Mining Sector Working Paper

Appendix B

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Executive Summary

"In our increasingly globalised world, companies are major economic actors who can play a significant role in areas like poverty alleviation, climate change, trade liberalisation, supporting good governance, technology transfer and capacity-building."

Cynthia Carroll, CEO of Anglo American

This paper is one of nine sector working papers written as part of the process of developing a National Strategy on Climate Change and Low Carbon Development for Rwanda and follows on from the Baseline Report produced in February 2011, which presented the local Rwandan context for all the sectors. It should be read in conjunction with the Strategic Framework, including a vision for 2050, objectives, guiding principles and strategic pillars for the National Strategy. The aim of each paper is to review the sector, both the status in Rwanda and global best practice and relevant case studies, and to propose an action plan for addressing climate change and low carbon development in the short, medium and long term. This action plan includes policies, actions, timescales, stakeholders, indicators and sources of funding, and is subject to stakeholder review.

This paper focuses on the mining industry, which contributed over 38% of Rwanda's export earnings in 2010 (96.4 million USD) and is expected to support economic growth and job creation in the coming decade. Although a relatively small industry at present, it has the potential to make a significant contribution to low carbon development. Due to the very limited exploration and lack of ore resource knowledge, it is difficult to predict future production (both ore type and quantity) and impacts that the mining industry in Rwanda will have. Even if domestic production is limited however, there is potential for value addition through processing of both domestic and imported ores and manufacturing of construction materials and jewellery. There is also potential for a services industry to support mining in the region.

The Government of Rwanda (GoR) adopted its Revised Mining Policy[1] in 2010 which has five strategic pillars which support the growth of the mining industry. If this is considered 'business as usual' for the next decade, then mining and mineral processing is likely to contribute significantly to energy use, greenhouse gas (GHG) emissions and water use in Rwanda. This paper proposes a sixth strategic pillar for the Mining Policy – low carbon, climate resilient development – which would aim to reduce GHG emissions and demand on energy and water. It has four focus areas: energy efficiency, renewable energy, water management and capacity building. For each focus area, a number of options were reviewed and analysed based on best practice and the same three criteria used in the Revised Mining Policy - suitability, feasibility and acceptability. Twelve policy options and actions are given with the two 'quick wins' for immediate action by the GoR being monthly reporting on energy and water, and joining the Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development (IGF).

The industry is at a critical stage as recent privatisation of concessions and proactive government policy drives its development. It can choose to follow the conventional path and contribute to GHG emissions and the resultant negative consequences, or it can take the opportunity and do it right the first time. It is far more expensive to convert a high carbon system to a low carbon one, than to implement it from the start. As pressure to protect the environment, support local communities and contribute to development increases, it makes sense for mining companies to adopt a new approach.

Contents

Acronyms and Abbreviations

ADF	African Development Fund
AfDB	African Development Bank
CDM	Clean Development Mechanism
CDP	Carbon Disclosure Project
CRC	Cooperative Research Centre
CSRP	Centre for Sustainable Resource Processing
DWA	Department of Water Affairs (South Africa)
EDPRS	Economic Development and Poverty Reduction Strategy
EWRP	Emalahleni Water Reclamation Plant
EWSA	Energy, Water and Sanitation Authority
DRC	Democratic Republic of Congo
GHG	greenhouse gas
GoR	Government of Rwanda
GRI	Global Reporting Initiative
ICMM	International Council for Mining and Metallurgy
IGF	Intergovernmental Forum on Mining, Minerals, Metals and Sustainable Development
IPP	independent power producer
IWRM	Integrated Water Resource Management
LOM	Life of Mine
MIDIMAR	Ministry of Disaster Management and Refugee Affairs
MINALOC	Ministry of Local Government
MINECOFIN	Ministry of Finance and Economic Planning
MINELA	Ministry of Environment and Lands
MINICOM	Ministry of Trade and Commerce
MINIFOM	Ministry of Forestry and Mines
MININFRA	Ministry of Infrastructure
MINIRENA	Ministry of Natural Resources
Ml	megalitre
MW	megawatt
MWh	megawatt hours
NAFA	National Forestry Authority
NAPA	National Adaptation Programme of Action
NLC	National Land Centre
OGMR	Office of Geology and Mines of Rwanda
PPP	public-private partnership
PSF	Private Sector Federation
RDB	Rwanda Development Board
REACT	Renewable Energy and Adaptation to Climate Technologies
RNRA	Rwanda Natural Resources Authority
RURA	Rwanda Utilities Regulatory Agency
SAIMM	Southern African Institute of Mining and Metallurgy
SD	Sustainable Development
SWP	Sector Working Paper
WCI	World Coal Institute
WBCSD	World Business Council for Sustainable Development

Introduction

The mining industry in Rwanda is in a state of transition, with recent privatisation of big concessions and moving from artisanal mining to a sustainable economic and competitive industry. As the largest export earner, it plays a significant role in the economy and is a key focus area for the Government of Rwanda (GoR). It provides employment to over 35,000 people and earned USD 96.4 million, 38% of export revenue, in 2010[2]. The main exports are cassiterite (tin ore), wolframite (tungsten ore) and coltan (tantalum ore) with small amounts of gold and sapphires. Due to limited exploration and lack of ore resource knowledge, the future potential is uncertain, but it is likely that tin, tungsten, coltan, gold and possibly nickel will be the main export earners. There is also potential for a number of gemstones and construction materials to be quarried and mined.

