginal in terms of ROI are best suited to CDM, since the purpose of CDM is to help make emissions-reducing investments that would not otherwise be made. However, even projects that fall within the hurdle rate may be eligible if they are postponed because of such factors as new technologies that may increase investment risk, or if they are being resisted by technical managers because of potential disruptions to the production routine. As explained in later sections, demonstrating that CDM has helped a company to overcome one or more such barrier is an essential part of the CDM process.[6]

Time limits on purchase of carbon credits

The Kyoto Protocol's first commitment period stretches from 2008 to 2012. As a result, most buyers will only purchase credits up to the end of 2012. If you started work on a CDM project now, you would only be able to claim credits for around six years, and probably a lot less. This may change if current negotiations succeed in extending Kyoto for another commitment period. Some buyers will offer to purchase credits after 2012 on a rights-of-first-refusal basis, or offer to buy them at a lower price than credits purchased before 2012.

Step 3: Ask the environment manager if any of these projects involve activities that must be implemented to meet national air quality or other environmental regulations

If the project activities are required by local or national environmental regulations, then it may not qualify for CDM because it has to be done anyway. The environmental manager may also be able to tell whether or not the project is likely to encounter other environmental restrictions, for example if it will require an environmental impact assessment (EIA) and if so, are there any aspects of the project that are likely to encounter resistance during the public review process.

The following three sections of the information pack are addressed to managers at three levels: engineering, financial and environmental.

A simple decision matrix

Depending on how a company proceeds, an evaluation of the information from divisional managers may be needed to develop a prioritised list of CDM projects for presentation to the company's board. The decision matrix shown in Figure 2 may be of use in carrying out this task. The matrix is presented as a simplified flow-chart, detailing the questions to be asked to identify which of several possible projects is most likely to qualify initially for development as a CDM project. The key issues identified by the matrix are:

- The need to assess the project's financial feasibility using the company's standard hurdle rate for capital investments
- The existence of other barriers to proceeding with the project, for example market or internal management barriers
- The potential emission reductions that the project will realise compared to the current baseline of emissions from the affected facility
- The potential environmental impact of the project, including its socio-economic impacts on local populations.

The chart shows that deciding whether or not to proceed with developing a CDM project involves close interaction among all key managers – financial, engineering and environmental. For example, a company will need to assess whether or not the project will pay for itself without the additional revenue from carbon credits. If it does, the additionality of the project – an essential requirement for a project to gain approval as a CDM project – may be in dispute.

If the project will pay for itself through energy or other savings, other barriers may still outweigh any purely financial aspects and make it possible to argue that the project will only proceed with the benefit of carbon credits. A company will need to marshal evidence that this is so before proceeding. Finally, a company will need to know how the project's environmental benefits (or negative impacts, if any) will affect the feasibility of proceeding with it, and whether or not there will be any public objections to the project.

Reviewing all of these issues is an essential prerequisite for the decision to proceed with a project design document, the key step in the process and potentially the most expensive one. We will return to the question of barriers and the importance of assessing project feasibility in advance, at the end of this section.

CDM project cycle

Once a decision to proceed with a CDM project has been made, the people assigned to this work will need to take the project through a series of specific steps in the approval process. These steps are usually referred to as the project cycle, and involve a wide range of activities from

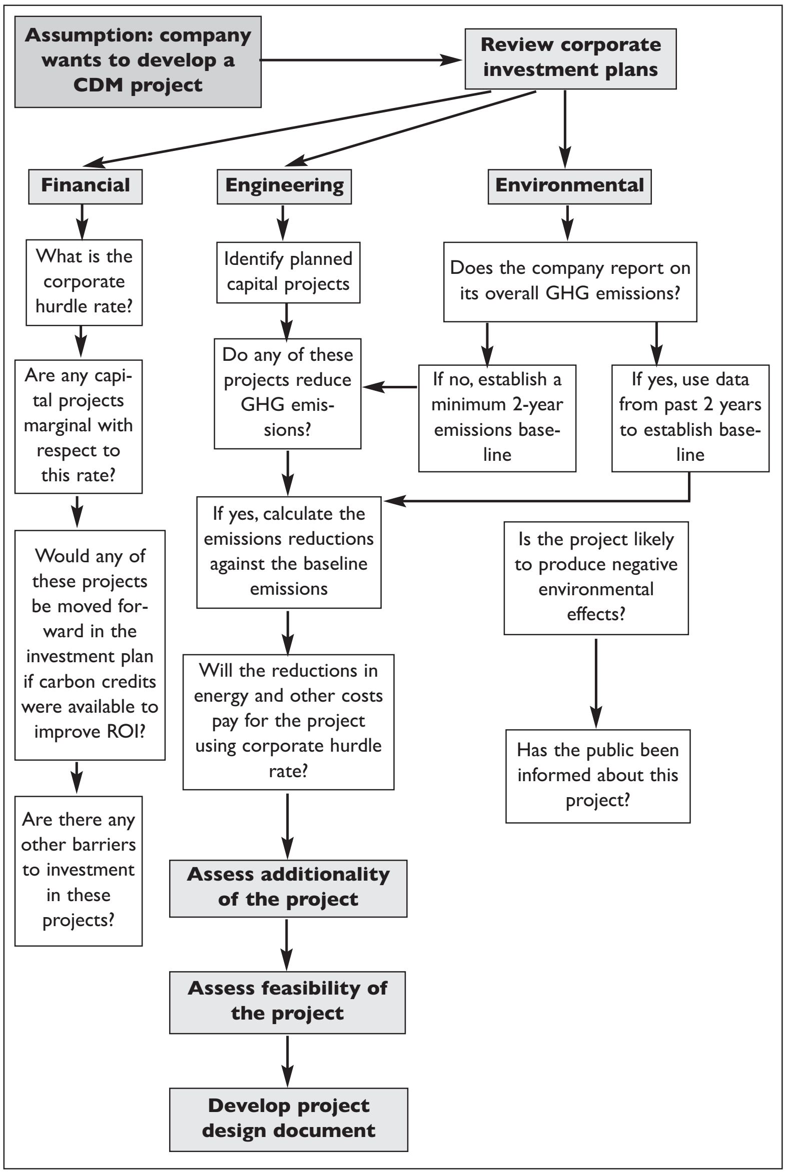


Figure 2: CDM decision matrix flow chart

design of the project itself (including detailed calculations of current emissions baseline and proposed emissions reductions); to validation of the project by an independent authority; eventual approval by the South African government; and registration of the project with the CDM Executive Board so the emissions credits can actually be transferred to a buyer.

Although potentially complex, the project cycle can also be represented graphically by a flow chart, as shown in Figure 3.

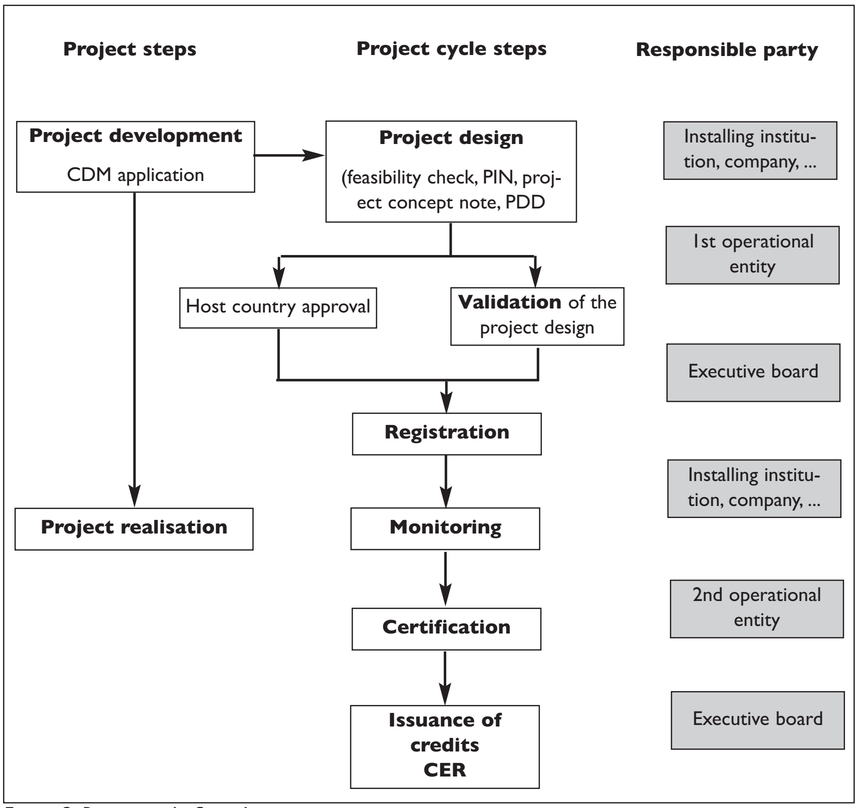


Figure 3: Project cycle flow chart

There appears to be only two basic phases: project development and project realisation, however, as the middle column shows, there are actually six to seven independent steps. These begin with project design, which can itself involve a preliminary project idea note (PIN) followed by a more developed project design document (PDD) and ending with the final issuance of credits once the CDM Executive Board has registered the project. After registration, the project remains subject to periodic monitoring and certification[7] by an independent authority to ensure that the predicted reductions are actually being achieved. Adjustments made at this stage can potentially affect the amount of credits actually issued to the purchaser of those credits over the full crediting period.

It is important for management to recognise that the process from design to registration can take anywhere from six months to two or more years to complete, depending on the complexity of the project and whether or not the methods used to analyse and measure reduction of greenhouse gas emissions have been previously approved by the CDM Executive Board. Of equal import for managers is the considerable cost of implementing this process – often referred to as transaction costs in the CDM literature. These costs should be factored into the overall investment decision. If the project is fairly small[8], these costs could be as low as R90 000 – 100 000; while for a larger project they could exceed R500 000.

Host country approval

Countries that originate CDM projects (host countries) are expected to establish their own criteria for judging the sustainability of these projects. South Africa's designated national authority (DNA) for CDM, located within the Department of Minerals and Energy, has developed a set of criteria that anyone developing a CDM project must consider. As a result, getting national approval for CDM projects in South Africa includes a number of steps that are not shown in the project cycle flow chart. These include the issuance of a letter of no objection after submission of a PIN (not a mandatory step, but a good idea for obtaining financial assistance in advance), and a public review period following submission of the PDD, during which the public can comment freely on the project. In some cases, a separate environmental impact assessment may also be required, although this step is not determined by the DNA. For further information on the sustainability criteria, refer to www.dme.gov.za/dna/dna_project_cycle.stm. South Africa's project approval cycle, which mirrors the overall CDM project cycle but includes additional steps, has been included in Annexure 4.

As explained in Section 3 some of these developmental costs can be recovered, either by forward payment of revenue from sale of credits, or by grants offered by some developed countries' governments and international donors.

Critical risk factors

As shown in the CDM decision matrix, there are several major factors that can increase the risks of CDM project development. Ideally, these need to be addressed before starting the project cycle, because they can potentially influence the rate of progress, the probability of getting speedy approval, and thus the overall costs of developing such projects.

The first of these is the feasibility factor. In practice, most companies that have identified capital projects or any projects involving improvements in energy efficiency or greenhouse gas emissions will have done so without the benefit of a detailed feasibility study. Such studies are typically implemented only when the capital plan is at a more advanced stage, and when companies need to decide which projects to implement first – to prioritise their investment plans. However, if the detailed information produced by a feasibility study is not available, evaluating potential CDM projects (as suggested by the decision matrix) will also be difficult, since information on baseline emissions will not be available, nor will the detailed technical and risk assessment information needed to establish the project's eligibility for CDM. It is extremely important to undertake some feasibility work before deciding on which projects to consider for CDM.

Example

To take a simple example: If a company is planning to substitute some kind of waste material for coal in a combustion process as a CDM project, it will need to have detailed information on the energy qualities of the waste material, including its moisture content and calorific value when dried. It will also need information on transport costs if the waste material is coming from other locations, and a clear understanding of how the new fuel will be handled in bringing it to the boiler or furnace in which it will be burnt – including any drying that may be needed before using it as a fuel. Having this information on-hand as a result of a detailed feasibility study will greatly increase the accuracy of the data on emissions reductions; not having it means estimates may be produced that will later be rejected by the consultant validating the project. This will incur additional costs to re-evaluate the figures.

The second risk factor is the methodology barrier. This is actually a function of the formal project cycle, but is often misunderstood and overlooked by companies planning a CDM project, because not everyone will encounter it to the same degree. Simply put, the project methodology is a set of analytical steps to be followed to establish the emission baseline, emissions reductions and the way in which each of these will be monitored. There is no uniform or generic methodology, rather each type of project requires a specific methodology, which must be approved beforehand by the CDM Executive Board.[9]

Fortunately there are many methodologies that have been pre-approved by the Executive Board. A company may be able to use these as a template for its PDD – if, that is, the project meets the applicability criteria stipulated in the methodology.[10] In some cases, there will be small variations requiring the approval of a revised methodology, and in others a company will have to develop and get approval for an entirely new methodology. This could delay the approval of the project by anywhere from four to 12 months. Thus the possible cost of developing or revising methodologies should be factored into the overall investment decision.

To minimise the adverse impacts of this barrier for companies in the South African mining industry, an annexure listing all methodologies approved to date that may be relevant for the mining and metallurgical sectors, and citing their applicability criteria is included. The following section contains a more detailed discussion of this topic.

The way forward

The finer details of the CDM project development process are explained in the following three sections, including explanations of the various parties involved and how the basic steps can lead to a number of secondary steps specific to South Africa, for example, establishing the project's sustainability and its environmental impacts. The annexures provide details on the key steps in the CDM process and technical and important methodological issues.

Section 2

CDM for the engineering manager

Technical aspects

Developing a CDM project is in large part a technical exercise, requiring significant inputs from the engineers in the company. Engineering managers need to take a leading role in both assembling and analysing the information needed for the project.

Why should the mining industry be interested in CDM?

Mining is inherently an energy intensive business, as is the processing of mineral ores. Although the sector accounts for a high percentage of industrial greenhouse gas emissions in South Africa, serious efforts to improve energy efficiency and atmospheric emissions are only beginning to be implemented. This presents mining companies with a unique opportunity to capitalise on the benefits available from the CDM, which can in turn provide a revenue stream that makes energy efficiency, process change and fuel substitution projects more attractive.

What should be done first?

As outlined in Section 1, a company first needs to decide on the kinds of projects that may qualify for CDM, and to prioritise these so that projects having the greatest likelihood of success and the highest potential for emissions credits are looked at first. Once a priority project has been identified, a company can kickstart the development process by formulating a PIN, which is basically a shorter form of the PDD that will eventually be needed for project approved.

A template for the PIN is available on the website of the South African DNA for CDM (see Annexure 3), together with an application form that must accompany it. A hard copy is included in Annexure 4.

The process of developing a PIN is essentially the same as will be required for a PDD, but the level of technical detail is much lower. Submitting a PIN is not mandatory, but it is a good idea to gain some initial feedback on the concept, and in particular on its adherence to the national sustainability criteria. (For more on sustainability, see Section 4.) Once it approves the PIN, the DNA will issue a letter of no objection, which can be useful when seeking financing for the project development process.

What kind of information is required?

CDM projects are regulated by the CDM Executive Board, which has provided detailed guidelines for both the collection and analysis of data. To develop a CDM project and have it validated and registered by the Executive Board, a company will have to assemble the following information:

- Baseline emissions for at least two recent years. These are the historical emissions that occur before the project is implemented. The baseline is measured in tons of CO_2-equivalent per year as are the reductions in emissions. Include in this measurement are any of the three main greenhouse gases emitted by the company – CO_2, methane and nitrous oxide – which are directly related to the project, and then convert emissions from methane and nitrous oxide to their carbon dioxide equivalents using the standard factors agreed by the Intergovernmental Panel on Climate Change (IPCC).[11] This is particularly important if the project involves a change in combustion processes, which typically emit all three of these gases – although CO_2 is always the dominant emission. The same will be true if a project involves changes in the use of fossil fuels for transport. If a company is only considering changes to processes that involve decomposition of biomass, such as composting, landfills or digesters, then it will be concerned primarily with the baseline for methane emissions.

  In the unlikely event that the project involves emissions of the three additional greenhouse gases (hydroflourocarbons, perfluorocarbons and sulphur hexafluoride), a company will need to have reliable methods for measuring these for the baseline period. Unlike gases produced by combustion, these minor gases are produced directly by industrial processes and must be measured directly.

  A fuller explanation of the six greenhouse gases is provided in the section on emissions reductions.

Example

Here are few examples, taken from the IPCC and other sources, of emissions from energy sources commonly used in South Africa, expressed as the number of kilograms of CO_2-equivalent emitted for each gigajoule (gJ) of energy produced or used. All numbers are averages, and indicative only. Actual emissions will vary for particular circumstances and fuel types.

Energy source	*Emissions in kg CO_2e/gJ*
Coal used in raising steam	*79.35*
Coal used in electricity generation	*85.74*
Diesel/light fuel oil used in furnaces	*74.07*
Natural gas used in gas turbines	*56.10*
Electricity, delivered to customer (in South Africa)	*290.90*

- Project boundary. These are the activities arising from or related to the baseline emissions that are directly controlled. If the primary activity of a company is mining, the boundary will normally include only those processes that are altered by the project. Other mining processes that are unaltered and where no emission reductions result from the proposed project do not need to be considered. For example, if a company disposes of waste from a mining activity off-site and this activity is altered by the project, the activity will probably be considered as within the boundary. If the coal used to raise steam or smelt ore is transported to site by an independent transport company or by rail, this will be deemed to be outside the boundary because the company does not control it directly.

- Emissions mitigated or saved. In the simplest terms, this is the difference between the baseline and the project, i.e. the emissions avoided if the project is implemented. As with baseline determination, the emissions reductions must be from one of the six gases that are listed as official greenhouse gases in the Kyoto Protocol, and they must be converted to tons of CO_2-equivalent per year, using standard factors.

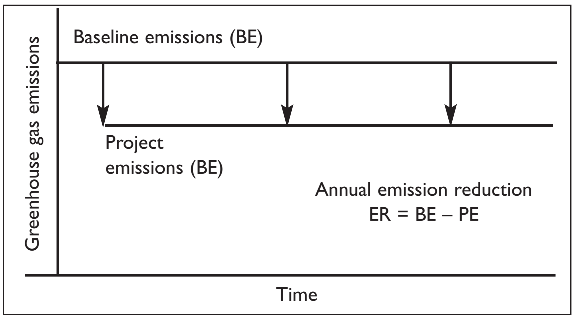


Figure 4: Relationship between the baseline and emission reductions

Emissions savings (as well as baseline emissions) must be calculated using different factors for different sources, for example bituminous coal, heavy fuel oil or delivered electricity. Most of the factors have been established by the IPCC and are published on its website.[12] The IPCC does not publish emissions factors for supply of electricity because:

1. the energy sources used to generate electricity vary significantly from country to country, and in most countries, are a mix of sources, often with different mixes for dealing with peak vs off-peak or base loads

2. the efficiency with which electricity is generated, transmitted and distributed varies enormously, and so the emissions resulting from the electricity actually delivered to a plant or mine must be calculated for each location.

Table 1(at the end of this section) shows one such calculation, based on the heating value of sub-bituminous coal taken from Witbank Colliery. The table shows that although the generation of electricity in South Africa produces approximately 89 tons of CO_2-equivalent for each terajoule (TJ) of electricity produced, the actual amount emitted to deliver that terajoule to an end-user is more than 290 tons, taking into account efficiency and line losses.

The figures used will vary depending on the energy source used for generation, the local generation mix, the actual losses during transmission and distribution, and the operating and build margins used for the local generation/distribution system.

- Leakage from a project. Leakage is defined as the net change in anthropogenic emissions by sources of greenhouse gases that occur outside the project boundary, and which are measurable and attributable to the CDM project activity, for example emissions from the transport of alternative fuels to the site or from the production of new kinds of inputs to the production process. The rule-of-thumb for leakage is that, because it is outside of the boundary, it is by definition something over which a company has no control, i.e. something that it cannot mitigate, but which is still

The six major greenhouse gases

- *Carbon Dioxide (CO_2): Mostly from the combustion of fossil fuels (electricity generation, industry, transport), comprising 70% of the total greenhouse effect. Global warming impact = 1*

- *Methane (CH_4): Emitted during waste management and agriculture, comprising 20% of the total greenhouse effect. Methane has an impact on global warming 21 times that of CO_2*

- *Nitrous Oxide (N_2O): From burning fossil fuels, industrial processes and fertiliser production in particular, comprising 6% of the total greenhouse effect. Nitrous oxide has an impact on global warming 311 times that of CO_2.*

Reductions of the three gases will probably represent over 95% of the opportunities for CDM projects in South Africa.[13] In addition there are three long-lived gases emitted during industrial processes, which in combination comprise only 4% of the total greenhouse effect:

- *Hydroflourocarbons (HFC): These gases do not occur naturally, but are manufactured as a replacement for the older refrigerants – CFCs and HCFCs – which themselves have a negative effect on the ozone layer. HFCs have a global warming impact of 100 – 1 300 times that of CO_2*

- *Perfluorocarbons (CF_4): The major source of this gas is aluminium production, and also fire extinguishing systems. CF_4 has a global warming impact of 5 000 – 10 000 times that of CO_2*

- *Sulphur hexafluoride (SF_6): The major sources of sulphur hexafluoride release include leakage from electrical switchgear, from magnesium smelting processes and use in semiconductor manufacture. SF_6 has a global warming impact of 23 000 times that of CO_2.*

quantifiable. If a company is planning to use a biomass fuel as a substitute for coal in a furnace or boiler, for example, it will have to show that it has assessed the emissions from the vehicles (road or rail) used to transport the biomass fuel to site and that they are less than, or equal to, the emissions produced by transport of the current fuel, i.e. coal.

Although a company has no direct control over the activities producing leakage, it will have to factor it into the emissions reduction estimates. If the leakage is significant, it may have to adjust the baseline to include the activities producing leakage. It will also have to include this leakage in the monitoring plan (see below).

- Methods used to monitor the emissions over time. All CDM projects must be monitored and the expected emissions verified on a regular and systematic basis. Although the actual verification will be done later by an outside expert – the designated operational entity – it is the responsibility of the project developer to prepare a monitoring plan that sets out the activities to be measured and the methods used to measure them. This plan will be reviewed during the validation of the project by the first designated operational entity. The monitoring plan must show how the key variables will be measured and the final reductions determined, as well as by whom and at what times.

Developing a PDD

The development of a PDD is the most important and potentially the most time consuming step in the entire CDM project cycle. It is not possible to outline the entire process here, but it is simply a detailed expansion of the PIN and includes the five basic items of information outlined above, namely:

- baseline determination
- boundary determination
- assessment of emissions reductions
- identification of leakage and
- development of a monitoring plan.

In addition, the results of the public review process and any environmental impact assessment required for the project will need to be included. Maps or charts showing the precise location of the project should be attached, as well as process or flow diagrams to illustrate the technical details of the project.

Most PDDs run to 30 or more pages, although the basic form is only11 pages in length. Both the PDD forms and a Guideline to Completing the PDD are downloadable from the CDM website, details of which are found in Annexure 3. On the same website are parallel forms for small-scale projects and forms for developing monitoring methodologies.

Some of the processes involved in developing a PDD are illustrated in the case studies in Annexure 1.

Selecting a methodology

The term methodology was explained briefly in Section 1. Methodologies are basically the technical/analytical procedures required to produce a PDD. They are usually quite specific and cover aspects such as:

- how to determine the baseline for emissions, i.e. the emissions before the project is implemented
- how to measure expected emissions reductions
- the boundary of the project, i.e. the emissions-producing activities that can be influenced directly
- whether or not there is leakage, i.e. increased emissions owing to the indirect impacts of the project outside its boundary, such as changes in transport emissions
- how to determine additionality
- how to establish a monitoring plan for ongoing verification of emissions.

The CDM Executive Board has established a procedure for the approval of methodologies that will greatly simplify the process. First, check the CDM Executive Board website to see if a methodology has been developed (website references in Annexures 2 and 3). There are three different categories of methodology listed:

1. Methodologies for CDM project activities
2. Methodologies for afforestation/reforestation activities
3. Simplified methodologies for small-scale CDM project activities.

The site lists methodologies for each of the categories that have been approved and those that are under consideration. The latter refers both to methodologies that are too new to have been approved, and those that have been rejected and/or are being revised.

Companies in the mining sector will generally only be interested in methodologies in categories 1 and 3, unless they are planning a forestry project as a means of offsetting their carbon dioxide emissions.

There are also consolidated methodologies for some types of project – methodologies that incorporate the knowledge of several different approved methodologies for a common project type. For example, there are consolidated methodologies for the following types of activity:

- Landfill gas projects
- Generation of electricity from renewable sources
- Substitution of fossil fuels with alternative fuels in cement manufacture
- Use of waste gas and/or heat for power generation
- Coal bed methane and coal mine methane capture and

use for power (electrical or motive) and heat and/or destruction by flaring

- Industrial fuel switching from coal or petroleum fuels to natural gas
- Conversion from single cycle to combined cycle power generation
- Grid-connected electricity generation from biomass residues.

Consolidated methodologies may also include a separate methodology for monitoring.

There is a single methodology (often referred to as the barriers test) for establishing additionality, which is common to all of the approved methodologies, consolidated or otherwise.

By the end of March 2007 48 technology-specific methodologies had been approved by the CDM Executive Board, plus 10 consolidated methodologies, seven for afforestation/reforestation, and 21 small-scale methodologies. Another 100+ were in various stages pending approval.

The 21 methodologies for small-scale CDM can be used only for projects that are either under 15 mW in size (if they involve electricity generation), or under 15 gWh in savings (if they involve electrical efficiency improvements), or under 15 000 tons of CO_2-e emissions reductions for other kinds of projects. These methodologies require a far less onerous approach to establishing baselines, additionality and monitoring, consistent with the fact that they will provide fewer benefits in terms of CERs. They are also permitted to use the same designated operational entity for both validation and verification.

As noted in Section 1, selecting a project that has an approved methodology is one way of substantially reducing risks and ultimately development costs. Each approved methodology (whether consolidated or specific) can be used as a boiler plate for the PDD, since the methodologies are basically formatted in the same way. Each methodology stipulates what its applicability is, so a company can easily determine if a project fits the methodology, or not.

If a project is not covered by an approved or pending methodology, a company will probably need to devote considerable additional time and effort to get the methodology approved before the PDD can be submitted. Estimates of the time-lag between submission and approval of methodologies vary depending on whether the methodology has to be re-submitted or not, but the average appears to be around 8 – 10 months.[14] As the methodology format is basically the PDD format, the PDD will be ready for submission for validation as soon as the methodology is approved.

For convenience in dealing with this complex subject, Annexure 2 contains a list of approved (and pending) methodologies that potentially relate to the mining industry. Included are methodologies for small-scale projects and some that apply to the cement industry, as a number of the Chamber of Mines' member companies are involved in the production of gypsum and limestone for the cement industry.

The methodologies in this annexure are subject to constant revision, so to be absolutely sure of the status of a particular methodology, check the CDM website: cdm.unfccc.int/methodologies.

Additionality

In practical terms, additionality means that carbon credits cannot be claimed for something that would have been done in the absence of the carbon credit revenue. Application of this concept has been facilitated by the Executive Board's publication of an additionality tool, the latest version of which was published in February 2007.

Implementation of the additionality tool is based on a number of steps:

<u>Step 0: Preliminary screening.</u> This step is applicable to projects that were implemented prior to registration with the CDM Executive Board. Such applications must:

- prove that the project started between 1 January 2000 and 31 December 2005[15]
- prove that the CDM was a serious consideration in the justification of the project.

<u>Step 1: Identification of alternatives to the project consistent with current laws and regulations.</u> In this step all realistic and credible alternatives to the proposed project that are allowed within the current legal and regulatory framework must be identified.

<u>Step 2: Investment analysis.</u> A detailed financial analysis of the project and the alternatives identified in Step 1 must be made. If it is found that the proposed CDM project is unlikely to be the most financially attractive, the analysis can proceed to Step 3. If this is not the case, and the barrier analysis in Step 3 indicates that the project faces barriers that do not prevent the baseline scenario from occurring, the project is considered not to be additional.

<u>Step 3: Barrier analysis.</u> The focus is on identifying barriers that will prevent the proposed project, or not prevent the implementation of at least one of the alternatives. The following may be considered:

- Investment barriers
- Technological barriers
- Barriers caused by prevailing practice.

Should there be no barriers to prevent the implementation of the project, and not prevent the implementation of an alternative, the project is not additional.

Step 4: Common practice analysis. The preceding additionality test must be complemented by an analysis of common practice for the technology or activity in question as a credibility check to complement the investment analysis and the barrier analysis.

In practice, the implementation of Steps 1 to 3 are integrated into the normal project approvals framework of the business as indicated in the schematic.

What happens after submission of a PDD?

Submission of a PDD is the first step in the final approval process. Subsequently, the following must be completed:

1. Validation by a designated operational entity
2. Public posting and approval by the DNA
3. Approval by the CDM Executive Board
4. Sale of the registered credits (may be pre-sold)
5. Registration in the pending account of the CDM Executive Board
6. Eventual posting to the national registry of the entity to which the credits are being sold.

For the purposes of this document, the first two steps are the most important and potentially the most time consuming.

Validation refers to the technical review of a PDD by a designated operational entity (DOE). DOEs are independent organisations that have been accredited by the CDM Executive Board to review PDDs. Currently, there are 29 accredited DOEs worldwide, but only one of these is resident in South Africa.[16] Each DOE is accredited only for specific scopes for validation and/or verification/certification. For example, South Africa's DOE is only accredited for validation work on energy industries (renewable and non-renewable), energy distribution and energy demand projects. Companies wishing to obtain validation for projects using specific manufacturing processes, transportation, chemicals or fugitive emissions will, for the time being, have to employ a DOE from outside the country.

The validation process can take anywhere from two to six or more months, depending on whether the DOE requires additional information, or has to undertake a special analysis. During this time, the project developer is free to submit the PDD for approval to the DNA, who will post it on the website for the regulatory 30 days. Thereafter, the DNA will summarise the comments received from the public and ask the proponent to address these. The DNA will also undertake a comprehensive review of the PDD on its own, in particular addressing the project's rating on the country's sustainability criteria. The proponent can use this process as an opportunity to ensure that the PDD is fully updated with regard to public consultation and overall environmental concerns. Once the DOE agrees to validate the PDD, it can be submitted to the DNA for final national approval.

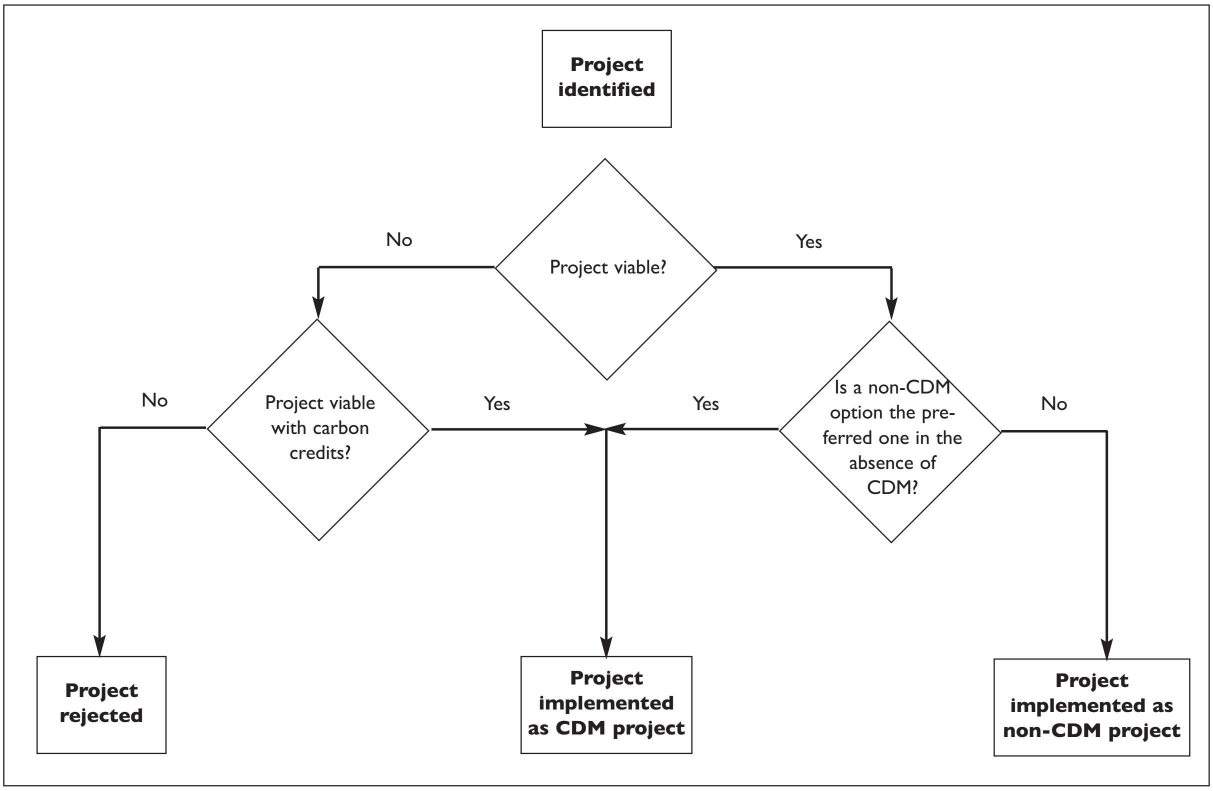


Figure 5: A simplified view of the additionality tool

The remaining steps in this process are currently indeterminate as relatively few projects have moved to the approval/registration stage. Out of 1 800+ projects in the CDM pipeline, only 590 have been registered and only six of these are from South Africa. Generally speaking, South African organisations submitting a PDD for approval can expect a wait of 45 days before the DNA will give approval (assuming the PDD is validated within the period), and another three to four months before CDM Executive Board approval is given and registration requested.

The official DNA approval cycle, including the additional steps required for national approval beyond the basic project cycle outlined in Section 1, is presented in Figure 5.

Summary: The role of engineering managers in CDM project development

The role of the engineering manager is critical, since the bulk of work required is technical. Nevertheless, a successful CDM project will also require input from top management, financial management and the environmental division of a company. As a rule, however, it is the engineering section that has the largest role to play in preparing a PDD and in monitoring the project emissions over time.

Table 1: Example: Calculate CO^2 Emissions from Combustion of Coal

	Value	Units	Source/comments
Calorific value of coal	26.8	GJ/t coal	Witbank sub-bituminous coal
Carbon content of coal	58%		Witbank sub-bituminous coal
Moisture content of coal	3%		Witbank sub-bituminous coal
CH_4 generated from combustion of coal	1	kg/TJ	IPCC
N_2O generated from combustion of coal	1.6	kg/TJ	IPCC
CH_4 generated from coal mining	11.7	kg/t coal dry basis	IPCC
CH_4 generated from coal mining	12.0618557	kg/t coal as mined	
Molecular weight of CO_2	44	kg/kmol	
Molecular weight of Carbon	12	kg/kmol	
Global Warming Potential for CH_4	21	t CO_2e/t CH_4	IPCC
Global Warming Potential for N_2O	310	t CO_2e/t N_2O	IPCC
Conversion efficiency of coal to electricity	34%		Eskom (w/out line losses)
Conversion of GJ to MWh	3.6	GJ/MWh	
% of electricity made from coal in SA	89%		
Tons of coal per TJ	37.31	t coal/TJ	
Carbon content per ton of coal	0.58	t C/t coal dry weight	
CO_2 generated from burning 1t of coal	2.13	tCO_2/tcoal	
CH_4 generated from mining of coal	0.0117	tCH_4/tcoal	
CH_4 generated from combustion of coal	0.000027	tCH_4/tcoal	
N_2O generated from combustion of coal	0.000043	tN_2O/tcoal	
Total CO_2 emissions from combustion of 1 ton of coal	2.39	t CO_2e/tcoal	
Total CO_2 emissions from combustion of 1 TJ equivalent of coal *			
MWh generated from 1 ton coal @ 30% efficiency	89.04	†tCO_2e/TJ	IPCC uses a value of 96 tCO_2/TJ
	2.53	MWh/t coal	
CO_2 equivalent generated per MWh		t CO_2e/MWh generated from coal	
†CO_2 equivalent generated per MWh	0.94		
	0.84	t CO_2e/MWH in the grid	
CO_2-equivalent missions tons/TJ	290.97	t CO_2e/TJ	34% efficiency/10% line losses

* Eskom used a factor of 0.89 to 0.91 t/MWh on average in its annual reports (1999 to 2003)

Section 3

CDM for the financial manager

The carbon market

'...Properly designed market-based regulation has the potential to unlock private ingenuity and capital to solve complex environmental problems. The Kyoto Mechanisms have created an architecture and framework for market-based management of the global atmosphere.'

State of the Carbon Market 2006, World Bank, May 2006.