The Ministry of Natural Resources (MINIRENA) is responsible for policy development while the Geology and Mines Department at the Rwanda Natural Resources Authority (RNRA) is responsible for implementing policy. The current focus is on exploration and new targets in the Economic Development and Poverty Reduction Strategy (EDPRS 2008-2012) aim to triple production and increase revenue by to USD 120 million by 2013. The key challenges are lack of ore reserve knowledge, limited local technical and business skills and low investment in the sector. The mining industry is vulnerable to global price shocks and to global climate change. Opportunities for product diversification and mining services are therefore very important for the stability and growth of the industry. Rwanda could position itself as a regional mining services hub and contribute to achieving Vision 2020 which strives towards a knowledge-based economy. As the industry grows, it has the opportunity to develop in a low carbon way. This is largely dependent on the type of energy used in mining and mineral processing, but water use and energy efficient technologies and methods also play an important role. Import substitution through quarrying construction materials in Rwanda could significantly bolster the domestic market but also reduce transport emissions.

This Mining Sector Working Paper (MSWP) will summarise vulnerabilities and opportunities related to climate compatible development and identify focus areas for further analysis. It will review relevant best practice and propose policies and actions that the GoR could take. The MSWP recognises that although the industry is small it has the potential to grow. The Rwanda Revised Mining Policy has five pillars and eight key objectives (figure 1.1) aiming for increased productivity, investment, jobs and exports by 2020[1]. This paper assumes that this will happen and therefore it provides challenges and solutions for a larger industry. It looks to the year 2050 and proposes that best practice is possible in Rwanda.

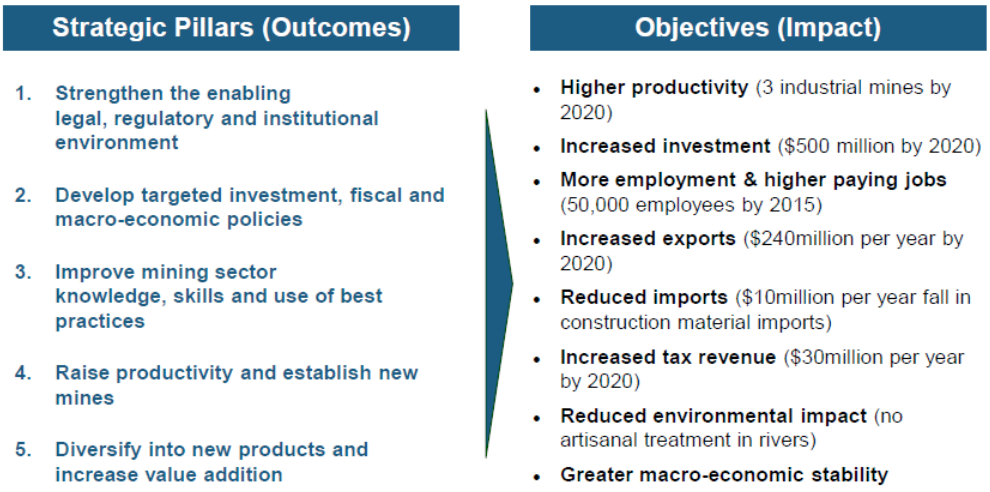

Figure 1.1: The Pillars and Objectives of the Revised Mining Policy for Rwanda
Source: MINIFOM, 2010

The paper covers the whole scope of the mining industry, from exploration to closure, though the focus is on operations. Operations include a number of steps shown in figure 1.2, from mining through the different stages of mineral processing, though not all minerals require all stages of processing. Not all of these are present in Rwanda at this point but are likely to be in the future.

It is difficult to know which parts of the mining industry in Rwanda produce the most GHG emissions as there is no data available. Rwanda's Second National Communication to the United Nations Framework Convention on Climate Change (UNFCCC) does not mention mining although cement and lime production emissions were estimated. It is likely that the nine mineral processing plants are the biggest source of emissions at present in Rwanda, but as the industry grows other areas will also contribute significantly to emissions. Across the global mining industry, energy use varies according to mining and processing methods used. Examples of the split of energy and emissions in mining are shown in the figures below. The US mining industry is dominated by open cast mines and the highest energy use is in concentrating at 44% followed by hauling (21%), as shown in figure 1.3. Anglo Platinum (figure 1.4) is dominated by deep-level underground mines and as a result uses much more energy in mining (37%) but it also has a complex mineral processing involving concentrating, smelting and refining which together use 63% of energy, dominated by smelting (28%) and then concentrating (24%).