The basics: carbon emissions as a market

As the quotation suggests, the Kyoto Protocol has effectively created a market for greenhouse gases, based primarily on the commitments made by the industrial or Annex 1 countries.[17] The value of this market is determined largely by the shortfall in allowances or caps set by these countries for their polluting industries – that is, by their anticipated failure to meet the emissions limits to which they have agreed. To meet these shortfalls, emitters are allowed to purchase a certain percentage of emissions credits from emissions reduction projects in either other industrial countries (called joint implementation) or in developing countries (the CDM). Alternately, they can purchase credits directly through various emissions trading schemes that have emerged.

Carbon as an asset

From a South African mining company perspective, the major effect of Kyoto and the CDM has been to create a new kind of asset: carbon emission reductions. This asset currently has no place on the balance sheet of a company, since until recently, there has been no accepted way to value it or even to estimate how many such assets a company may have.

This situation is changing rapidly. Carbon dioxide emissions credits are now traded on several national and international markets and, to a limited extent, there is fungibility – though not necessarily equivalence in value – between the different credits being traded. More important, a basis for valuing emissions reduction credits is gradually emerging, and methods to assist companies in handling opportunities for developing CDM projects on the one hand, and mitigating climate change risk on the other, are also available.

The credit that is produced by CDM projects in developing (non-Annex 1) countries is called a certified emission reduction (CER). As with all other credits, it is defined as one metric ton of carbon dioxide emissions, or the equivalent in other greenhouse gases. The asset created by CDM is thus the total CERs reduced or avoided by a particular project or activity, over a period of time defined as the crediting period.

Other types of carbon credits

- *An allocated allowance unit (AAU) is the unit required by Annex 1 governments to comply with their Kyoto Protocol targets*
- *An emissions reduction unit (ERU) is the credit generated under a joint implementation project, located in an Annex 1 country*
- *An European Union allowance (EUA) is the credit generated by any surplus in the allowances provided to major industrial and utility emitters in the European Union*
- *A verified emissions reduction (VER) is a project credit not certified for Kyoto compliance purposes, but verified according to a sales contract, i.e. it is created by emissions reduction activities carried out on a voluntary basis, perhaps to meet corporate goals independent of Kyoto.*

What is the value of a carbon credit?

Carbon credits are valued by transactions, that is, they are purchased by organisations needing them either to meet their allowances/caps, or to satisfy an internal requirement to improve their carbon emissions footprint. Their precise value, therefore, depends on two factors:

- the specific circumstances of the transaction, i.e. who is buying and why; and
- the state of the market into which they are being sold.

In principle, CERs have special value because they are the only credit that can be exchanged with all other credits. In practice, however, this does not necessarily mean that they have the same value as these other credits – a fact often misunderstood, to the detriment of corporate financial planners. As an example of this misunderstanding, many CDM project developers around the world have assumed that the value of CERs will increase over time as do other markets, but especially the EUA market, which is today the largest single market for carbon transactions, creating a demand for purchase of CERs to meet allowance shortfalls.[18] Developers have assumed that there would be convergence in the value of these two kinds of credit, with the convergence occurring at the upper end of the EUA price spectrum. In the second quarter of 2006, this assumption was challenged by a sudden and dramatic fall in the value of EUAs.

The flaw in this thinking is explained by the specific characteristics of the two kinds of credit. The price of an EUA includes the full risk of non-delivery – that is, it is nothing more nor less than a compliance tool and its delivery is in a sense guaranteed. Put another way, parties purchasing an EUA know that they are purchasing an actual allowance from another European entity, which can then be used directly to meet their own compliance needs.

The CER, by contrast, is a project-based credit, and as a result has a substantial delivery risk. CERs can fail to be delivered for all kinds of reasons, from technical faults in the project design through changes in production activities to poor management of the company delivering them. In a competitive market in which several kinds of credit are available, CERs will tend, over time, to have a lower value than guaranteed compliance credits such as EUAs – unless there is a substantial shortfall of compliance credits, combined with greater certainty of delivery for CERs.

CERs are also different from voluntary markets (VERs). VER credits may be purchased to offset a company's carbon footprint or to stimulate the market for carbon overall (as the World Bank does when it purchases credits essentially to retire them[19]). The VER market is informal and ill-defined and can only be accessed via direct links to potential buyers.[20] At the same time, many experts think it will continue to grow and will eventually exceed the market for CERs, ERUs and compliance credits.

With all these complexities, how does a financial manager determine the value of CERs generated by the company's CDM projects, or the opportunity cost of not developing such projects?

A simple answer would be to watch the markets. However, CERs are not actually traded on a market as yet, because very few CDM projects have been registered and in any case there is no international registry where purchased credits can be placed for future trading. So while the price of CERs is responsive to market factors, most purchases take place on a one-to-one basis between an interested buyer (sometimes involved in the development of the project) and a project owner.

Despite the private nature of most CDM sales transactions, some brokers and asset managers active in the carbon finance field publish information on purchases of CERs, based on surveys of project developers and national entities. These surveys suggest two things:

1. That the price of CERs has generally settled into a range of from €5 – €10/ton of CO_2-equivalent. This figure accounted for a high percentage of transactions in this market from 2005 through the first quarter of 2007.
2. A few transactions have been recorded at higher prices, but most of these are either purchases on VERs or purchases having special sustainability value and therefore a lower risk. Most of these are spot market transactions rather than averages over time.

By comparison, the EUA market saw prices as high as €31/ton of CO_2-equivalent in early 2006, although this fell to €9 at the end of April 2006 and at the time of writing had settled at around €2-3/ton. This extreme volatility is typical of allowance markets, and is mirrored in the experience of markets for emissions reductions of sulphur dioxide and nitrogen oxides in the United States and some of the early carbon markets in European countries.

The price of CERs has not imitated the European market's volatility, suggesting that this is viewed as a different kind of carbon credit and that its price will be determined by the specifics of project delivery risk, as well as country and technology risk. At the same time, continued price uncertainty in the EUA market will probably influence CER prices in the longer run.[21]

When and how should CERs be sold?

Selling credits at the best possible price is critical to the success of a CDM project. There are at least two basic models for the sale of CERs, and a multitude of purchasing arrangements.

By far the largest number of CER sales occur on what is referred to as a unilateral basis. Thus projects are implemented in a developing country by a local entity, such as a mining company, and then sold directly to an entity in an industrial country to help it meet the caps imposed by its government to meet national Kyoto commitments.

The Kyoto Protocol also provides for bilateral arrangements, in which a buyer from an industrial country both finances and helps to develop a seller's project. Although originally expected to be a major source of capital flow and technology transfer between industrial and developing countries, such arrangements have been relatively rare. However, if a bilateral arrangement is entered into, then the sale of credits is usually determined as part of the arrangement, i.e. some or all of the credits are sold to the industrial country entity, which has invested in the project, and the terms of this sale are set in advance.

The sale on unilateral projects is most often made through an intermediary, either a broker or asset manager, or an industrial country government interested in purchasing credits that can then be used to reduce its Kyoto commitments, or in some cases an international organisation such as the World Bank.

Selecting the optimal method for sale of credits may significantly increase their asset value. This is a key issue for a developer/owner, since development of a CDM project involves huge front-end costs, which are often not recovered for some years. Several options exist, each having advantages and disadvantages:

1. <u>Owner sale.</u> An owner and/or developer may decide to hold on to the potential credits, hoping to sell them

directly on a spot market, arguing that the value of the credits is likely to increase in the long run, justifying any front-end expenditures on the developer's part. As these expenditures can run into hundreds of thousands of rands, such a strategy is only practical for well-established companies with substantial assets and retained earnings. This option means that a seller is shouldering all the price risk which, given the current uncertainties around Kyoto's future, may be considerable. The value of these credits in the future has to be discounted using the standard corporate discount rate.

2. Developer payment. If a project developer is a different party from the owner, arrangements can often be made for a developer to shoulder some or all of the front-end costs in return for a portion of the credits, which the developer can then sell to recover costs. A number of independent CDM project developers are currently working in South Africa, some with links to international organisations that can also provide project financing. Some developers are offering turnkey arrangements where full responsibility for implementing the project is assumed by the developer in return for a full share of the CERs. This option is one of the most attractive for sellers, since it involves substantial risk sharing and in some cases transfers the whole risk to the developer.

3. Fund buyers. Private or public fund buyers can provide emission reduction purchase agreements (ERPAs) that allow coverage of all or part of the front-end costs, which are then reflected in the price for the CERs. In addition to reducing initial investment costs, this has the advantage that an owner is guaranteed a fixed value for the credits generated by the project, and can often use this as a form of collateral to attract other financing. It has the disadvantage that the credits will be sold at a value determined by today's market, which may or may not be a benefit. However, fund managers will sometimes develop ERPAs that allow for renegotiation of the sale price if prices improve substantially, or for a buy-back of some of the credits at a set increment or penalty, regardless of market price.

4. Brokers. Selling to a broker is also an option. These are organisations that specialise in carbon market transactions, charging a commission on the final value of the transaction – typically around 7%, but often negotiable. Buyers identified by a broker may include a wide range of types: pools or funds, individual companies seeking allowance credits, or even companies seeking VERs. The advantage of using a broker is that a seller theoretically gets the best price possible, while minimising its own costs for locating buyers. The disadvantage, aside from payment of the commission, is that the seller sacrifices some control over the terms of the sale.

It should be noted that Table 2 includes only a sampling of fund buyers, for example the World Bank has a total of nine funds under management, totalling over US$1-billion in assets, while large private fund managers like Natsource will have more than one fund to manage. Some fund buyers and asset managers have offices in Africa.

Table 2: Examples of carbon fund buyers

Funds	Institution/operator	Type of fund	Contact details
Greenhouse Gas Credit Aggregation Pool (GGCAP)	Natsource Asset Management Inc.	G-CAP) is the world's first private sector mechanism that will purchase and manage delivery of a large pool of greenhouse gas (GHG) emission reductions (ERs) that buyers can use to comply with emission reduction requirements.	www.natsource.com info@natsource.ca Phone: +1-403-215-5587
Prototype Carbon Fund (PCF)	World Bank/DBSA	As the first carbon fund, its mission is to pioneer the market for project-based greenhouse gas emission reductions while promoting sustainable development and offering a learning-by-doing opportunity to its stakeholders.	www.carbonfinance.org Local: Development Bank of Southern Africa, Phone (27 11 313-3159
Community Development Carbon Fund (CDCF)	World Bank/DBSA	The CDCF provides carbon finance to small-scale projects in the poorer areas of the developing world.	www.carbonfinance.org Local: Development Bank of Southern Africa, Phone (27 11 313-3159
Millennium Development Goals Carbon Facility (MDGCF)	UNDP	Pooling approach to ensure a balanced portfolio of offset projects delivering multiple environmental and development benefits.	Energy and Environment Group, Bureau of Development Policy(212) 906 5705 dgcarbonfacility@undp.org
Cleantech Fund	Ecoenergy Carbon Brokerage	Private equity fund, focused on Latin American projects	1925 K Street, NW, Suite 230 Washington D.C. 20006 USA Tel: 202.822.4980 Fax: 202.822.4986
ICECAP	ICECAP Carbon Portfolio	Private sector hedging vehicle	5 – 8 The Sanctuary London SW1P 3JS United Kingdom Tel: +44 (0)207 3400910 Fax: +44 (0)207 2223139
Sterling Waterford	Sterling Waterford Securities	Derivatives Fund	Liesbeek House River Lane, Mowbray 7700, RSA Tel: 083-459-7272

Table 3: Examples of carbon brokers/traders

Company	Type of broker/trader	Contact details
CO_2-e LLC	Primarily a broker/trader, with special interest in renewable energy projects	CO_2e Limited One Churchill Place, Canary Wharf London E14 5RD, UK Ph: +44 20 7894 8333 Fax: +44 20 7894 8334\ www.co2e.com
Ecosecurities Group PLC	Brokerage and trading, but also active in project development including several South African projects	EcoSecurities Group plc Regus House, Harcourt Rd Dublin 2, Ireland Tel: +353 1 477 3431 Fax: +353 1 402 9590 www.ecosecurities.com
Natsource LLC	Asset management involving a range of different funds (see GGCAP above)	Headquarters 100 William Street, Suite 2005 New York, NY 10038 Tel: 1 212 232 5300 Fax: 1 212 232 5353 www.natsource.com
Evolution Markets LLC	Broker/trader with special interest in environmental and energy markets	Headquarters 10 Bank Street White Plains, NY 10606 Tel. +1 914.323.0200 Fax +1 914.328.3701 www.evolutionmarkets.com

How is carbon put on the balance sheet?

Because the value of carbon is difficult to determine in advance, treating it as an asset on the balance sheet is problematic. Ultimately, a set of potential projects or activities that can reduce carbon emissions must be identified and then assigned probabilities. If a company has a broader mandate, for example to reduce its carbon footprint to improve its overall environmental performance, then projects or activities that reduce emissions can be included regardless of whether or not they are expected to qualify for CDM. CDM projects bring added value to the asset side of a balance sheet, because they will ultimately attract buyers of the resulting CERs. By comparison, non-CDM projects may only bring reduced environmental impact and perhaps some savings in energy or other resource use.

As a rule, the carbon credits generated will vary in price according to:

- the technologies employed, and whether they represent a known method of emissions reduction or one that is relatively untested
- the time at which the emissions will be achieved (any emissions produced post-2012 will have a lower value than those produced pre-2012, because of the uncertainties surrounding the second commitment period of Kyoto)[22]
- the country in which the project is located. As South Africa is a relatively stable and modern country, credits generated locally will tend to have a higher value than credits generated in, say Angola or Zimbabwe
- the perceived delivery risk, which is a function of many of the above factors as well as the reputation of the project owner/developer.

This means that credits sold for a high-risk project will be valued at the lower end of the spectrum – €3 to €4 per ton – while credits from the same project that will only be issued in 2013 will have an even lower value, even if it is possible to sell the credits, other than on a rights-of-first-refusal basis. By comparison, credits sold for projects involving mitigation of high-value greenhouse gases, such as nitrous oxide, may sell closer to the top of the range – €8 a ton or more, providing that the project uses an approved methodology. A few projects with excellent sustainability credentials, such as those awarded the Gold Standard[23], may exceed this amount, particularly if they are sold to the VER market. Table 4 lists the factors that may lead to low and high prices for CERs. These include such technical factors as whether a project requires a new methodology or has developed a full project design document, as well as contractual and financial issues such as whether there are penalties for non-delivery of credits and whether or not the developer/owner has a good credit rating.

It is important to recognise that carbon can be a liability as well as an asset. If a company (or perhaps its head office in Europe or North America) has embarked on a programme to reduce greenhouse gas emissions, or if it has locations that either now or in the near future will be subject to regulation on greenhouse gas emissions, then the current levels of greenhouse gas emissions may have to be treated as a liability. Issues around reporting of a company's carbon emissions footprint/inventory are discussed in Section 4.

Another consideration from an accounting point of view is that until recently there have been no accepted accounting principles governing carbon assets. This is changing: a set of generally accepted carbon accounting principles (GACAP) have been developed by an organisation called the Carbon Disclosure Project (www.cdproject.net), and a similar protocol can be accessed on the website of the GHG Accounting Protocol (www.ghgprotocol.org).

Crediting periods and ERPAs

Any decision to sell carbon credits, or agreement to sell them in future, will be tied to a specific time period during which the project is expected to be registered, and to the credits made available for sale. The exact period during which emissions reductions will be claimed, as well as other terms such as the price per CER and the variations in emissions reductions (if any) during the period, are stipulated in an emissions reduction purchase agreement (ERPA). Templates for the agreement can be downloaded from the website of the International Emissions Trading Association (www.ieta.org).

The basic period during which emissions reductions will be implemented is referred to as the crediting period, and this is specified in the PDD for each project. All CDM projects are required to select one of two crediting periods, either a single 10-year period or three seven-year periods (21 years in all). While this selection is based primarily on technical considerations, i.e. on the probable duration of the project, it also affects the number of verification visits, which are an added cost to the project.[24]

Regardless of duration, ERPAs rarely provide a basis for the purchase of CERs during the full crediting period. This is because the Kyoto Protocol currently supports the sale of CERs only for the period from 2008 – 2012. Negotiations for a second commitment period post-2012 are underway, but are unlikely to be concluded before 2007 and possibly later. This means that if a project is being developed for implementation in 2007, the maximum period covered by the ERPA is likely to be five years.

Managing financial risk in the CDM arena

As with any other investment project, CDM involves an assumption of risk by a company that must be evaluated and become part of a company's overall risk profile. As the above discussion of purchase strategies suggests, purchasing CERS – as opposed to buying allowances through a national or regional market – is seen by many buyers as inherently risky. While CERS can be viewed as tangible project outputs, the amount and timing of CERs produced by a specific project can be significantly affected by human error or misjudgment, not to mention technological failures.

Table 4: CEPR price fluctuations

Factors favouring a low price

- Only a PIN available
- Project developing new methodology
- No host government approval
- Poor credit
- Project not registered
- Flexible CER delivery schedule
- No punitive damages
- Unilateral
- Upfront payment
- Payment upon CER
- Issuance into pending account

Factors favouring a high price

- PDD available
- Approved methodology
- Host government approval
- Strong project partners, technology supplier
- Good credit
- Ability for buyer to become a Project Participant (multilateral)
- Project registered
- Guaranteed delivery schedule with punitive damages for non-delivery
- Payment on delivery into buyer's national registry account

By permission of: Natsource Asset Management Inc, 2006

To manage risk, buyers usually include in the ERPA a provision for non-performance by the seller and also for variations in emissions outputs that are the fault of neither party, but judged likely to occur because of technology or local factors. The risks are often reflected in the pricing, rather than being tied to specific penalties, but there may also be provision for some kind of compensation by the seller in the event of non-delivery.

For an owner/developer of CDM projects, there are several ways of dealing with risk in developing a project:

- It is possible to insure some types of project against specific forms of non-performance, for example climate variations in the case of wind energy projects
- If a buyer is agreeable, some CERs can be held back as a hedge against price variations on the world carbon markets
- Some buyers may be willing to allow an owner to buy back some of the CERs at a small premium.

For a more detailed discussion of risk management strategies and the financial aspects of CDM, consult the references listed in Annexure 3.

Section 4

CDM for the environmental manager

The Challenge

Global climate change is possibly the greatest environmental challenge facing the world this century....The developing world faces greater challenges than the developed world, both in terms of the impact of climate and the capacity to respond to it....There could be benefits to be derived from adopting a future strategy that is designed to move the economy towards a cleaner development path...

A National Climate Change Response Strategy for South Africa, Dept of Environmental Affairs and Tourism, September 2004

CDM and the environment

Greenhouse gases are a global rather than a local pollutant therefore reducing them by developing a CDM project confers no direct benefits on the local environment. Nevertheless, there are many co-benefits that derive from greenhouse gas reduction, and many ways in which reductions may affect the overall environmental performance of a company. Corporate environmental managers need to be aware of the following facts about CDM:

1. CDM projects themselves will almost certainly require a preliminary environmental assessment, and this may, in some cases, lead to a formal EIA
2. Reducing greenhouse gas emissions through CDM projects will often have secondary environmental benefits that may assist companies in meeting the conditions of their emissions permits
3. CDM project development in particular, and greenhouse gas mitigation in general, should be integrated with overall corporate environmental and sustainability reporting.

This section examines three issues: environmental assessment as it relates to the CDM project cycle; the possibility of secondary or co-benefits; and the linkages to corporate reporting. A detailed explanation of the source and impacts of the six major greenhouse gases is included in Section 2.

CDM and environmental management

The CDM project cycle (outlined in Sections 1 and 2) includes a number of specific steps where input from environmental managers may be required.

Step1: Measurement of greenhouse gas emissions, if required by the PDD. The development of a CDM project requires that the developer establish an emissions baseline – the historical emissions from a selected facility, technology or process. In some cases, this information is derived inferentially from performance data, such as the production of carbon dioxide, methane and nitrous oxide from the combustion of fuel or coal used by the affected process or system. In a few instances, it might be necessary to measure actual emissions, for example methane from digesters, nitrous oxide from a chemical process or perfluorocarbons from an aluminium smelter. Once established, the baseline provides a foundation for measurement of emission reductions of the same gases.

Step 2: Development of a monitoring plan for ongoing verification of emissions. The PDD also requires the establishment of a plan for monitoring emissions on a recurring basis. In the case of flue gas emissions from the combustion of alternative fossil fuels or biomass, this can usually be satisfied by tests to establish the calorific value of the new fuel, perhaps augmented by standard efficiency tests to measure flue gas temperature, flow rate and either O_2 or CO_2 levels in the flue gas. In the case of direct emissions from processes, a methodology to provide regular gas sampling will be required. The resultant monitoring plan will be subjected to validation by the operational entity, which performs the validation of the project, and by a separate operational entity during later verification.[25]

Step 3: Preliminary assessment of environmental impacts to meet DNA requirements. Both the CDM Executive Board and the South African Designated National Authority have set conditions for environmental assessment of CDM projects. The Executive Board's requirements are set out in the template for the PDD, Section F, which requires the proponent to indicate whether or not the host party (i.e. the South African government) requires documentation of the environmental impacts of the project, and if so, how this will be determined. If an EIA has been conducted as a result of this requirement, a summary of the results of the EIA must be included. The DNA, on the other hand, requires a more detailed accounting before national approval for the project is granted. These requirements, which are part of the overall sustainability criteria for CDM projects in South Africa, are referred to in Annexure 4, and may also be accessed on the DME website.

Step 4: Preparation of an environmental impact assessment if required by statute. If a full EIA needs to be undertaken, either as a result of local, provincial or national requirements, the results must be incorporated into the PDD. This requirement can add substantially to the cost of PDD development, and may force significant changes in the CDM project itself, as happened recently with the Durban Landfill Project.[26]

Step 5: Public consultation on both environmental and socio-economic impacts. Section G of the PDD requires that all CDM projects assess stakeholder comments and report on these at three levels:

- How the comments were invited and compiled
- A summary of the comments
- A report on how due account was taken of the comments received.

As a rule this activity would be supervised by a corporate environmental or sustainability manager.

Secondary benefits

Because CDM projects can include a wide range of emission reduction activities, their impact on the environment is extremely variable. For example, some emissions reduction activities involve a change in the efficiency of combustion or the type of fuel used. Such changes will normally reduce other atmospheric pollutants, for example reducing the consumption of coal or fuel oil in industrial boilers through improved efficiency will invariably result in parallel reductions in NOx and SOx, as will the substitution of natural gas or most forms of biomass.

Similarly, reducing carbon dioxide emissions indirectly through reduced electricity use will reduce other pollutants produced by South Africa's primarily coal-fired generation system – although this impact will be felt nationally rather than locally.

Finally, process changes may bring about substantial air quality improvements, although in many cases the process change only reduces the specific greenhouse gases being targeted (for example when nitrous oxide emissions are reduced, other NOx are not affected).

In assessing the secondary environmental impacts of greenhouse gas reduction, it is important to remember that specific removal of SOx and NOx is often achieved by specialised technologies unrelated to the rate of combustion, such as electrostatic precipitators, wet and dry scrubbing, and flue gas desulphurisation. These technologies generally remain effective when fuel consumption is decreased through efficiency measures, although extractive efficiency itself may be altered – thus the slight parallel emissions gains realised when greenhouse gas emissions are reduced may be offset by other factors.

The example gives a rough rule-of-thumb for estimating parallel emissions from electricity generation, and hence emissions reductions from a CDM activity. Emissions from combustion and process sources can be developed using standardised emissions factors from the IPCC and other sources.[27]

Example

In South Africa, emissions from electricity delivered to the end-user are:

CO_2: 250 tons per TJ (higher if other greenhouse gases are included)

NOx: 1.005 tons per TJ

SO_2: 2.28 tons per TJ

Source: Eskom Annual Report, 2003

The impact of greenhouse gas emissions reductions is also important for a company's efforts to meet local atmospheric emission standards, particularly as the standards become more stringent following implementation of the Air Quality Act. This issue cuts both ways – reducing greenhouse gas emissions may result in reduced emissions of other pollutants; and meeting national standards for pollutants caused by, for example, fossil fuel combustion may reduce greenhouse gas emissions. The interaction between these two goals and their link to the Air Quality Act and CDM are detailed in the text box below.

The Air Quality Act and greenhouse gas emissions

The development of local permitting systems for atmospheric emissions is now being augmented in South Africa by a set of minimum ambient standards, outlined in the Air Quality Act, 2004.[28] Point-source licensing will continue under the new regime, but based on ambient standards given in parts per million for a wide range of atmospheric pollutants, including SOx, NOx, lead and particulates. It does not provide standards for any of the six greenhouse gases, for the simple reasons that they are not local pollutants and South Africa is not required to limit greenhouse gas emissions as it is a non-Annex 1 party to Kyoto. This does not preclude future limits on greenhouse gas emissions in the next phase of Kyoto or even self-imposed standards.

It is almost certain that South Africa, along with several other developing countries with relatively high emission intensities, will agree to accept some limits on greenhouse gas emissions after 2012, and that plans to do so may be vetted well before that time. Recognising this prospect, some people have suggested that companies implementing CDM projects now will naturally tend to focus on the 'low-hanging fruit', and leave the more costly and more difficult projects until later when they have to bear the full cost of implementation themselves.

This argument is compelling but makes little real sense. For one thing, the rules of CDM actually make it more difficult to undertake the most cost-effective projects, because such projects are financially attractive anyway and may therefore be precluded on grounds of non-additionality; so CDM can actually help companies undertake projects that would otherwise be *financially marginal. For another, the eventual acceptance of greenhouse gas caps by South Africa will probably be done in the context of an emissions trading system like that in the EU, which means that, in theory at least, companies should be able to buy emissions credits at a lower price than their own marginal abatement costs. Finally, the value of pursuing projects now – when emissions credits are readily saleable – probably outweighs the value of deferring projects until some indeterminate future date when projects may be required to meet regulatory standards.*

Corporate/sustainability reporting

Many companies in the mining sector have in recent years undertaken to report annually on their sustainability performance. The main motivation for sustainability reporting is the need to demonstrate corporate social responsibility. Sustainability reporting typically involves providing information on a much wider range of activities than the purely environmental. However, sustainability reporting most often falls within the portfolio responsibilities of corporate environmental managers, and it is thus important to understand how this responsibility relates to the development of CDM projects and greenhouse gas mitigation.

Most of the major mining houses in South Africa have produced basic measurements of their carbon footprint, i.e. the extent to which their activities are responsible, directly and indirectly, for the emission of greenhouse gases. This has been done through several mechanisms:

1. Adherence to CDP principles
2. Use of the Greenhouse Gas Reporting Protocol developed by the World Business Council for Sustainable Development and World Resources Institute
3. Adoption of the Global Reporting Initiative[29]
4. Voluntary reporting protocols based on sector-specific standards such as those being developed by the World Business Council for Sustainable Development and International Institute for Environment and Development (IIED) under the Mining, Minerals and Sustainable Development Initiative[30]
5. Internal corporate mandates, for example inclusion of sustainability reporting within, or linked to, annual financial reporting.

Greenhouse gas mitigation projects, including CDM projects, provide an opportunity to improve the corporate carbon footprint and as such the potential of these projects needs to form part of the corporate reporting structure as actual or potential assets. To do this, the carbon mitigation potential of various capital projects and operational/maintenance activities must be identified – an issue addressed in Sections 1 and 2. Although there is no need to rank such projects exclusively on the basis of their carbon mitigation potential, knowing how the implementation will affect the corporate carbon footprint should be a crucial part of overall corporate environmental planning and reporting.

Conclusion

Although the role of environmental managers is crucial to the CDM process, their involvement is often limited because the development of CDM projects tends to focus on engineering and financial aspects. By ensuring that environmental managers have a more proactive role in the project cycle, companies can often limit the risks that accrue from developing projects that fail to meet the national sustainability criteria or local, provincial and national emissions permitting requirements.

Annexure 1

Case studies of CDM projects from the mining and minerals beneficiation sector

The aim in this section is to illustrate the implementation of CDM projects through the use of a series of case studies. It offers examples of projects proposed and implemented from the global mining and minerals processing industry.

The projects presented were selected on the grounds of their relevance to mining and minerals processing operations and their contribution to an understanding of the CDM regulatory regime. The selected projects cover three key areas:

- minerals processing
- iron smelting
- mine methane mitigation.

The information in this section was taken from documents available in the public domain at the end of April 2006. Sources of information include the CDM Executive Board website[31], the websites of project validators[32] and the UNEP RISØ CDM project pipeline[33].

Case study 1:

Low-grade ore beneficiation by Rajasthan State Mines and Minerals Limited

The Rajasthan (India) project was selected as a case study as it offers a good example of the implementation of some of the principles of greenhouse gas emission reductions and the CDM in a minerals processing project. The principle conveyed by this case study is that the specific energy consumption of a mining and minerals processing operation can be used as the metric for the implementation of a CDM project.

The Rajasthan project reduces the energy consumption of the operation expressed in kilowatt hours (kWh) per ton of ore by 8%. As there is a direct link between energy consumption and greenhouse gas emissions, the project is a candidate for carbon credits through the CDM.

This is a small-scale project and the case study therefore highlights the reduced regulatory requirements of small-scale projects. It also illustrates the risk of proving additionality in CDM projects, since it was implemented prior to registration as a CDM project. The project carries a significant regulatory risk.

As it is still in the validation stage, it is impossible to comment on whether or not the project will be registered by the Executive Board.

Project description

The description of the project is based on the information presented in the PDD. The template for small-scale projects was used by the project developer[34].

It is based on reducing greenhouse gas emissions from a mining operation at the Jhamakarota Mine. Implementation of new technology resulted in a reduction of energy consumption in the mining and minerals processing operation. An energy saving of 8%, or 15 kWh per ton of ore was achieved.

The project was commissioned in December 2003, and yielded a reduction in greenhouse gas emissions of 2 102 tons of CO_2e in the 2003/2004 financial year. The project documentation was however only submitted for validation in December 2005[35].

Prior to the implementation of the project, the operation worked on the following basis. Phosphate rock with a P_2O_5 content in excess of 31% was mined, crushed and sold into the market. Significant amounts of low-grade ore were extracted with the overburden and discarded to waste. The low-grade ore has a P_2O_5 content of around 17%. There is no commercial application of the low-grade ore.

The project is based on implementing new technology to upgrade the low-grade ore to marketable material containing P_2O_5 in excess of 31%. A hydro-metallurgical process is used to achieve a recovery efficiency in excess of 80%. The net result of the utilisation of the new process to exploit the low-grade ore is a reduction in the electricity consumption of the operation per ton of ore processed. Electricity consumption for the high-grade ore process is 54 kWh per ton of ore and electricity consumption of the low-grade ore is 39 kWh per ton. The project increases the capacity of the plant from 1 500 tons/day to 3 000 tons/day using the new low-grade ore process. The project is compared to a baseline that considers the plant expansion using the old technology to process high-grade ore to achieve the same increase in capacity (1 500 to 3 000 tons/day). In practice, this explanation of the baseline may cause problems, as it is not clear why the baseline activity would use high-grade ore and the higher 54 kWh per ton consumption rate.

The operation draws electrical power from the Northern Indian grid. As the main source of power for this grid is coal fired power stations, the emission factor is relatively high. The project claims an emission factor of 0.77 tons of CO_2e/mWh.

The total electricity saving of the project is 8 400 mWh a year. This translates into an emission reduction of 6 400 tons of CO_2e a year.

The project has a crediting period of seven years with two possible renewals.[36]

Methodology

To make the CDM more accessible and less onerous to the developers of smaller projects, the regulatory framework of the CDM makes provision for what it terms small-scale projects. The eligibility criteria for small-scale projects are specified by the Executive Board and have been explained in Annexure 2.

A project qualifying as a small-scale project may use one of a number of methodologies approved by the Executive Board. These methodologies are generally much less onerous than methodologies of normal projects. For example, a normal methodology consists of between 50 and 100 pages for the baseline, monitoring and verification methodologies. In the case of a small-scale the methodology will normally require only two pages.

The Rajasthan project qualifies as a Type (ii) (Energy efficiency) project as its emission reduction of 8.4 gWh a year is less than the limit of 15 gWh a year.

Baseline

One of the most important aspects of the definition of a CDM project is the definition of the project boundaries. In this case the project boundary is taken as the physical site on which the project is implemented.

The baseline of the project is taken as the electricity consumption in the business as usual scenario, i.e. 54 kWhr per ton of ore. This amount is multiplied by the emission factor of the North Indian electricity grid from which the project draws it power to get to the greenhouse gas emissions in the baseline scenario.

No provision is made for leakage in this project.

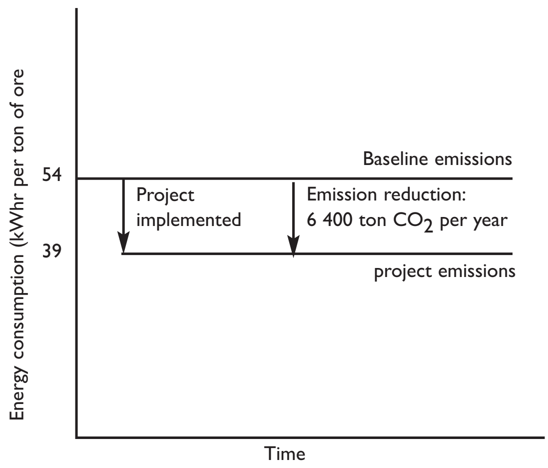


Figure 6: Rajasthan project baseline

Monitoring and verification

Monitoring and verification is important in a CDM project as it forms the basis on which the amount of CERs issued by the Executive Board is calculated. In drafting a PDD extreme care must be taken to ensure that the correct variables are specified for measurement. Measurements must be defined in a way that will ensure the integrity of the data generated and the auditability of the process. A number of new methodologies and project applications have failed because of deficiencies in the area.

The approved methodology used here requires the monitoring and verification of the annual amount of the emission reduction achieved by the project calculated as the difference between the electricity consumption in the base case less the actual amount consumed, as measured, multiplied by the production as measured.

Contribution to sustainable development

The project's developers list the following as being its contribution to sustainable development under the criteria developed by the Indian government.

- The utilisation of low-grade ore contributes to a reduced demand for ore. Thus ore reserve will not be depleted as fast as would have been the case if low-grade ore was not used
- The reduction of electricity consumption by the operation reduces the environmental impact of electricity generation. It also lessens the dependence on fossil fuels.

Contributions will have to be approved by India's DNA.

Additionality

Even though the Rajasthan project was already implemented in 2003, it only made it into the CDM pipeline by December 2005. The concession to apply for project

Table 5: Rajasthan project monitoring and verification plan

ID Number	Data type	Data variable	Data unit	Measured (m), calculated (c) or estimated (e)	Recording frequency	Proportion of data to be monitored	How will the data be archived?	For how long is archived data to be kept?	Comment
1	Electricity consumed from the regional electricity grid	Electricity	kWh	m	Monthly	100%	Electronic & paper	Two years beyond crediting period	
2	Consumption of electricity per ton of LGO beneficiation	Electricity	kWh	c	Monthly	100%	Electronic & paper	Two years beyond crediting period	
3	Ore beneficiation	Production	Ton	m	Daily	100%	paper	Permanent	

registration retrospectively was made in terms of Decision 17/CP.[37] The reason for the decision was to allow people who started projects in anticipation of the implementation of the Kyoto Protocol to claim credits for such projects. Refusal to do so would amount to punishing them for the delays in the implementation of the Protocol. This concession was extended at the 11th Conference of Parties (COP11) held in December 2005 in Montreal. The new cut-off date was 31 December 2006.

Additionality in the Rajasthan project is argued on the basis of technological and financial barriers.

- Technological barrier: The project developers argue that the novelty of using the hydrometallurgical process in the beneficiation of low-grade phosphate ore presented a technological barrier to project implementation
- Financial barrier: It is argued that, even though the IRR of the project is 28.75%, it is extremely sensitive to sales volumes. A small fall in sales volumes will result in a dramatic reduction of the project returns. The revenue from the CERs must, therefore, help mitigate the financial risk in the project.

The latter argument is somewhat suspect. To convince a validator the company would have to show that the baseline itself is not sensitive to sales volumes, or in other words, that this financial barrier does not prevent the continuation of the baseline activity as opposed to the project activity.

Project implementation

The project is still in the validation stage. Following successful validation it will have to be posted on the Executive Board website and will be registered if no review is requested. As no comment on the validation of the project is available, it is appropriate to highlight some of the issues raised.

1. The implementation of the project prior to registration coupled with the relatively high internal rate of return makes for a questionable additionality argument. Should the project registration not be successful – this will probably be the reason
2. The principles illustrated in the case study with respect to the use of the specific energy consumption of a minerals processing facility is sound
3. The developers have not demonstrated that the financial barrier does not prevent the implementation of at least one of the alternatives (the baseline). Ideally, they should be able to prove that the baseline is not sensitive to sales volumes.

Case study 2:

SESA waste heat recovery-based power generation

The SESA waste heat recovery-based power generation project was selected as a case study as it illustrates an opportunity that exists in South African operations, particularly those involved with the production of ferro and other alloys. The project involves utilisation of furnace off-gas for the generation of power. In South Africa, there are similar opportunities in the steel, ferro alloy and ilmenite smelting industries. A number of South African companies have evaluated similar projects and found that they are not financially viable. The contribution made by carbon credits to the finances of these projects could alter this picture.