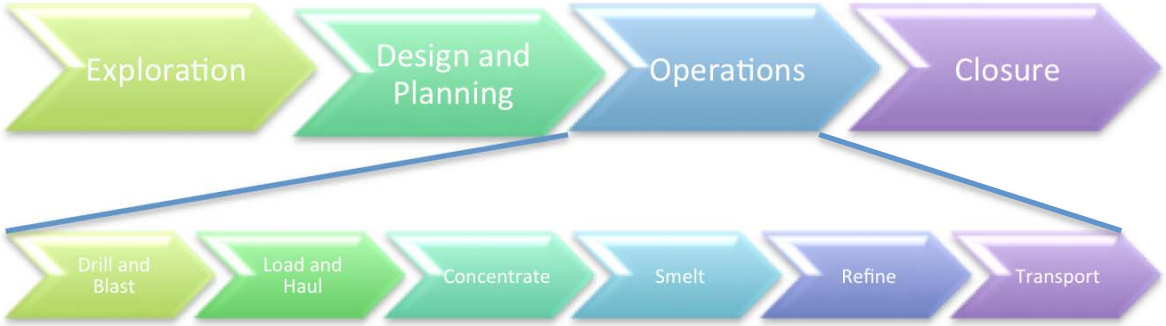

Figure 1.2: Phases of operation in a mining company

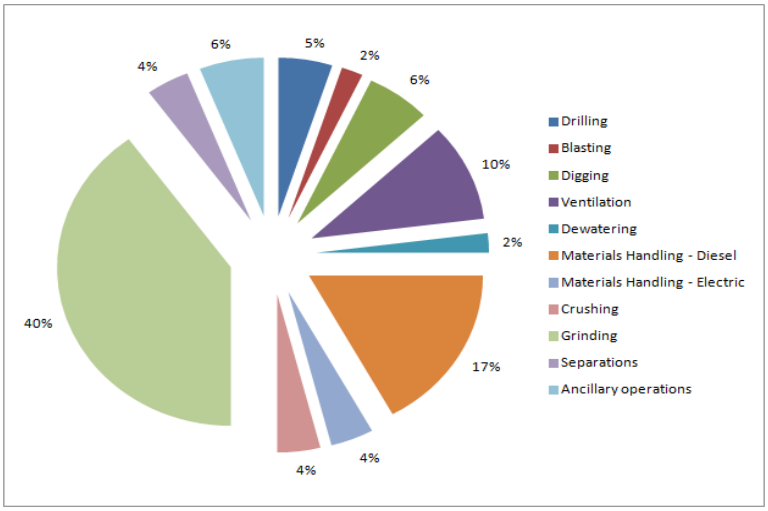

Figure 1.3: Contribution of energy use by equipment across the US Mining Industry[3]

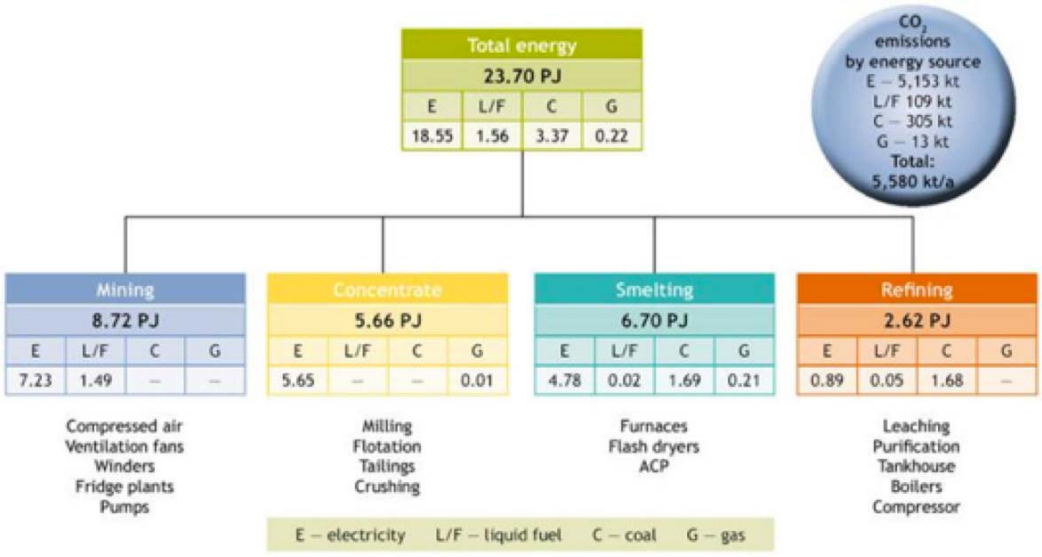

Figure 1.4: Anglo Platinum's energy and carbon footprint in 2009[4]

The vision proposed for the National Strategy on Climate Change and Low Carbon Development is:

> *For Rwanda to be a developed, climate-resilient, low-carbon economy by 2050, having led the way for other developing countries to do the same.*

The mining sector in Rwanda can contribute to this vision by becoming low carbon and climate resilient. This will reduce GHG emissions, reduce energy costs and reduce costs of stoppages due to extreme weather events. Mining has much potential for supporting economic growth in Rwanda. The opportunity that it now has, is to take climate change into account at an early stage of its development and avoid the mistakes of the past, setting an example for the future.

Vulnerabilities

The mining sector in Rwanda faces a number of challenges to its growth and development, which are listed in table 2.1. Not all are climate change-related, but they do affect development and therefore are relevant. These issues generally overlap with other sectors, listed in the table and discussed more in chapter 4.

Table 2.1 covers the whole spectrum of vulnerabilities for the mining sector in Rwanda, which include direct and indirect vulnerabilities to climate change. The indirect vulnerabilities include lack of relevant training, the impact of climate change on neighbouring countries and limited institutional frameworks. The direct physical impacts of climate change which require adaptation are shown in table 2.2.

Table 2.1: Vulnerabilities in the Mining Sector in Rwanda

Parameter	Vulnerabilities	Sector Overlaps
Economic/ Finance	Low private investment as resources uncertain	Finance
	Dominated by small scale miners	Local government
	Royalties and taxes may result in under-reporting	Finance
	High costs of fuel and electricity discourage investment	Transport, Energy
	Limited access to reliable water supply	Water
Social/ Capacity	No university courses (geology, mining etc.)	Education
	No technical courses (drilling, blasting etc.)	Education
	Limited land available – competition for land	Land
	Revenue could benefit communities more	Finance
Technology/ R&D	Low tech/not mechanised	Energy
	High tech exploration done by consultants	Water
Political	Difficult to import ores from neighbouring countries due to their conflict minerals	
	Obligation of required certified trading chain incurs added costs	
Legal /Institutional	Low capacity to implement law and policy	
	No requirement for reporting on energy and water use	Energy, Water
	Difficult to regulate artisanal miners	Local government
Environment /Climate	Causes environmental degradation (e.g. river pollution)	Environment, Land, Water
	Can cause deforestation	Forestry
	At risk from floods and storms	Disaster Management
	Workforce affected by disease, heat waves	Health
Communication /Information	Low safety awareness	Education
	Government funding difficult to obtain	
	Negative perception of industry due to land use conflict	Lands
	Lack of data on energy and water sources and use	Energy, Water

Table 2.2: Climate change direct impacts on mining

Meteorological Change	Direct impact	Impact on mining
Increase in temperature	Heat wave	Reduced human productivity
	Spread of disease	Reduced human productivity
	Stronger storms	Damage to equipment and infrastructure –electricity and transport hindered Landslides cause damage, injury and death
Change in rainfall	Floods	Damage to equipment and infrastructure –electricity and transport hindered Landslides cause damage, injury and death
	Droughts	Reduced water supply Competition for water supply