Project description

The project is based on the reduction of greenhouse gas emissions through the recovery of energy from waste heat in a plant producing pig iron and coke. The PDD[38] lists the sources of combustible gas in the steel making plant as being from two sources.

- During the reduction of iron ore to metal carbon monoxide (CO) gas is formed according to the reac-

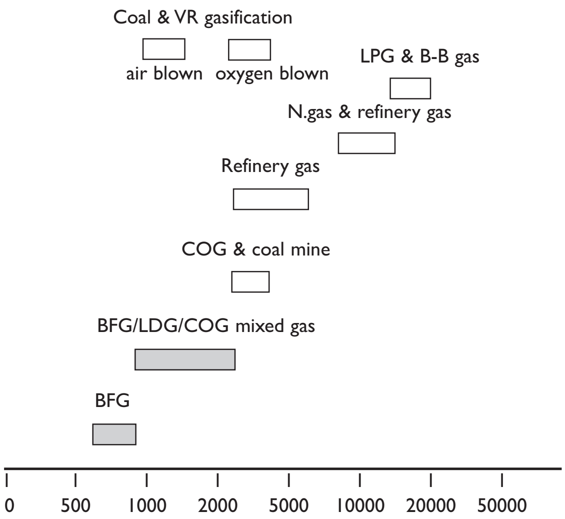


Figure 7: Offgas calorific values

tion: $Fe_2O_3 + C \rightarrow 2 Fe + 3CO$. The CO comes from the blast furnace gas (BFG).

- Coke is manufactured by driving the volatile compounds from coal at high temperatures. Volatile organic compounds are released in the coke oven flue gas (COFG or COG).

Both CO and COFG can be used as fuel in waste heat boilers. The calorific values of these gases are very low when compared with fuels such as natural gas. The low calorific values lead to engineering challenges in the design of the power plant. The combustion values of these two gases, as compared to other sources of fuel, are given in Figure 7.

The proposed plant configuration for the utilisation of the low calorific value gas is waste heat boilers and steam turbines. The plant will have a capacity to raise 30 MW of power. It will consist of two waste heat recovery boilers (WHRBs) with a capacity of 64 tons an hour of steam each. The steam will power a 33 MW turbine using superheated steam at 65 Bar. The configuration of the plant can be seen in Figure 8.

Electricity from the plant will be used to displace grid connected power with excess power being sold into the grid. The emission factor of the grid is taken as 0.755 tons of CO_2e/mWh[39]. Note that in South Africa, the comparable figure would be 0.96 t/mWh, thus yielding a higher carbon emissions reduction value for projects of this kind.

Methodology

The project uses approved methodology Number 4 – ACM0004[40]. At the time of writing it is one of 29 projects in the CDM project pipeline based on this methodology. ACM004 is applicable to electricity generation projects that displace electricity generation with fossil fuels in the electricity grid or displace captive electricity generation from fossil fuels. In this project the electricity is used to displace coal-based electricity from the Indian grid, and the methodology is therefore applicable.

The project boundary in terms of the methodology is the physical boundary of the site. The implementation of this principle on the specific site is indicated in Figure 8.

The emission sources included and excluded from the project, following this methodology, are shown in Table 6.

The application of these requirements dictates that the emissions from the generation of the electricity on the grid are the main emission source. The methodology further calls for the identification of alternative scenarios and baselines.

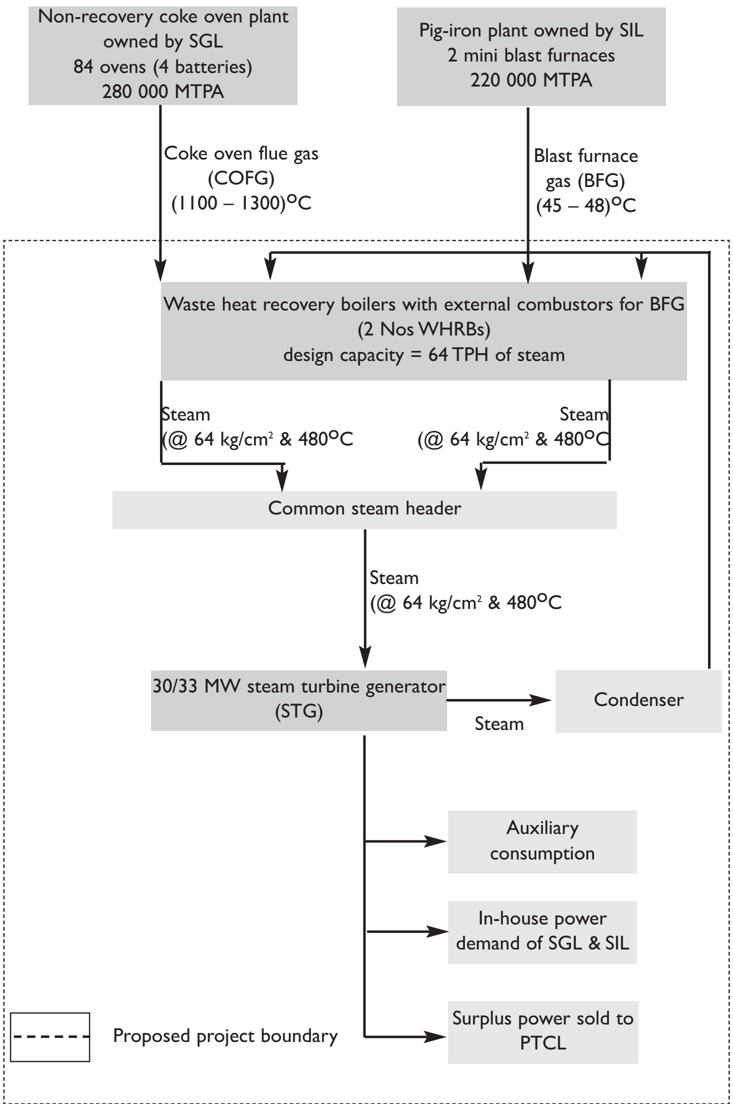


Figure 8: SESA waste heat recovery-based power generation

Table 6: Emission sources in ACM004

	Source	Gas		Justification/explanation
Baseline	Grid electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
	Captive electricity generation	CO_2	Included	Main emission source.
		CH_4	Excluded	Excluded for simplification. This is conservative.
		N_2O	Excluded	Excluded for simplification. This is conservative.
Project activity	On-site fossil fuel consumption due to project activity	CO_2	Included	May be an important emission source.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.
	Combustion of waste gas for electricity generation	CO_2	Excluded	It is assumed that this gas would have been burned in the baseline scenario.
		CH_4	Excluded	Excluded for simplification.
		N_2O	Excluded	Excluded for simplification.

The following are excluded as alternatives:

(a) scenarios that do not comply with the regulatory framework within which the project operates

(b) scenarios based on fuels, materials or technology that are not available in the area.

The methodology specifies that alternative scenarios and baselines should include:

(a) the proposed project not undertaken as a CDM project activity

(b) importation of electricity from the grid

(c) existing or new captive power generation on-site, using other energy sources than waste heat or gas, such as coal, diesel, natural gas, hydro and wind

(d) a mix of options (b) and (c), in which case the mix of grid and captive power should be specified

(e) other uses of the waste heat and waste gas

(f) the continuation of the current situation, whether this is a captive or grid-based power supply (if not already included in the options above).

Baseline

When establishing a baseline for a CDM project one needs to quantify the emissions that would have been emitted in the absence of the CDM project. The Executive Board published a draft baseline selection tool after its 19th meeting.[41] The process proposed by the document is summarised in Figure 9.

The PDD lists the following alternative baseline scenarios.

(a) Importation of electricity from the grid

(b) Coal-based captive power plant without any surplus power generation

(c) Coal-based power plant with surplus power generation

(d) Gas-based captive power plant without any surplus power generation

(e) Gas-based power plant with surplus power generation

(f) Diesel-based captive power plant without any surplus power generation

(g) Diesel-based power plant with surplus power generation

(h) Waste heat recovery-based plant without CDM benefits.

A complete financial analysis of all the options was done and the conclusion was that, in the absence of a CDM, the most economically attractive option was option (a), importation of electricity from the grid. This conclusion is further substantiated by the following facts:

(a) The scenario under which power is imported from the grid is the current status quo, prior to the CDM project implementation

(b) The CO_2e emission factor of the grid is more conservative than the coal and diesel based options considered.

In addition to the financial viability analysis the company conducted a barrier analysis and identified the following barriers.

(a) Investment barrier: The project has a high capital cost with substantial investment risk

(b) Operational barrier: The biggest operational barrier identified relates to the selling of the excess power produced into the grid

(c) Managerial barrier: The company recognises that it is a coke and pig iron manufacturing unit, and that the operation of a power plant within the current management regime carries significant managerial risk.

The baseline selected for the project is the importation of power from the grid. In terms of ACM0004 the calculation of the baseline is as indicated in Figure 9.

The methodology does not require any leakage to be taken into consideration.

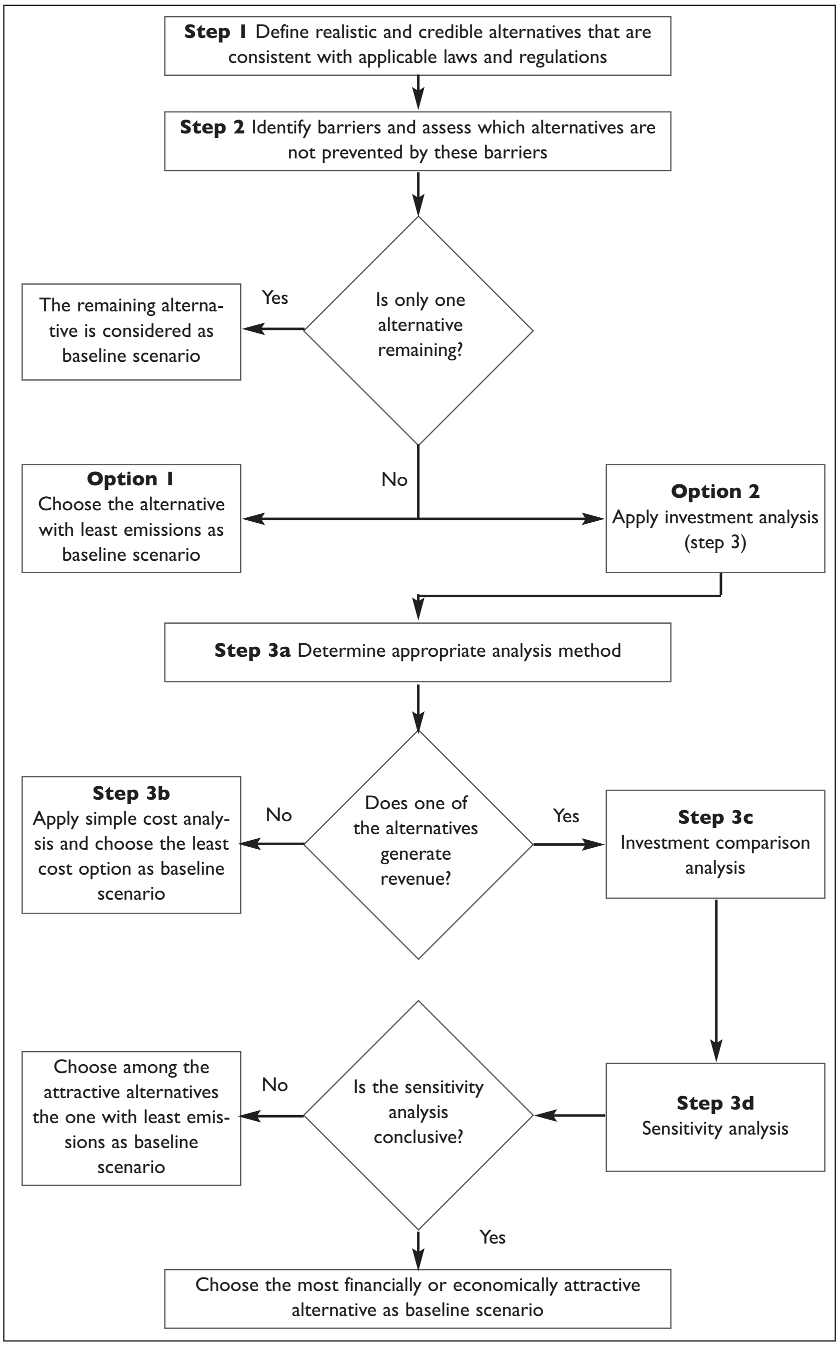


Figure 9: Draft baseline selection tool

Monitoring and verification

The methodology requires monitoring of the following variables:

(a) Net electricity generation from the proposed project activity

(b) Data needed to calculate carbon dioxide emissions from fossil fuel consumption caused by the project activity

(c) Data needed to recalculate the operating margin emission factor, if needed, based on the choice of the method to determine the operating margin, consistent with 'Consolidated baseline methodology for grid-connected electricity generation from renewable sources' (ACM0002)

(d) Data needed to recalculate the build margin emission factor, if needed, consistent with 'Consolidated baseline methodology for grid-connected electricity generation from renewable sources' (ACM0002)

(e) Data needed to calculate the emissions factor of captive power generation.

The data collected in the monitoring programme is used in calculating the emission reduction achieved by the project. The emission reduction is calculated according to the formulas in Figures 10 and 11. Where the baseline emission is calculated by the formulas in Table 6 and the project emission is zero.

Impact on sustainable development

The sustainable development contribution of the project is included in the PDD. The first contribution relates to the optimal utilisation of energy and the elimination of consumption of fossil fuel based grid connected electricity. The second contribution comes from the abatement of pollution related to both the emission of off gases from the steel plant as well as the generation of power.

Additionality

The additionality of the project is established in terms of the additionality tool. The development of alternatives was discussed in

$$EF\ captive\ y = \frac{EF_{CO2,i}}{Eff\ captive} \times \frac{44}{12} \times \frac{3.6TJ}{1\ 000MWh}$$

where:

EF captive y = *emissions factor for captive power generation* (tCO_2/MWh)
$EF_{CO2,i}$ = CO_2 *emissions factor of fuel used in captive power generation (tC/TJ)*
Eff captive = *efficiency of the captive power generation (%)*
44/12 = *carbon to carbon dioxide conversion factor*
3.6/1000 = *TJ to MWh conversion factor*

Figure 10: Baseline calculation for ACM0004

$ER_y = (BE_y - PE_y)$

Where:

ER_y = total emission reductions resulting from the proposed project activity during the year y (in tons of CO_2)

BE_y = total baseline emissions due to displacement of electricity in the grid during the year y (in tons of CO_2)

PE_y = total project emissions during the year y (in tons of CO_2)

'y' is any year within the proposed crediting period of the proposed project activity

Since $PE_y = 0$, hence

$$ER_y = BE_y$$

Figure 11: Project emission reduction calculation

$BE_y = EG_y \oslash EF_y$

Where:

BE_y = baseline emissions due to displacement of electricity during the year y (in tons of CO_2)

EG_y = net units of electricity substituted in the grid during the year y (in tons of CO_2)

EF_y = emission factor of the grid (in tCO_2/MWh)

'y' is any year within the proposed crediting period of the proposed project activity

Figure 12: Baseline emission calculation

the section on baseline selection. The additionality of the project is founded on the fact that the preferred alternative in the absence of the CDM in terms of this analysis is to buy electricity from the grid.

Case study 3:

Huainan Panyi and Xiequiao Coal Mine methane utilisation project

The Huainan project is based on the utilisation of coal mine methane. Many South African coal mines also have small quantities of methane that could be recovered for electricity generation, and the case study is therefore seen as being relevant to the local situation.

It is generally accepted that South African coal mines have much lower quantities of methane than mines in other parts of the world. The Huainan project was selected as a case study because, like mines in South Africa, it does not have huge reported quantities of methane. The project will produce in the order of 17 MW of electricity and an additional 10 MW of thermal power.

The case study serves to illustrate the impact of the additionality of the carbon revenue on the implementation of the project. In the absence of the carbon revenue, there is insufficient justification to invest capital to upgrade the quality of the gas drained from the mine to such a level that it can be used for energy production. The additional project revenue from the carbon credits makes the investment profitable. The project will only be financially viable if carbon credits can be obtained.

The energy produced by this project would not be used in the absence of carbon credit revenue, which illustrates the sustainable development contribution made by the CDM. Given the severe shortages in electricity supply in South Africa, such projects should receive high priority from both industry and government.

Project description

The project description is based on the information presented in the PDD, as posted on the website of the validator DNV[42].

The Huainan Mining Group, which produced 29 million tons of coal in 2004, operates coal mines near the town of Huainan in the Anhui province of China.

It currently extracts methane from its operations through ventilation fans, underground boreholes and gas drainage galleries. All of the coal mine methane extracted is vented to the atmosphere.

The current project is based on methane extraction at the Panyi and Xieqiao coal mine sites.

The methane removed is generally of a quality that is too low for use in energy production. Previous work done on the subject convinced the company that any project to upgrade the gas to higher methane content, would not be profitable in the absence of some form of subsidy.

The Huainan project will be implemented in two stages. In the first stage the quality of the gas from the mines will be upgraded. This will be achieved by blending low quality drainage gas with higher quality gas from goaf wells. The goaf wells will be designed to maximise their production and life. Significant investment is required to drill the wells. The planned gas quality produced from this phase will be in the order of 30% to 70% methane.

The second phase of the project involves the use of methane gas to produce energy. The first application at the Panyi Mine is the conversion of two coal-fired boilers to gas. These boilers produce in the order of 12 tons per hour of steam. In addition, 15 000 households will be connected to a network of gas pipelines. The company will install gas-fired engines and generators with a capacity of 8.8 MW. Chilling capacity to the extent of 4.8 MW to produce cool air for mine ventilation will also be installed.

The installation at the Xieqiao Mine involves a 8.3 MW electricity generator and 5 MW of thermal (chilling) power.

Table 7: Expected methane quality and utilisation

Project site	Existing methane concentration	Projected methane concentration using goaf wells	Number of goaf wells producing gas	Utilising percentage of drained gas
Panyi Central	26%	40%	3	42%
Panyi South	20%	32%	3	38%
Xieqiao	27%	34%	3	46%

Electricity generation will be done with gas-fired reciprocating engines, which will have a rating of 1.3 MW each and operate at an electrical efficiency of 35% to 40%.

The project will reduce greenhouse gas emissions by 663 000 tons of CO_2e per year. Its contribution to sustainable development lies in the reduced consumption of coal as well as in the supply of gas as heating fuel to the local community.

Methodology

The project is based on approved consolidated methodology ACM0008 (see Annexure 2). The history of the methodology is interesting in that it serves to highlight the ultra-conservative approach taken by the Executive Board of the CDM. The consolidated methodology was a merger of five project-specific methodologies proposed to the meth panel. When it was submitted to the Executive Board for approval at the 21st meeting in September 2005, the Executive Board decided that the methodology needed 'further consideration and elaboration'. The methodology was then revised by the methodology panel, and approved by the Executive Board at their 22nd meeting in the last week of November 2005.

Methodology ACM0008 is applicable to projects that extract methane from coal mines where the baseline is the release of all, or some of the methane to atmosphere.

In terms of the applicability criteria of the methodology, methane may be captured in a number of ways. The first is from surface drainage wells designed to capture coal bed methane (CBM) associated with mining activities. Underground boreholes in the mine to capture pre-mining coal mine methane (CMM) may also be used. Surface goaf wells, underground boreholes, gas drainage galleries or other goaf gas capture techniques, including gas from sealed areas may be used to capture post-mining CMM.

All the CBM or CMM captured by the project should either be used or destroyed, and cannot be vented. Methane can be destroyed by flaring or used in the production of electricity, motive power and/or thermal energy. The methane not captured, but diluted for safety reasons, may be vented.

This methodology is not applicable to projects where methane is captured from abandoned or decommissioned coalmines. Neither can it be used for projects designed to capture or use virgin coal-bed methane (for example methane of high quality extracted from coal seams independently of any mining activities). The use of CO_2 or any other fluid/gas to enhance CBM drainage before mining takes place is also not permitted. Finally, the methodology is not applicable to open cast mines.

Methodology ACM0008 prescribes that the baseline emissions of the project must be taken as methane emissions that would be captured in the project scenario, CO_2 emissions from the destruction of methane in the baseline scenario and CO_2 emissions from the production of heat and power (motive and electrical) that is replaced by the project activity.

The project emissions, on the other hand, include CO_2 emissions from the combustion of methane in a flare, engine, power plant or heat generation plant, CO_2 emissions from the combustion of non-methane hydrocarbons (NMHCs), if they represent more than 1% by volume of the extracted coal mine gas, CO_2 emissions from on-site fuel consumption caused by project activity, including transport of the fuel, and fugitive emissions from unburned methane.

Baseline and project boundaries

The project is based on claiming emission reduction from two general areas. The first is the removal of methane from the atmosphere. The Intergovernmental Panel of Climate Change[43] (IPCC) published a list of the global warming potential (GWP) of greenhouse gases in its Second Assessment Report in 1996.

Table 8: Planned energy production from the Huainan Project

Project site	Electricity	Thermal cooling	Town gas	Boilers
Panyi Central	2.0 MW	n/a	15 000 homes	2 – 2 ton, 2 – 4 ton
Panyi South	6.8 MW	4.8 MW	n/a	n/a
Xieqiao	8.3 MW	5.0 MW	n/a	n/a

Table 9: Baseline emissions

Source	Gas		Justification/explanation
Emissions of methane as a result of continued venting	CH_4	Excluded	Only the change in CMM/CBM emissions release will be taken into account, by monitoring the methane used or destroyed by the project activity.
On-site fuel consumption due to the project activity, including transport of the gas	CO_2	Included	If additional equipment such as compressors are required on top of what is required for purely drainage, energy consumption from such equipment should be accounted for.
	CH_4	Excluded	Excluded for simplification. This emission source is assumed to be very small.
	N_2O	Excluded	Excluded for simplification. This emission source is assumed to be very small.
Emissions from methane destruction	CO_2	Included	From the combustion of methane in a flare, or heat/power generation.
Emissions from NMHC destruction	CO_2	Included	From the combustion of NMHC in a flare, or heat/power generation, if NMHC accounts for more than 1% by volume of extracted coal mine gas.
Fugitive emissions of unburned methane	CH_4	Included	Small amounts of methane will remain unburned in flares or heat/power generation.
Fugitive methane emissions from on-site equipment	CH_4	Excluded	Excluded for simplification. This emission sources is assumed to be very small.
Fugitive methane emissions from gas supply pipeline or in relation to use in vehicles	CH_4	Excluded	Excluded for simplification. however, taken into account among other potential leakage effects (see leakage section).
Accidental methane release	CH_4	Excluded	Excluded for simplification. This emission sources is assumed to be very small.

Table 10: Project emissions

Source	Gas		Justification/explanation
Emissions of methane as a result of continued venting	CH_4	Included	◆ Main emissions source. However, certain sources of methane may not be includes, as noted in the applicability conditions. ◆ Recovery of methane from coal seams will be taken into account only when the particular seams are mined through or distributed by the mining activity. ◆ Recovery of methane from abandoned coal mines will not be included. ◆ The amount of methane to be released depends on the amount used (for local consumption, gas sales, etc.) in the baseline.
Emissions from destruction of methane in the baseline	CO_2	Included	Considers any flaring or use for heat and power in the baseline scenario
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	Excluded	Excluded for simplification. This is conservative.
Grid electricity generation (electricity provided to the grid)	CO_2	Included	◆ Only CO_2 emissions associated with the same quantity of electricity as electricity generated as a result of the use of methane included as baseline emission will be counted. ◆ Use of combined margin method as described in AMC0002 should be used.
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	Excluded	Excluded for simplification. This is conservative.
Captive power and/or heat, and vehicle fuel use	CO_2	Included	Only when the baseline scenario involves such usage.
	CH_4	Excluded	Excluded for simplification. This is conservative.
	N_2O	Excluded	Excluded for simplification. This is conservative.

The concept of GWP was designed to normalise the climate change impact of all greenhouse gases to that of CO_2. The GWP of carbon dioxide is given as one. In its studies, the IPCC found that, over a 100-year period, one ton of methane has the same impact on global warming as 21 tons to carbon dioxide. In terms of the CDM one can therefore claim 21 tons of CO_2-equivalent for each ton of methane removed from the atmosphere.

The second area where carbon credits can be claimed in this project is a result of the replacement of other sources of energy with energy that would normally go to waste – the methane vented to atmosphere in the case of BAU. This project is designed to replace both electrical and thermal energy from other sources.

The project boundaries are specified by the methodology as being the physical boundaries of the site including the area where the methane is captured and the flaring and electricity generation activities.

The project baseline was selected through a process involving a number of steps as in the Baseline Selection Tool of the Executive Board:

<u>Step1: Identification of technically feasible options</u>

The first step was to identify ways in which methane could be extracted from the mines. methods identified include ventilation air methane, pre-mining CMM extraction (including CBM to goaf drainage and/or indirect CBM to goaf only), post-mining CMM extraction, as well as possible

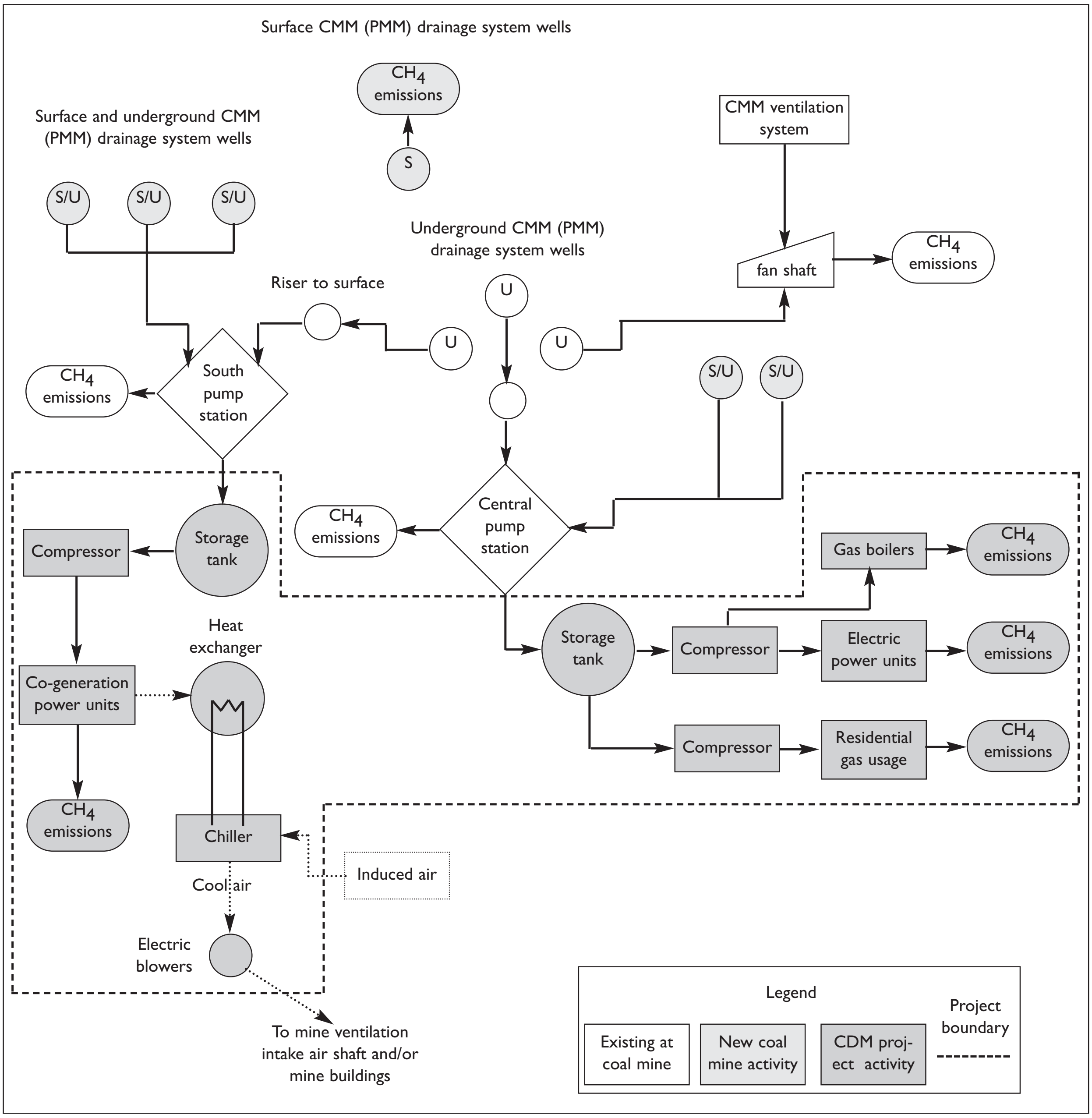


Figure 13: Project boundary for Panyi Mine

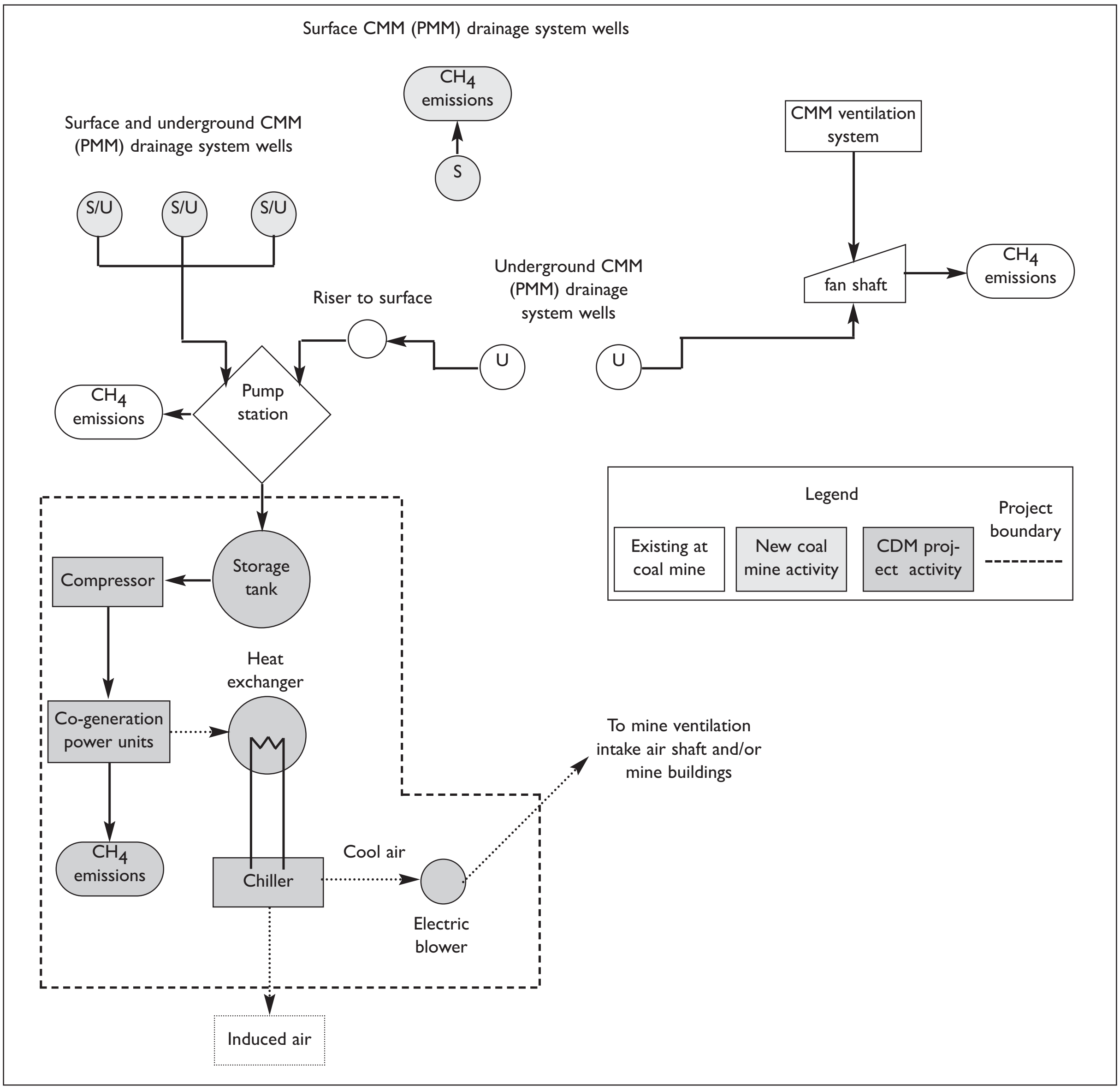


Figure 14: project boundary for Xieqiao Mine

combinations of options with the relative shares of gas specified.

The next step was to consider the options for the destruction of the methane. Options identified were venting (the current practice in the two coalmines), using or destroying ventilation air methane rather than venting it, flaring of CBM and CMM. Uses for the methane were listed as additional grid power generation, captive power generation, heat generation and the use of the gas as gas pipeline feed. Combinations of the listed options with the relative shares of gas treated under each option specified are also possible.

Step 2: Eliminate baseline options that do not comply with regulatory requirements

As there is no limitation on the amount of coalmine methane that may be vented in China, all options comply with the regulatory requirements.

Step 3: Formulate baseline scenario alternatives

The alternatives identified for the extraction of the methane included the continuation of the current practice, and the implementation of a scheme based on new in-mine drainage boreholes and surface-drilled goaf wells; improvement of the extraction system gathering lines; succeeding gas storage tanks construction and low quality; and high quality drained gas streams segregation. This will guarantee a minimum methane concentration of drained gas at 30% – 40%. This is the proposed project activity not implemented as a CDM project.

With respect to the treatment of the methane, the only alternative identified was to vent all methane to the atmosphere.

Monitoring and verification

The project's monitoring and verification plan includes all the aspects as specified in the methodology to ensure that the emission reduction achieved can be calculated accurately. The measured variables specified in the plan include:

- Methane destruction of thermal demand in the baseline
- Baseline emissions from methane released into the atmosphere
- Baseline emissions from heat generation replaced by the project
- Combustion emissions from additional energy required for CMM capture and use
- Combustion emissions from use of captured methane
- Uncombusted methane from end uses.

For the PDD, the project emissions are calculated by a series of equations, using the measured data. Having calculated the variables, the emission reduction can then be calculated.

The emission reduction projected for the project is in the order of 660 000 tons a year, with a 10-year crediting period.

Contribution to sustainable development

The PDD includes a detailed analysis of the environmental impacts of the project, including:

- Air quality
- Water quality
- Floodplains and wetlands
- Fauna & Flora
- Topography

$$PE_y = PE_{ME} + PE_{MD} + PE_{UM}$$

Where:

PE_y = Project emissions in year y (tCO_{2e})

PEME = Project emissions from energy use to capture and use methane (tCO_{2e})

PE_{MD} = Project emissions from methane destroyed (tCO_{2e})

PE_{UM} = Project emissions from uncombusted methane (tCO_{2e})

Equation 1: Project emissions

$$BE_y = BE_{MDy} + BE_{MRy} + BE_{UMse,y}$$

Where:

BE_y = Baseline emissions in year y (tCO_{2e})

BE_{MDy} = Baseline emissions from destruction of methane in the baseline scenario in year y (tCO_{2e})

BE_{MRy} = Baseline emissions from release of methane into the atmosphere in year y that is avoided by the project activity (tCO_{2e})

$BE_{UMse,y}$ = Baseline emissions from the production of power, heat or supply to gas grid replaced by the project activity in year y (tCO_{2e})

Equation 2: Baseline emissions

$$LE_y = LE_{d,y} + LE_{o,y}$$

Where:

LE_y = Leakage emissions in year y (tCO_{2e})

$LE_{d,y}$ = Leakage emissions due to displacement of other baseline thermal energy uses of methane in year y (tCO_{2e})

$LE_{o,y}$ = Leakage emissions due to other uncertainties in year y (tCO_{2e})

Equation 3: Leakage calculation

$ER_y = BE_y - PE_y + LE_y$

Where:

ER_y = Emissions reductions of the project activity during year y (tCO_{2e})

BE_y = Baseline emissions during year y (tCO_{2e})

PE_y = Project emissions during year y (tCO_{2e})

LE_y = Leakage emissions during year y (tCO_{2e})

Equation 4: Emission Reduction calculation

- Noise
- Traffic and transportation
- Visual impact.

The result is that there are no undue impacts on the environment. The contribution to development, on the other hand, focuses on the development of waste energy sources and the supply of alternative fuels to the community.

Additionality

The application of the additionality test for the project focused mainly on the investment analysis section of the additionality tool.

The project financials are based on a set of data (Table 11):

Table 11: Projected Emission reduction

Years	Annual estimation of emission reductions (tons of CO_2e)
2006	341 354
2007	347 049
2008	660 377
2009	660 377
2010	660 377
2011	660 377
2012	660 377
2013	660 377
2014	660 377
2015	660 377
Total emission reduction (tons of CO_2e)	5 971 419
Total number of crediting years	10
Annual average over the crediting years of estimated reductions (tons of CO_2e)	597 142

The results from the financial analysis are:

- The Xieqiao CMM power project offers a 6.6% IRR (before taxes), and a 10-year payback
- The Panyi Central CMM power project, residential gas, and boiler conversion offers a -3.6% IRR and a 15-year payback
- The Panyi South co-generation project offers a 4.5% IRR and a 12-year payback.