The largest threat from climate change direct impacts in Rwanda, is that of floods and storms which could flood working areas, damage equipment, cause landslides (and possibly injuries) and isolate the operation from transport and infrastructure. This would have large financial impacts and unfortunately there is very little that most mines and quarries in Rwanda can do about this at present. In the future however, there are a number of actions that they could possibly take to address all aspects of adaptation. These are:

- Site infrastructure in low risk areas
- Design weather resilient facilities
- Develop low water-intensive operations and processes
- Geographic diversification of supply chain
- Diversification and expansion of infrastructure
- Train employees to recognise and respond to new diseases

The government can also act at a local, regional and national level to support mining companies in adapting to climate change. Some examples are[5]:

Local/ Regional

- Increase aquifer storage volume
- Install early warning systems
- Use non water-based sanitation

National

- Integrate risk management and adaptation into development policy
- Upgrade emergency response planning
- Develop national health programmes for public awareness and prepare for spread of new diseases

These programmes are all being addressed in other Sector Working Papers and reports.

Apart from the obvious costs from direct impacts and adaptation actions mentioned above, climate change could also increase the operating cost of a mine due to increasing energy and water costs, carbon taxes and the added costs of measuring, reporting and monitoring energy and water use and GHG emissions.

Opportunities

The mining industry in Rwanda has seen large growth in the last decade due to privatisation and mining sector reform (regulations, cooperatives, organisational development), yet it is still a young industry. This means that there is potential for growth and to contribute to the development of the economy. The main benefits of mining to Rwanda would be foreign exchange, economic development and employment. A services industry could develop to support the industry in both Rwanda and the region, estimated to be able to generate an additional USD 83 million by 2020[6]. Mining companies could also contribute to infrastructure – roads, dams and pipelines – to support them and the communities in the surrounding areas. Opportunities that are open to the mining sector in Rwanda are summarised in table 3.1 below.

Table 3.1: Opportunities for the mining sector in Rwanda

Parameter	Opportunities	Sector overlaps
Economic /Finance	Develop mining services industry	Finance
	GoR use taxes, fees and royalties to develop resources and infrastructure to promote investment	Transport, Energy
Social /Capacity	Job creation and socio-economic development	Education
	Education and Training - Skills development	Education
	Supporting services industry – SMEs	Industry
Technology /R&D	Mechanisation of mining and processing activities	Energy, Water
	Drilling companies for geothermal energy also provide mining services	Energy
	Value addition through processing and refining	Industry
Political	Processing of ore from region	Energy, Water
	Regional expertise - could create a Institutes and Societies for knowledge sharing	
Legal/ Institutional	Regular reporting on water, energy use and source	Energy, Water
	Reporting on targets vs actual and audits	Water
Environment /Climate	Energy efficiency	Energy
	On-site energy generation	Energy
	On-site water management	Water
	Water treatment	Health, Built enviro.
Communication /Information	Promote benefits of mining - jobs, revenue, energy and water services	Education, Industry
	Communicate potential to foreign investors	
	Develop database on energy and emissions to set targets	Finance
		Energy

One area of opportunity for the mining sector in Rwanda is mineral processing of ore from other countries in the region. Table 3.2 lists the mineral and quarry resources in Rwanda and surrounding countries as well processing facilities in the region (sourced from USGS[7]). Mineral processing would have economic benefits to the country but would increase energy demand significantly and therefore potentially increase GHG emissions significantly. Energy efficiency and low cost renewable energy would be important in making this viable. Rwanda currently has two smelters but neither is operational due to the high cost of electricity, making it cheaper to process the ore in another country. Another area of opportunity is product diversification and import substitution of construction materials, indicated in table 3.4, as only cement, bricks and tiles are manufactured in Rwanda at present and in small quantities. This would benefit the local economy and it would reduce related transport emissions.

As mining is an energy intensive industry, there are many opportunities for mitigation of GHG emissions, though these should not come at the expense of economic development. Measures that can be taken include energy efficiency, demand-side management, renewable energy, new technology, carbon footprinting, emissions reduction targets, water efficiency and research and development. Energy costs are high in Rwanda and

Table 3.2: Mineral and other resources and processing capacity in and around Rwanda

Country	Metals	Gemstones	Other	Processing
Rwanda	tantalum, tungsten, tin, gold (nickel)	sapphire, ruby (amethyst, tourmaline, opal, amethyst, topaz, garnet, chiastorite, agate)	granite, limestone, sand, stone, clay, kaolin, diatomite, marble	Wolframite, cassiterite, coltan, tin smelting (in rehabilitation)
Kenya	gold	ruby, sapphire, tsavorite, aquamarine, cordierite, emerald, tourmaline	limestone, soda ash, fluorspar, gypsum, marble, granite, sand, shale	cement, lead
Tanzania	gold, copper, cobalt, nickel, (platinum), silver	tanzanite, diamond, amethyst, aquamarine, cordierite, emerald, garnet, ruby, sapphire, spinel, tanzanite, tourmaline	limestone, phosphate, soda ash, stone, sand, gravel, dolomite, bauxite, marble	cement, lime, diamonds, semi-processed steel, crushed stone
DRC	copper, cobalt, niobium, tantalum, tin, silver, tungsten, gold, zinc, lead	diamond, tourmaline	stone, lime	copper & cobalt smelting aluminium smelter proposed
Zambia	copper, cobalt, gold, silver, (manganese), nickel, lead	beryl, citrine, tourmaline, amethyst, aquamarine, emerald, garnet	limestone, clays, sand, gravel	copper & cobalt smelting, cement, oil, bricks, lime
Uganda	gold, lead, cobalt, iron ore, tungsten, tantalum, tin		limestone, gypsum, salt, vermiculite, phosphate	steel, cobalt smelting
Burundi	gold, niobium, tantalum, tungsten, tin (nickel, cobalt, copper, gold, vanadium)		limestone, sand, gravel	niobium & tantalum concentrating

Table 3.3: Potential diversification and import substitution[1]

Mined product	Estimated resource	Manufactured product
Sand	6.5 million tonnes	Glass manufacturing
Fine clays	4.5 million tonnes	Bricks, roof tiles, ceramics (e.g. insulators, porcelain, paint)
Limestone, kaolin, gypsum	2.9 million tonnes	Lime, chalk, fertiliser, concrete
Talc	Unknown	Cosmetics
Dimension stones - granites, marble, amphibolites, schist, siltstone	Abundant	Tiles (stone cutting and polishing)
Gemstones	Unknown	Jewellery

electricity can be unreliable. Efficiency improvements are win-win as they reduce operating costs and emissions but they may require initial upfront investment in new technology. Operations could also invest in on-site clean electricity generation to improve security of supply, come with lower operating cost and near zero emissions. Each operation would require an economic analysis to determine the optimal approach. These opportunities will be discussed in detail in the following chapters.

Sector Overlaps

There is a large amount of overlap with the mining sector and other sectors, and MINIRENA, RNRA, private companies and cooperatives need to work with other sectors to address both vulnerabilities and opportunities that it faces. As an industry, there is much overlap with the Trade and Industry sector, which faces similar challenges relating to climate change. Much of what is discussed in this working paper is relevant to other industries operating in Rwanda, particularly on energy and water efficiency. The Ministry of Trade and Commerce (MINICOM), the Rwanda Development Board (RDB) and the Private Sector Federation (PSF) are key stakeholders for industry. Mining is a big user of energy and has the ability to become a producer of energy. There therefore needs to be close working relationships with the energy sector, both government and private sectors. The Ministry of Infrastructure (MININFRA), the Energy, Water and Sanitation Authority (EWSA) and the Rwanda Utilities Regulatory Agency (RURA) are all key stakeholders for mining.

Mining is also a user of water and is often guilty of degrading water resources in mining areas which affects local communities. Mining needs to work with water stakeholders in different levels of government and in civil society to ensure that it does not have a negative impact on other sectors. MININFRA, EWSA, MINIRENA, RNRA, local governments and NGOs are key stakeholders. As the climate changes and heavy rain and storms become more frequent, mines will be affected, especially the quarries and small scale mines. The sector should work with the Ministry of Disaster Management and Refugee Affairs (MIDIMAR) to find ways to reduce vulnerability. Financing new mining projects and introducing sustainable mining practices is a challenge in Rwanda and the sector will need to work with RDB, the Ministry of Finance and Economic Planning (MINECOFIN) and MININFRA to make good practice affordable. Lastly, mining requires land, a scarce resource in Rwanda. Land use management is of utmost importance for the country as its population grows rapidly. Allocation of mining concessions needs to take other possible land uses into account and should be done in consultation with local government, the Ministry of Local Government (MINALOC) and the Land and Mapping Department and the Forestry Department at RNRA.

Focus Areas

In order to transform mining into a low carbon industry, energy use has to decrease and clean energy sources need to be utilised. Energy efficiency is the simplest and cheapest approach as it usually only requires improved management of the status quo. It results in cost savings for the operation as less energy is used. But energy efficiency is limited in reducing GHG emissions and more substantial emissions reduction would be gained by utilising clean energy instead of high carbon energy. The mining industry is Rwanda is fortunate as there are many clean energy options and the government is pursuing a low carbon energy future, meaning that future grid electricity could have minimal associated GHG emissions. Mines are big users of electricity and could act as anchor customers to new large scale renewable energy projects in Rwanda.

One of the impacts of climate change is variation in rainfall which affects water resources. Water management is an important operational and environmental matter for the mining industry. Without water, the industry cannot operate, and yet it has a bad reputation for mismanaging the water it relies on. Using water usually requires energy for pumping and therefore improving water efficiency reduces energy consumption. Although Rwanda has high rainfall, it has limited storage capacity and infrastructure. As the mining industry grows, it will require larger, more reliable sources of water. The changing rainfall patterns may also result in more flooding and severe storms, which can impact on mining. Flood water management also needs to be taken into account on mine operations.

Due to the nature of the industry, there is limited human capacity in Rwanda which is a limiting factor on its growth. University degrees and technical training courses need to be offered in the country to support its development. This is particularly true in relation to addressing climate change, where new understanding and skills are required.

The focus areas for the mining sector in Rwanda for the National Strategy on Climate Change and Low Carbon Development can be summarised as:

- Energy efficiency
- Renewable energy generation
- Water management
- Capacity building

These will be explored in more detail in chapter 7, after a review of best practice and relevant case studies.

Review of Best Practice and Case Studies

The mining industry is estimated to contribute 1.8% of global GHG emissions[8]. In South Africa, the mining industry is estimated to use 6% of all the energy consumed; in Brazil, the largest single energy consumer is mining giant Vale, which accounts for around 4% of all energy used in the country; and in the United States, the mining industry uses 3% of industry energy[9]. Many of the metals produced are essential for 'green technologies' which reduce emissions. Mining is a relatively large user of water but often develops water infrastructure (dams and pipelines) that is used by local communities. So the industry is both part of the problem and part of the solution to the climate change challenge. At an international level, there is full commitment to addressing climate change both in mitigation and adaptation. All the major mining companies have committed to energy efficiency targets and to improve water management on operations. All of them face significant business risk if they ignore climate change. Impacts are already being seen through extreme weather events causing mine closures (e.g. Australia in January 2011), governments proposing taxes on coal production and imports (e.g. India in March 2010), research shifting focus to energy and water efficient technologies, and government and shareholders becoming more demanding of reporting requirements.