These projects are feasible against the hurdle rate of 11.8%.

In the barrier analysis, the company found the following:

- Investment barrier – The proposed projects are too small and revenues and the IRRs are too low to attract international finance or capital
- Technological barrier – The technology required to handle the fluctuating gas conditions expected in the

Table 12: Financial parameters for the Huainan Project

Financial parameters	
Electricity price (US$/MWhr)	46.00
Gas drainage	0.13
Discount rate	10%
Costs	
Electric power plant (per MW)	800 000
Gas treatment	300 000
Gas boilers	225 000
Gas pipeline, valves, etc.	1 300 000
Monitoring and control	300 000
Shipping	75 000
Professional supervision	150 000
Training	50 000
Civil and construction	300 000
Electric generation operating cost	15.0
Insurance	2%

project is not available in China, and must be imported from overseas

- Prevailing practice barrier – The proposed project activity requires expertise and experience in CMM drainage for gas quality optimisation and maximising utilisation. A surface drilled goaf well on low permeability seams and extremely complex geological conditions area will be the first of its kind, commercial scale project implemented in China. Foreign gas drainage experts will work together with mining and ventilation engineers at the Huainan coal mines, which currently lack the necessary experience and training in optimising gas quality.

Project implementation

The project is one of only two coalmine methane projects in the CDM pipeline, both of which are in the validation stage.

Annexure 2

Methodologies for CDM projects in the mining sector

Background

Anyone wanting to register a CDM project must develop it according to a methodology approved by the Executive Board of the CDM. A methodology consists of two parts: the first is the baseline methodology according to which the upper line in Figure 15 is specified and the second is the monitoring and verification methodology, according to which project emissions are calculated.

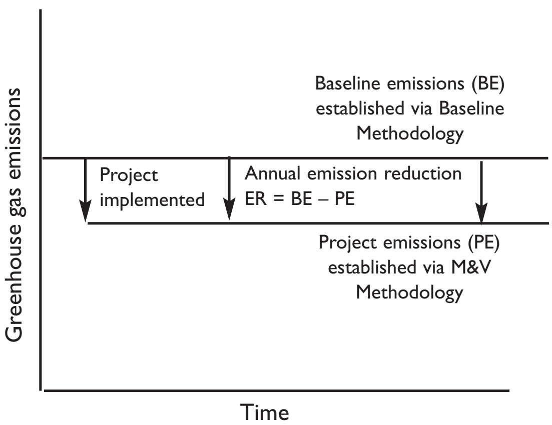


Figure 15: Methodology for CDM projects

Methodology approval process

Should a person wish to submit a CDM project, and there is no approved methodology, a new methodology must be submitted and approved prior to the project being registered by the CDM Executive Board.[44] As with PDDs, methodologies must be drafted using the standard forms provided on the Executive Board website. Submissions of new methodologies must be done through a registered operational entity, i.e. the proponent must hire an operational entity to submit the application for approval to the Executive Board. This is normally seen as part of the validation process, i.e. the operational entity hired for the validation also submits the new methodology.

Proposed new methodologies are posted on the Executive Board website for public comment.[45] Following public input, the Executive Board methodology panel evaluates the methodology and, once approved, it is submitted to the Executive Board for final approval.

Types of methodology

There are three categories of methodology:

1. Methodologies for CDM project activities
2. Methodologies for afforestation/reforestation activities
3. Simplified methodologies for small-scale CDM project activities.

Of the above, only the first and last are relevant to the mining industry. Methodologies can also be classified according to their status, i.e. approved, under review and withdrawn. Approved methodologies for categories 1 and 3, as well as a selection of methodologies for these same categories that are under review and might be of use to mining companies, are included.

Also included are approved methodologies for projects relating to cement production, as these may be of interest to members of the Chamber of Mines involved in that industry through the mining side.

Approved large-scale methodologies

Table13 summarises approved methodologies that could be applicable to the local mining industry. Table 14 gives four additional methodologies applicable to the cement industry.

Methodologies applicable to small-scale projects

To make the CDM accessible to as many people as possible, the procedures or modalities of the CDM make provision for simplified methodologies for small-scale projects. The criteria for classifying a project as small-scale are explained in Table 15.

A number of small-scale methodologies have been approved by the Executive board of the CDM and are shown in Table 16.

Table 13: Methodologies applicable to the mining industry

Methodology number	Title	Relevance to mining industries
AM8	Fuel switch from coal/oil to natural gas	Can apply to any industrial process presently using coal or oil to generate steam or to heat materials. NOTE: This has been consolidated into a methodology renamed ACMx,: 'Industrial fuel switching from coal or petroleum fuels to natural gas.'
AM0013	Avoided methane emissions from organic waste-water treatment	This methodology could be applicable to projects implemented by mining companies operating waste water treatment plants from their change houses and mining villages. Such projects will however probably be small scale projects, and therefore be covered under the methodologies for small scale projects discussed above.
AM0014	Natural gas-based package Co-generation	This methodology could be applicable to projects implemented by mining companies who wish to generate their own electricity using natural gas, in a package or turnkey approach.
AM0017	Steam system efficiency improvements by replacing steam traps and returning condensate – Version 2	This methodology could be applicable to companies operating mineral processing plants with steam as a source of process energy. Applicability only to the two improvements mentioned.
AM0018	Baseline Methodology for steam optimisation systems	This methodology could be applicable to companies operating mineral processing plants with steam as a source of process energy.
AM0019	Renewable energy project activities replacing part of the electricity production of one single fossil-fuel-fired power plant that stands alone or supplies electricity to a grid, excluding biomass projects – Version 2	This methodology could be applicable to mining companies wishing to generate electricity from renewable energy. Limited to direct replacement of specific power plants, and to renewable energy technologies such as wind power.
AM0020	Baseline methodology for water pumping efficiency improvements	Many mining companies pump vast quantities of water. Projects aimed at improving the efficiency of such pumping schemes can be developed using this methodology.
AM0022	Avoided Wastewater and On-site Energy Use Emissions in the Industrial Sector – Version 2	Mining companies operating their own waste water plants can develop projects using this methodology.
AM0025	Avoided emissions from organic waste through alternative waste treatment processes	Mining companies operating their own waste water plants can develop projects using this methodology.
AM0029	Methodology for Grid Connected Electricity Generation Plants using Natural Gas	This methodology can be used to develop projects should a mine decide to generate its own electricity using natural gas.
ACM0004	Consolidated methodology for waste gas and/or heat for power generation – Version 2	This methodology can be used to develop projects to generate electricity from waste gas, e.g. carbon monoxide from smelters.
ACM0008	Consolidated methodology for coal bed methane and coal mine methane capture and use for power (electrical or motive) and heat and/or destruction by flaring	This methodology is applicable to methane capture from coal mines, including both abandoned and existing mines and unexplored coal deposits.
AM0030	PFC emission reduction from anode effect mitigation at primary aluminium smelting facilities	This methodology is aimed at the avoidance of perfluoro-carbon (CF4 and C2F6) emissions in aluminium smelting, limited to facilities that use centre work pre-bake cell technology with bar brake (CWPB) or point feeder systems (PFPB).
AM0032	Baseline methodology for waste gas or waste heat based Co-generation system.	This methodology applies to Co-generation of steam and electricity utilising waste gas or waste heat as a fuel source, where the Co-generation plant is installed at the site and the waste gas used for Co-generation is surplus and not required to meet on-site energy requirements.
AM0038	Improved electrical energy efficiency of an existing submerged electric arc furnace used for the production of SiMn	This methodology applies to submerged electrical arc furnaces used for production of silicomanganese, providing that electricity is sourced from the grid and not by onsite generation. NOTE: The project on which this methodology is based takes place in South Africa.

Table 14: Methodologies applicable to the cement industries		
AM0024	Methodology for greenhouse gas reductions through waste heat recovery and utilisation for power generation at cement plants	This methodology can be used by cement plants to recover hot gases or heat from the kiln and use this to generate electricity on-site.
ACM0003	Emissions reduction through partial substitution of fossil fuels with alternative fuels in cement manufacture – Version 3	This methodology can be used by cement plants to allow substitution of a variety of bio-mass and waste products for coal or oil in firing the kiln .
ACM0005	Consolidated Methodology for Increasing the Blend in Cement Production – Version 3	This methodology can be used by cement plants to increase the amount of additives used to reduce limestone requirements.
AM0033	Use of non-carbonated calcium sources in the raw mix for cement processing	This methodology can be used by cement plants replacing CaCO3 or Mg CO3 with non-carbonated calcium in clinker production.

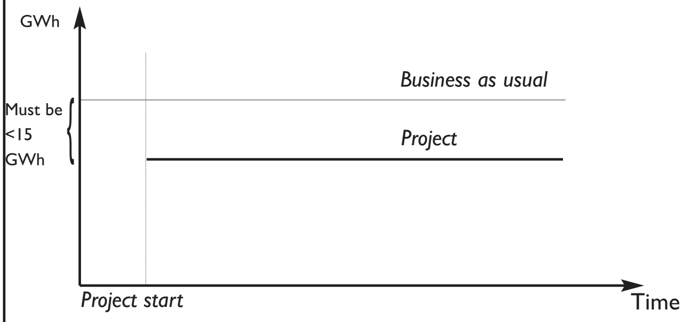
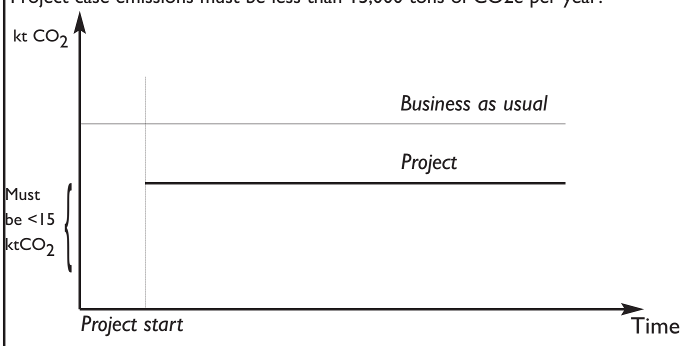
<table>
<tr><td colspan="3">Table 15: Eligibility criteria</td></tr>
<tr><th>Classification</th><th>Type</th><th>Eligibility criteria</th></tr>
<tr><td>Type (i)</td><td>Renewable energy projects</td><td>Projects generating power from renewable sources may not exceed a maximum power output of 15 megawatts.</td></tr>
<tr><td>Type (ii)</td><td>Energy efficiency improvements</td><td>The maximum energy reduction (saving) achieved by the project must be less than 15 gigawatt hours (GWh) per year:

</td></tr>
<tr><td>Type (iii)</td><td>Other projects</td><td>Project case emissions must be less than 15,000 tons of CO2e per year:

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Table 16: Methodologies for the mining industry

Methodology number	Title	Relevance to mining industry
AMS-I.A.	Electricity generation by the user	This methodology is applicable to projects where the user generates its own electricity, for example if a mine installs a turbine at the bottom of a shaft to generate electricity from water running down the shaft
AMS-I.B.	Mechanical energy for the user	This methodology is applicable in cases where the user generates mechanical energy. An example would be if water drives a turbine, which in turns powers equipment such as a mill or conveyor belt.
AMS-I.C	Thermal energy for the user	An example of a thermal energy project would be where a projects involves the generation of steam from a fuel such as waste gas, of if a mine uses waste heat to generate chilled water. Solar water heating for change houses will also fall in this category.
AMS-I.D.	Grid connected renewable electricity generation	This methodology is applicable to projects that involve the generation of power to be fed back into the grid from renewable energy such as biogas from waste treatment systems or from wind or small-scale hydro plants.
AMS-II.B	Supply side energy efficiency improvements – generation	This methodology is applicable to projects increasing efficiency for electricity generators.
AMS-II.C	Demand-side energy efficiency programmes for specific technologies	This methodology is applicable to energy efficiency projects, and can thus be very relevant to mining companies in South Africa.
AMS-II.D	Energy efficiency and fuel switching measures for industrial facilities	This methodology is applicable to projects that involve the switching of fuels from carbon intensive to less carbon intensive fuels. Examples in South Africa include projects involving the switch from coal to natural gas.
AMS-II.E	Energy efficiency and fuel switching measures for buildings	Projects implemented on this methodology will relate to the increase of building energy efficiencies. Examples could include the implementation of more energy efficiency lighting and air conditioning in large buildings.
AMS-III.B	Switching fossil fuels	Projects implemented using this methodology could include fuel switch projects involving a variety of fuels e.g. heavy fuel oil or coal to natural gas.
AMS-III.C	Emission reductions by low-greenhouse gas emitting vehicles	This methodology could be applicable should a mining company decide to switch to vehicles with reduced emissions as opposed to the vehicles used in the business as usual scenario.
AMS-III.D	Methane recovery	This methodology is applicable to projects involving the recovery of methane either for flaring (burning) or for the generation of electricity (by using methane as a fuel).
AMS-III.E	Avoidance of methane production from biomass decay through controlled combustion	This methodology is applicable in the biomass industries but may apply to some mining companies.
AMS-III.F	Avoidance of methane production from biomass decay through composting	Projects implemented with this methodology could include the composting of organic waste from mining operations such as wood chips that come from underground with the ore.
AMS-III.G	Landfill methane recovery	This methodology could be applicable to mining companies who operate landfill sites either for the mining operation, or for mining villages.
AMS-III.H	Methane recovery in wastewater treatment	This methodology could be applicable to mining companies who operate waste water treatment plants to treat sewerage from their change houses or mine villages.
AMS-III.I	Avoidance of methane production in wastewater treatment through replacement of anaerobic lagoons by aerobic systems	This methodology could be applicable to mining companies who operate waste water treatment plants to treat sewerage from their change houses or mine villages.

Annexure 3

References for further reading

References on CDM

1 *Managing Climate Change: a Guidebook for South African Organisations*: published by the Development Bank of Southern African and the National Business Initiative, June 2006

2 *The Clean Development Mechanism: A guide for Potential Participants in South Africa*: jointly produced by Future Energy Solutions, Harwell and the Energy Research Institute, September 2002

3 The Designated National Authority for CDM in South Africa: all required documents for CDM approval can be obtained at http://www.dme.gov.za/dna/dna_documents2.stm

4 The CDM Toolkit: prepared by the SSN Project, available at http://www.cdmguide.org

5 The UNDP – CDM User's Guide: http://www.undp.org/energy/climate.htm#cdm

6 UNIDO – Engaging the private sector in the clean development mechanism: http://www.unido.org/en/doc/4222

7 The GHG Protocol: http://www.wbcsd.ch

8 European CDM Portal: http://www.euro-cdm.org/whatiscdm.html

9 Making CDM work for developing countries: http://www.iisd.org/climate/global/cdm.asp

10 CDM Executive Board: http://cdm.unfccc.int/EB

11 Capacity Development for the Clean Development Mechanism: http://cd4cdm.org/

12 What is the CDM and JI: http://www.climnet.org/EUenergy/CDM.htm

References on carbon financing and risk assessment

On climate change and its risks:

13 *The South African National Climate Change Response Strategy*: available from Department of Environment and Tourism, 2004 (www.deat.gov.za)

14 *Climate Change: the Physical Science Basis*: available from the Intergovernmental Panel on Climate Change (IPCC), 2007. (www.ipcc.ch/pub/reports.htm). See also other IPCC reports on this same site

15 *Global Warming – The Complete Briefing (3rd Edition)*: John T Houghton, Cambridge University Press, August 2004

On climate change accounting and disclosure

16 The Carbon Disclosure Project, www.cdproject.net. Also contact the National Business Initiative, responsible for South African work on the CDP

17 Generally Accepted Carbon Accounting Principles, also at www.cdproject.net

18 Templates for ERPAs and related carbon contracts can be obtained at the International Emissions Trading Association's website: www.ieta.org

On carbon financing

19 Carbon Finance Africa: a website dedicated to carbon finance issues in Sub-Saharan Africa: www.carbonfinanceafrica.org.za

20 *CEO Briefing on Finance for Carbon Solutions*: published by UNEP-FI, available on their website as a PDF file: www.unepfi.org/fileadmin/documents/CEO_briefing_finance_for_carbon_solutions_2004.pdf

21 World Bank Carbon Financing programme, including Prototype Carbon Fund. Go to the following website: www.carbon-finance.org

22 Carbon Finance, a website dedicated to financing issues arising from Kyoto. Go to www.carbon-financeonline.com

23 *Partnering the Clean Development Mechanism in South Africa*: Development Bank of Southern Africa, 2005

References on greenhouse gas mitigation

On the Kyoto Protocol

24 Go to the GHG Clearinghouse website, www.ghgclearinghouse.org.za

25 Or, for more detail, go to www.unfccc.int, the website of the UN Framework Convention on Climate Change

On greenhouse gases

26 Go to www.ieagreen.org.uk/ghgs.htm

On carbon auditing and emissions profiling

27 Go to www.ghgprotocol.org/standard/tools.htm

28 Or go to www.ghgclearinghouse.org.za and check out ‘Other sources on CDM’ in the site’s Resource Centre.

On emissions factors for various fuels and non-fuel sources

29 www.ipcc-nggip.iges.or.jp/public/gl/invs6.htm

Annexure 4

South African DNA materials

1. Project idea note (PIN) template

2. Sustainability criteria

3. Approval cycle

Project idea note (PIN)

Description of size and quality expected of a PIN

Basically a PIN will consist of approximately five pages providing indicative information on:

- the type and size of the project
- its location
- the anticipated total amount of greenhouse gas reduction compared to the business-as-usual scenario (which is elaborated on in the baseline at PDD level)
- the suggested crediting life time
- the suggested certified emission reductions (CER)/ emission reduction units (ERU) or verified emission reduction (VER)price in US$ or € /ton CO_2e reduced
- the financial structuring (indicating which parties are expected to provide the project's financing)
- the project's other socio-economic or environmental effects/benefits.

While every effort should be made to provide as complete and extensive information as possible, it is recognised that full information on every item listed in the template will not be available at all times for every project.[46]

Template for PINs

Project Idea Note

A. Project description, type, location and schedule

Name of Project:______________________________ Date submitted:______________

Technical summary of the project

Objective of the project	Describe in less than 5 lines
Project description and proposed activities	About half a page
Technology to be employed	Describe in less than 5 lines. Please note that support can only be provided to projects that employ commercially available technology. It would be useful to provide a few examples of where the proposed technology has been employed.