As part of the Carbon Disclosure Project (CDP), Acclimatise produced a report on the global mining industry in 2010 called 'Building business resilience to inevitable climate change'[10]. It reviewed the CDP submissions from all mining companies and the challenges facing the mining industry in regard to climate change. The challenges identified were: Natural resource pressures (water, land); Carbon management and emissions control; Pollution and land contamination; Reputation and brand; Local community impacts; Economic growth (reduced investment in infrastructure); Workforce health; Political stability and geo-political risks; Financial crisis (increased cost of capital); Transport logistics (supply chain); Operating costs; Energy and security of supplies; Contingency and decommissioning liabilities; and Intangible asset value.

The report also looked at physical impacts of climate change, separating them into extreme (acute) events, namely floods, droughts, cyclones etc., and incremental (chronic) climate change namely increasing temperatures. For extreme events mining companies need to expand the 'coping range' of assets while for incremental climate change a step-change is required.

The mining companies' responses showed that the three biggest perceived risks are water supply, energy cost and energy security, and asset damage while most action had been taken on securing water supply. The top opportunity identified was increased demand for products. The overall conclusion by the report was that there is very limited risk management underway in the industry.

The report highlights six drivers for response by mining:

- Large uncertainty of future legislation poses a risk to investors

- Potential litigation for failures in risk management
- Business cannot claim ignorance due to the wealth of information available
- Pressure from governments, consumers, communities and NGOs
- Directors have a duty to disclose future risks
- Banks are looking at lending risks

This chapter will look at the mining industry's response to climate change across the world. Case studies that are relevant to Rwanda are highlighted to show what is possible. Although Rwanda has a long way to go to develop a large mining industry, it has the ambition to do so, and therefore needs to consider what is happening in the international arena.

6.1 International Organisations and Initiatives

In the last few years, climate change has become a big issue for businesses across the world, including the mining industry. Climate change poses a number of risks and opportunities to business. In response, international organisations have developed climate change policies and a few influential global initiatives have begun. Mining, as part of the business community, finds itself with more demanding stakeholders, a more active public and more reasons to address environmental and social challenges, exacerbated by climate change.

6.1.1 International Council on Mining and Metals

The International Council on Mining and Metals (ICMM) is a CEO-led industry group that addresses key priorities and emerging issues within the industry. It seeks to play a leading role within industry in promoting good practice and improved performance and has a vision for a respected mining and metals industry that is widely recognized as essential for society and as a key contributor to sustainable development. It has 19 member companies and 31 member associations covering over 800 mine sites in 54 countries. The ICMM developed a Climate Change Policy in 2009 which calls for "comprehensive and sustained global action... to reduce the scale of human-induced climate change and to adapt to its impact." It commits itself and its members to "play our part in making possible the concerted global effort that is needed to address the climate change issue."[11] Although the mining industry in Rwanda is too small to be compelled to adopt this policy, it indicates the direction that the industry as a whole is moving in, which is relevant for Rwanda's long term future.

6.1.2 Cancun Communiqué

In November 2010, business leaders of over 250 global companies issued the Cancun Communiqué, a three-page statement from the international business community setting out the business case for a strong and effective UN climate framework. It called for an ambitious, robust and equitable global deal on climate change that responds credibly to the scale and urgency of the crises facing the world today. This included a call for a mitigation strategy focusing on five key areas of action:

1. Energy efficiency across all sectors
2. Low carbon energy systems
3. Emissions capture and storage
4. Emissions from other greenhouse gases
5. Urban planning, land use management and land use change

It was an initiative of The Prince of Wales's Corporate Leaders' Group on Climate Change which is run by The University of Cambridge Programme for Sustainability Leadership. It built on the success of The Copenhagen Communiqué, The Bali Communiqué and The Poznan Communiqué which were published in advance of previous UN climate summits. The major mining companies signed up to the Communiqués, reiterating their commitment to addressing the challenge of climate change. There are no major players in Rwanda but, as with the ICMM policy, these communiqués indicate the direction that the mining industry is moving in.

6.1.3 Intergovernmental Forum

The Intergovernmental Forum on Mining, Minerals, Metals, and Sustainable Development (IGF) is an outcome of the World Summit on Sustainable Development held in Johannesburg in 2002. The IGF is the only global intergovernmental policy forum in the mining/metal sector. It is a voluntary initiative officially established in 2005 by national governments interested in promoting good governance in the management of mineral resources, a driver of development[12]. The objectives of the IGF are to improve and promote the contribution of the mining, minerals and metals sector to sustainable development and poverty reduction. It has 43 member countries - including Burundi, Kenya, Uganda and Tanzania. In December 2010 the IGF produced a Mining Policy Framework. Although it doesn't address climate change directly, it does cover water management and recommends policies that would drive the development of the industry. By joining the IGF, Rwanda would have access to best practice in the mining and sustainable development and have the opportunity to learn from other countries facing similar challenges.

6.1.4 Global Reporting Initiative

The Global Reporting Initiative (GRI) is a network-based organisation that developed the world's most widely used sustainability guidelines for reporting on economic, environmental, and social performance. GRI's Reporting Framework is developed through a consensus-seeking, multi-stakeholder process including business, civil society, labour, academic and professional institutions. The cornerstone for the Framework is the Sustainability Reporting Guidelines. The third version of the Guidelines, G3, was published in 2006, and is freely available. Other components of the Framework include Sector Supplements, with unique indicators for industry sectors, and National Annexes, containing unique country-level information. The G3 Guidelines contain performance indicators for six categories: Environmental, Human Rights, Labour Practices and Decent Work, Society, Product Responsibility and Economic[13]. The Environmental Indicators that are relevant to climate change are shown in table 6.1.

The GRI and ICMM have developed sector-specific sustainability reporting guidance for the mining and metals sector - the GRI Mining & Metals Sector Supplement[14]. The Supplement deals with biodiversity, indigenous rights, labour, community, artisanal and small-scale mining, resettlement, closure planning and materials stewardship. The content of the Supplement was developed by a multi-stakeholder working group formed by volunteers from mining and metals companies, investors, labour and non-governmental organizations. The development of this Supplement aims to enhance sustainability reporting in the sector. It offers commentaries on the existing Guidelines, includes sector-specific issues in disclosures and provides 11 sector-specific performance indicators.