Project developer	
Name of the project developer	
Organisational category	a. Government b. Government agency c. Municipality d. Private company Non-governmental Organisation
Other function(s) of the project developer in the project	a. Sponsor b. Operational Entity under the CDM c. Intermediary d. Technical advisor
Summary of the relevant experience of the project developer	Describe in less than 5 lines
Address	Address, PO Box, City, Country
Contact person	Name of the Project Development Manager
Telephone/fax	
E-mail and web address, if any	
Project sponsors	
(List and provide the following information for all project sponsors)	
Name of the project sponsor	
Organisational category	a.Government b.Government agency c. Municipality d. Private company e. Non-governmental Organisation
Address (include web address, if any)	Address, PO Box, City, Country
Main activities	Not more than 5 lines
Summary of the financials	Summarise the financials (total assets, revenues, profit, etc.) in not more than 5 lines.

Type of project	
Greenhouse gases targeted	CO_2 / CH_4 / N_2O / HFCs / PCFs / SF_6 (mention what is applicable)
Type of activities	Abatement/CO_2 Sequestration
Field of activities	
a. Energy supply	Renewable energy, excluding biomass/biomass/Co-generation/improving energy efficiency by replacing existing equipment/minimisation of transport and distribution/fuel switch (e.g., switch coal to biomass) (mention what is applicable)
b. Energy demand	Replacement of existing 'household equipment'/improvement of energy efficiency of existing production equipment (mention what is applicable)
c. Transport	More efficient engines for transport/modal shift/fuel switch (e.g. public transport buses fuelled by natural gas) (mention what is applicable)
d. Waste management	Capture of landfill methane emissions/utilisation of waste and wastewater emissions (mention what is applicable)
e. Land Use Change and Forestry	Afforestation/reforestation/forest management/wetlands management/watershed management/ improved agriculture/land degradation prevention (mention what is applicable) -> Additional information to be provided in Annexure I
Location of project	
Region	East Asia & Pacific/South Asia/Central Asia/Middle East/North Africa/Sub-Saharan Africa/Southern Africa/Central America and the Caribbean/South America/Central and Eastern Europe (mention what is applicable)
Country	
City	
Brief description of the location of the project	No more than 3 – 5 lines
Expected schedule	
Earliest project start date	Year in which the plant will be operational
Estimate of time required before becoming operational after approval of the PIN	Time required for financial commitments: xx months Time required for legal matters: xx months Time required for negotiations: xx months Time required for construction: xx months
Expected first year of verified Emission Reduction or CER / ERU delivery	Year
Project lifetime	Number of years
Current status or phase of the project	Identification and pre-selection phase/opportunity study finished/pre-feasibility study finished/feasibility study finished/negotiations phase/contracting phase/etc. (mention what is applicable and indicate the documentation [e.g., the feasibility study] available)
Current status of the acceptance of the Host Country	Letter of No Objection is available/Letter of Endorsement is under discussion or available/Letter of Approval is under discussion or available/Host Country Agreement is under discussion or signed/ Memorandum of Understanding is under discussion or available / etc. (mention what is applicable)
The position of the Host Country with regard to the Kyoto Protocol	The Host Country a. signed or acceded to the Kyoto Protocol or b. signed and has demonstrated a clear interest in becoming a party in due time (e.g., countries which have already started or are on the verge of starting the national ratification, acceptance or approval process) or c. signed the Kyoto Protocol, d. .is a Party to the UNFCCC. (mention what is applicable)

B. Expected environmental and social benefits	
Estimate of Greenhouse Gases abated/CO_2 Sequestered (in metric tons of CO_2-equivalent)	Annual: Up to and including 2012: xx tCO_2-equivalent Up to a period of 10 years: xx tCO_2-equivalent Up to a period of 7 years: xx tCO_2-equivalent Up to a period of 14 years: xx tCO_2-equivalent
Baseline scenario	CDM/JI projects must result in GHG emissions being lower than 'business-as-usual' in the Host Country. At the PIN stage questions to be answered are at least: * Which emissions is the proposed Clean Development Mechanism (CDM)/Joint Implementation (JI) project displacing? * What would the future look like without the proposed CDM/JI project? * What would the estimated total greenhouse gas (GHG) reduction be? (About 1/4 to 1/2 page)
For sequestration projects only:Existing vegetation and land use	(What is the current land cover and land use? Is the tree cover more or less than 30%?)
Specific global and local environmental benefits	(In total about 1/4 page)
Which guidelines will be applied?	Name and, if possible, the website location
Local benefits	
Global benefits	
Socio-economic aspects What social and economic effects can be attributed to the project and which would not have occurred in a comparable situation without that project? Indicate the communities and the number of people that will benefit from this project.	(In total about 1/4 page)
Which guidelines will be applied?	Name and, if possible, the website location
What are the possible direct effects (e.g., employment creation, capital required, foreign exchange effects)?	
What are the possible other effects? For example:	training/education associated with the introduction of new processes, technologies and products and/or the effects of a project on other industries
Environmental strategy/priorities of the Host Country	A brief description of the relationship of the consistency of the project with environmental strategy and priorities of the Host Country (Not more than 1/4 page)

C. Finance

Total project cost estimate	
Development costs	xx US$ million
Installed costs	xx US$ million
Other costs	xx US$million
Total project costs	xx US$million
Sources of finance to be sought or already identified	
Equity	Name of the organisations and finance (in xx US$million)
Debt – Long term	Name of the organisations and finance (in xx US$million)
Debt – Short term	Name of the organisations and finance (in xx US$million)
Not identified	xx US$million
Carbon finance contribution sought	xx US$million
Carbon finance contribution in advance payments. (The quantum of upfront payment will depend on the assessed risk of the project by the World Bank.)	xx US$million and a brief clarification (not more than 5 lines)
Sources of carbon finance	Name of carbon financiers other than PCF that your are contacting(if any)
Indicative CER/ERU or VER Price (subject to negotiation)	
Total Emission Reduction Purchase Agreement (ERPA) Value	
A period until 2012 (end of the first budget period)	xx US$/€
A period of 10 years	xx US$/€
A period of 7 years	xx US$/€
A period of 14 years (2 x 7 years)	xx US$/€
If financial analysis is available for the proposed CDM activity, provide the forecast financial internal rate of return for the project with and without the CER revenues. Provide the financial rate of return at the expected CER price above and US$3/ tCO_2e. DO NOT assume any upfront payment from the PCF in the financial analysis that includes PCF revenue stream. Please provide a spreadsheet to support these calculations.	

Illustrative project categories and examples include:

Code	**Afforestation and reforestation**[46]
1	Rehabilitation of degraded tropical lands (e.g. Imperata grasslands) to
1a	forest
1	Agroforestry
2	Reforestation of degraded temperate grasslands or arid lands by tree planting
3	Establishing tree/shade crops over existing crops (e.g. coffee)
4	Plantations for wood products
4a	Small scale landholder driven
4b	Commercial scale
5	Landscape rehabilitation through planting corridors, etc.
6	Fuel wood plantings at a commercial scale
	Forest management
7	Improved forest management via fertiliser, in-plantings, etc.
8	Improved fire management
9	Reduced impact logging
10	Alternatives to fuel wood for forest/environmental protection
	Cropland management
11	Reduced till agriculture
12	Other sustainable agriculture
	Grazing land management
13	Revegetation of semi-arid and arid lands with shrubs or grasses
14	Improved livestock management leading to vegetation and soil recovery
15	Bio-fuels: Use of biological residue to produce energy
16	Other

The South African Designated National Authority will evaluate CDM projects submitted to it through consideration of the following three criteria:

1 Economic: Does the project contribute to national economic development?

2 Social: Does the project contribute to social development in South Africa?

3 Environmental: Does the project conform to the National Environmental Management Act principles of sustainable development? These are that: 'sustainable development requires the consideration of all relevant factors including the following:

a. That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be avoided, are minimised and remedied

b. That pollution and degradation of the environment are avoided, or where they cannot be altogether avoided, are minimised and remedied

c. That the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied

d. That waste is avoided, or where it cannot be altogether avoided, minimised and reused or recycled where possible and otherwise disposed of in a responsible manner

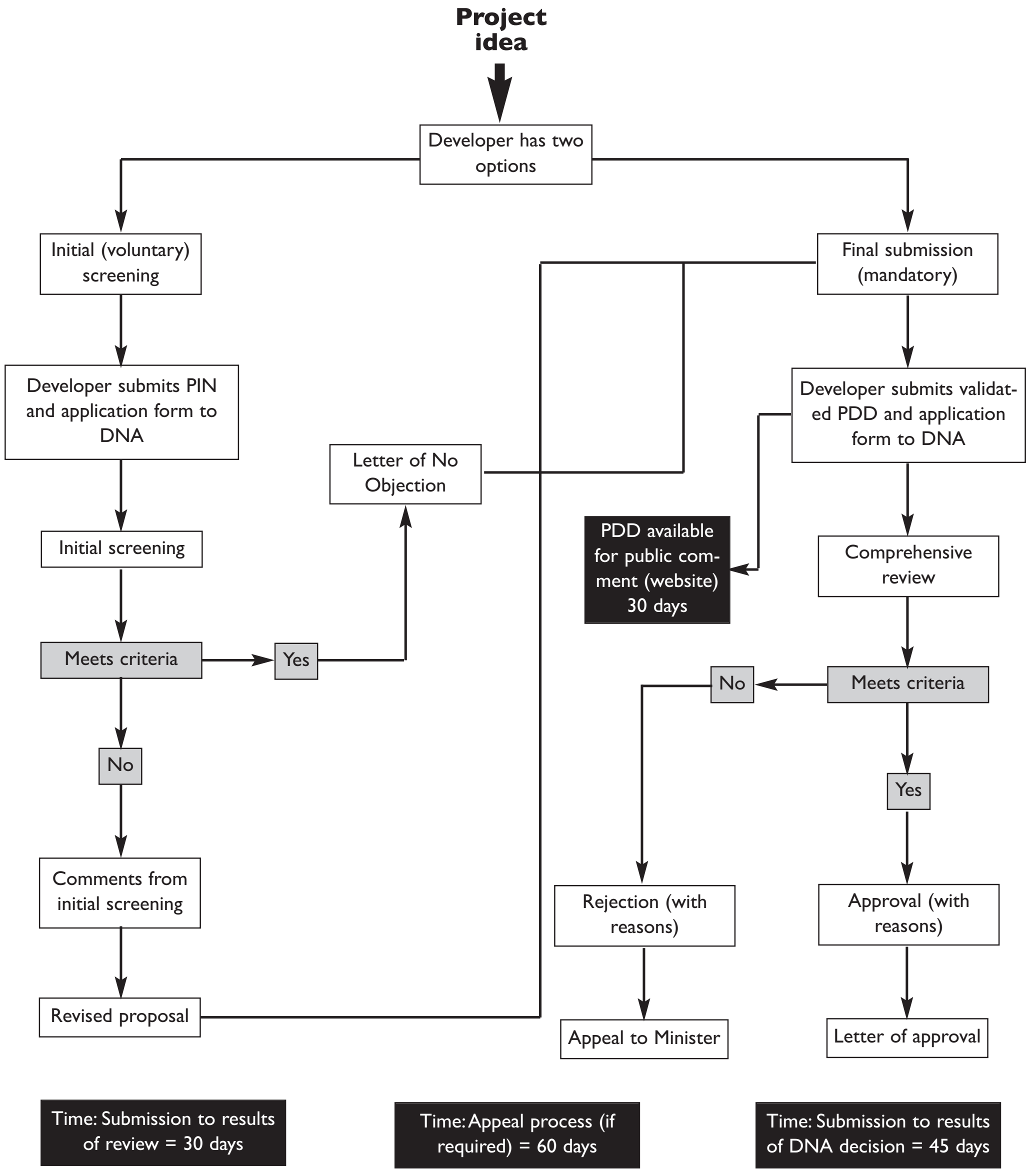
e. That the use and exploitation of non-renewable resources is responsible and equitable, and takes into account the consequences of the depletion of the resource

f. That the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised

g. That a risk averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions

h. That negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied'.

If a project is deemed by the DNA to be contrary to the spirit of the Kyoto Protocol or contrary to the intention of stated government policy the DNA reserves the right to refuse project approval until such time as suitable alterations are made to the project design. In such instances clear reasons for the rejection of a project must be provided by the DNA.



Project idea
Developer has two options
Initial (voluntary) screening
Final submission (mandatory)
Developer submits PIN and application form to DNA
Letter of No Objection
Developer submits validated PDD and application form to DNA
PDD available for public comment (website) 30 days
Initial screening
Comprehensive review
Meets criteria
Yes
No
Meets criteria
No
Yes
Comments from initial screening
Rejection (with reasons)
Approval (with reasons)
Revised proposal
Appeal to Minister
Letter of approval
Time: Submission to results of review = 30 days
Time: Appeal process (if required) = 60 days
Time: Submission to results of DNA decision = 45 days

Endnotes

1 This does not include emissions from the other sectors, for example domestic, commercial, agriculture and transport. Overall, the industrial sector, including mining, accounts for 9% of direct emissions, i.e. not counting indirect emissions through electricity use.

2 See further discussion of this figure in endnote 3.

3 South Africa: Initial National Communication, Department of Environment and Tourism, 2000. The figure for methane missions is based on what are known as default factors from the Intergovernmental Panel on Climate Change (IPCC), and not on specific data from South Africa. More recent work done for Coaltech 2020 by Lloyd and Cook suggests that the IPCC factors may overestimate methane emissions from South African mining by as much as 400%. This does not mean that opportunities for reducing methane emissions are not significant, only that South Africa's contribution to global warming through methane release should be somewhat smaller than originally indicated. (*Methane release from South African coal mines*, report to Coaltech 2020 by P Lloyd and A Cook, 2003)

4 The other two mechanisms are joint implementation (a project-based mechanism for generating credits in Annex 1 countries only) and emissions trading (which encompasses trading between Annex 1 countries in a variety of different types of emissions credits). Non-annex 1 countries, such as South Africa, are not permitted to participate in these two mechanisms.

5 Most of the current action on the buyer's side of CDM comes from the EU and Japan, as Canada has recently indicated that it may not continue to support Kyoto.

6 Demonstrating that the project would not have occurred without the benefit of CDM is referred to as additionality.

7 In this context, certification refers to the action taken by the CDM Executive Board to certify that the CERs are still being generated as predicted by the PDD. This results from a step called verification, which involves assessment by an independent monitor (see further description of this stage in the process in Section 2).

8 A small-scale CDM project is one that saves less than 15 000 tons of CO_2-equivalent a year, or less than 15 000 GWh of electricity. Such projects are less costly both to develop and to register, owing to special procedures put in place by the CDM Executive Board.

9 There are exceptions to this rule, for example there are consolidated methodologies for certain types of projects, particularly small-scale projects that can be used in a variety of applications.

10 Applicability means the conditions or criteria that the project must meet to use the methodology. The applicability of a method for conversion from coal to gas might, for example, stipulate that the methodology applies only to natural gas and not gas (methane) generated from digesters. Or it might stipulate the amount of historical data available, or the latest date on which the facility could have commenced production.

11 The factors are: 21:1 for methane and 311:1 for nitrous oxide. In some cases, the methodology used may dictate that only carbon dioxide emissions are to be measured.

12 www.ipcc.ch. The IPCC is responsible for development of national greenhouse gas inventories and for establishing the scientific basis for climate change.

13 The First National Communication by South Africa to the UNFCCC (2000) indicates that the three gases actually contributed over 99% of CO_2-equivalent emissions for the country in 1994.

14 CDM Pipeline, April 2006 (Meth Charts). Published on the web by UNEP-RISOE Centre, www.uneprisoe.org/cdmpipeline.

15 This limit has now been extended to December 2006.

16 The sole South African DOE is Price Waterhouse Coopers, which received final accreditation in May of 2006.

17 Annex 1 countries are those countries that have ratified the Kyoto Protocol and have agreed to emissions reductions commitments for the First Commitment Period, 2008 – 2012.

18 The opportunity to use CERs to meet EU allowance shortfalls has been created by an EU action called the Linking Directive, which states that CERS can be used to meet a percentage of the carbon allowances of EU entities.

19 The World Bank runs a number of funds, including the Community Development Carbon Fund.

20 Some examples of VER buyers include: the UNDP, World Bank and Future Forests.

21 For a detailed discussion of these factors, see the Point Carbon 2006 report, cited in Annexure 3.

22 The 2nd Commitment Period for Kyoto is currently under negotiation, and if agreed would commence in 2013.

23 The Gold Standard is a best practice methodology that accredits projects having exceptional sustainability features. See www.cdmgoldstandard.com.

24 Some buyers of carbon credits will absorb the initial costs of verification, as they will of validation. The most common arrangement is for the buyer to pay for the first verification and the seller any further verification.

25 See Section 2 for more detail on OEs and PDD requirements. Note that for small-scale projects, both validation and verification can be performed by the same OE.

26 Durban's landfill gas-to-electricity project was one of the pioneering CDM projects in South Africa, but local objections to the extension of a key landfill site led to a substantial reduction in the size of the project.

27 www.ipcc.int

28 Signed into law in early 2005.

29 www.globalreporting.org

30 *Breaking New Ground: Mining, Minerals and Sustainable Development*, Earthscan, London 2002.

31 cdm.unfccc.int/EB

32 For example: www.dnvcert.com/DNV/Certification1/Services/GreenhouseGas/ CDMProjects1/

33 cd4cdm.org/Publications/CDMpipeline.xls

34 cdm.unfccc.int/Projects/Reference/Documents/index.html

35 www.dnv.com/certification/climatechange/Upload/RSMML%20-%20LGO%20-%20DNV.pdf

36 Crediting periods for CDM projects can be either 10 years or 3 x 7 (=21) years, depending on the characteristics of the project. It should be noted that this formal crediting period is unrelated to the period during which credits can be sold, which is constrained by fact that the first commitment period of Kyoto ends in 2012.

37 cdm.unfccc.int/Projects/Validation/DB/S5988JSH5K97SK9MINNCAO8J8CDT35 /view.html

38 As calculated according to the IPCC approved methodology for grid connected power.

39 See Annexure 2 for details of this methodology.

40 cdm.unfccc.int/Panels/meth/Meth19_repan_09_Baseline_selection_tool.pdf

41 www.dnv.com/certification/climatechange/Upload/PDD_Huainan%20Panyi%20and%20 Xieqiao%20CMM_2006-01-01.pdf

42 www.ipcc.ch

43 cdm.unfccc.int/Projects/pac/howto/CDMProjectActivity/NewMethodology

44 dm.unfccc.int/methodologies/PAmethodologies

45 See Annexure 1 for Land Use and Land Use Change (LULUCF) project categories.

46 This is the only class of activities accepted under the CDM for the first commitment period.