GRI reporting has become common practice among large mining companies, and it is usually requested by shareholders. Although the mining companies in Rwanda are relatively small, they should also be reporting on water, energy and emissions. The GRI guidelines could be adapted to better suit Rwanda's context and form the basis of an annual reporting process. This could extend beyond the climate change related activities, and an integrated approach would be preferable.

6.1.5 Carbon Disclosure Project

The Carbon Disclosure Project (CDP) is an independent not-for-profit organisation holding the largest database of primary corporate climate change information in the world. It aims to address the challenge of climate change by putting information at the heart of decision making. Over 3,000 organisations in 60 countries measure and disclose their GHG emissions, water use and climate change strategies through CDP. This information is made available to institutional investors, corporations, policymakers and their advisors, public sector organizations, government bodies, academics and the public. CDP uses the information to develop international carbon

Table 6.1: GRI 3.1 Environmental Performance Indicators relevant to climate change

ENERGY	
EN3*	Direct energy consumption by primary energy source.
EN4*	Indirect energy consumption by primary source.
EN5	Energy saved due to conservation and efficiency improvements
EN6	Initiatives to provide energy-efficient or renewable energy based products and services, and reductions in energy requirements as a result of these initiatives.
EN7	Initiatives to reduce indirect energy consumption and reductions achieved.
WATER	
EN8*	Total water withdrawal by source.
EN9	Water sources significantly affected by withdrawal of water.
EN10	Percentage and total volume of water recycled and reused.
EMISSIONS, EFFLUENTS, AND WASTE	
EN16*	Total direct and indirect greenhouse gas emissions by weight.
EN17*	Other relevant indirect greenhouse gas emissions by weight.
EN18	Initiatives to reduce greenhouse gas emissions and reductions achieved.
EN19*	Emissions of ozone-depleting substances by weight.
EN20*	NO, SO, and other significant air emissions by type and weight.
EN21*	Total water discharge by quality and destination.
PRODUCTS AND SERVICES	
EN26*	Initiatives to mitigate environmental impacts of products and services, and extent of impact mitigation.
TRANSPORT	
EN29	Significant environmental impacts of transporting products and other goods and materials used for the organization's operations, and transporting members of the workforce.
OVERALL	
EN30	Total environmental protection expenditures and investments by type.

* Core Indicators are those Indicators identified in the GRI Guidelines to be of interest to most stakeholders and assumed to be material unless deemed otherwise on the basis of the GRI Reporting Principles.

reporting standards. CDP acts act on behalf of 551 institutional investors, holding USD 71 trillion in assets under management and some 60 purchasing organisations[15]. Companies are scored both for level of disclosure and for their performance and listed in the Carbon Disclosure Leadership Index and Carbon Performance Leadership Index for their sectors, each year. As shown in figure 6.1, CDP has grown rapidly in the last seven years, from 235 responses in 2003 to 3,050 responses in 2010. The leadership indices could become key factors in investor and business decision making and promote better planning for adaptation and mitigation in response to climate change.

Although mining companies in Rwanda are small, as they grow and there is more pressure on emissions reporting, they may need to consider their CDP scores.

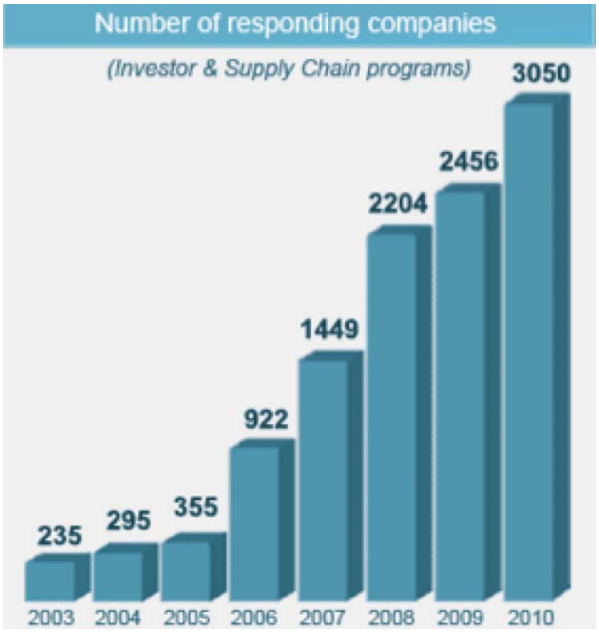

Figure 6.1: CDP respondents from 2003 to 2010 [15]

6.1.6 CEO Water Mandate

The CEO Water Mandate is a unique public-private initiative designed to assist companies in the development, implementation and disclosure of water sustainability policies and practices. It recognises that the business sector impacts water resources, through the production of goods and services, both directly and through supply chains. CEOs who endorse the mandate acknowledge that they have a responsibility to make water-resources management a priority, and to work with governments, UN agencies, non-governmental organisations, and other stakeholders to address the global water challenge. By doing so, they will contribute to the vision of the UN Global Compact and the realisation of the Millennium Development Goals[16].

The CEO Water Mandate covers six elements:

1. Direct Operations
2. Supply Chain and Watershed Management
3. Collective Action
4. Public Policy
5. Community Engagement
6. Transparency

It convenes two conferences per year and develops and distributes research and guidance documents. Endorsing companies of the CEO Water Mandate are required to develop annual reports, known as 'Communications on Progress-Water', explaining how they plan to implement the six elements of the mandate. This provides both a database of best practise and learning from across the business community, and an accountability mechanism for the initiative.

The CEO Water Mandate has three focus areas for 2011:

1. Business engagement with water policy and management
2. The human right to water and business
3. Corporate water disclosure

The CEO Water Mandate was launched in 2007 and has 76 signatories including Unilever, Coca-Cola, Nike and Siemens. It has only two mining companies as signatories – De Beers and Xstrata – as many large companies have been hesitant to commit to the requirements of the mandate. As public pressure on mining companies increases, however, CEOs of the major mining houses will have to endorse the CEO Water Mandate, setting higher standards for the industry across the world, including Rwanda.

6.2 Energy Efficiency

Energy efficiency is the primary approach that most mining companies are taking to address climate change. This is because it is the easiest solution which has the benefit of reducing operating costs. In some countries there is also a need to meet regulatory requirements. In Australia and New Zealand, all industries, including mining companies, are obliged to comply with the Equipment Energy Efficiency Programme, E3. This programme develops standards for energy efficiency for

commercial, residential and industrial products, and national and state legislation enforce the standards [17]. In South Africa, the government set a target in 2007 for the mining industry to reduce energy demand by 15% by 2015. 32 South African mining and industrial companies have now signed up to an energy efficiency accord, on a voluntary basis[8]. Individual companies have also set targets, for example Lonmin is aiming to improve its energy efficiency by 10% by 2012, based on 2007 efficiency levels, and AngloGold Ashanti promised to cut energy intensity by 15% in the short to medium term.

There are two ways to improve energy efficiency, demand-side management and technological changes. Some examples of demand-side management are:

- Mine design and planning to reduce haulage distances
- Operate plants at maximum throughput
- Optimise scheduling of heavy equipment
- Hot seating at shift change, and reducing number of shifts
- Installing process control software in plants that optimise operations

Some examples of technological solutions are:

- Water rock drills replacing compressed air drills
- Adjustable speed drives (ASDs) and gearless drive (GD) systems for machinery
- Remote sensing in exploration to minimise drilling and digging
- Install rolling mills rather than autogenous or ball mills
- Alternating-current drive systems for the heavy trucks which ensure that diesel engines run within their optimal speed ranges
- Low-speed applications, such as grinding mill drives, mine winder drives, bucket chain excavators and drag chains
- Trolley assist in open pits to reduce diesel consumption

The demand-side management is easier to implement as it does not require capital expenditure on new equipment and it will show immediate cost savings for the operation. The technological solutions are more difficult to implement as they often require research and development, have high upfront capital costs with long payback periods, and require new technical skills. They can often only be implemented on new mines or processing plants as the cost of replacing current equipment or changing the design of an operation is uneconomic. Rwanda has the advantage of starting from a low base technologically, and can therefore implement the most energy efficient technology that it can afford from the start. It also has access to technology transfer through the UNFCCC which would make implementation more affordable.

6.3 Renewable Energy Generation for Mining

While financial and climate pressures are forcing most mining companies to focus on energy efficiency to reduce costs and meet regulatory requirements, the more far-sighted are becoming energy producers with a focus on clean renewable energy. Typically the focus is on distributed energy, which is also appropriate for their requirements[9]. There is also a move to electricity generation as an internal risk management strategy, securing energy supply for operations. In 2008 South Africa experienced serious power cuts as the parastatal Eskom failed to deliver the required demand to the national grid. Since then the mining industry in South Africa has shown greater interest in both energy efficiency and generating power for its operations. Rwanda is also facing energy supply constraints however there are many clean renewable energy sources, namely hydropower, geothermal and solar power, that can be used to power the mining industry.

6.3.1 Hydropower

Hydropower is an attractive option for mining companies as it provides a large amount of steady

supply while being clean and renewable. Rio Tinto has 3,900MW of hydropower capacity with significant hydropower plants in Canada and Scotland. 23% of its primary energy use and 58% of its electricity comes from hydropower, much of it from its own plants[18]. Vale generates a significant portion of its energy requirements through hydroelectric power plants, owning stakes in eight hydroelectric plants[9]. Vale is currently in talks with the Liberian government to rehabilitate the Mount Coffee hydropower plant to its maximum capacity of 1,000MW[19].

Inga 3

BHP Billiton has an agreement with the government of the DRC to develop a 2,500MW hydropower plant, Inga 3, which would supply a proposed aluminium smelter. Construction is expected to start in 2014 and the hydropower plant and smelter would begin operations by 2018. The smelter would use 2,000MW to produce 800,000 tonnes of aluminium per year, and the remaining 500MW would feed the southern African power grid. The development of Inga 3 has been challenged by NGOs, who, in December 2010, sent a letter to the chairman of BHP Billiton, urging the corporation to impose a moratorium on the project until the Congolese government first fulfil its commitments to bring electricity to its citizens[20]. 94% of the DRCs population do not have access to electricity and the NGOs are concerned that Inga 3 will detract from the government achieving its target of 60% access to electricity by 2025. The NGOs propose that the government focus first on the rehabilitation of Inga 1 and Inga 2 dams and develop a plan for achieving their energy targets.

This case study highlights the challenges the mining industry faces in developing countries. Mines and processing plants require large amounts of energy to operate. In order to prevent high levels of GHG emissions, renewable energy is necessary. Developing countries face the challenge of supplying electricity to their people whilst at the same time, trying to promote business development and foreign investment. Mining creates employment and generates foreign exchange, contributing to the development of a country. It needs to ensure that it does not hinder development however, by utilising scarce natural resources of energy and water. The ideal is for mining companies to generate their own power at or near operations, and to partner with government to supply excess power to local communities. Rwanda has significant hydropower potential and mines could benefit from both large and small scale hydropower plants.

6.3.2 Solar and Wind Power

Solar and wind power is a new area for the mining industry and less attractive due its variable and unpredictable nature. Mining operations require large amounts of energy 24 hours a day and loss of energy supply can have serious financial implications. On the other hand, solar and wind installations are relatively cheap and simple and can be installed on mine sites. They could supplement the larger more reliable supply from hydropower or fossil fuels with cheap, clean power. Some examples of solar and wind power installations are mentioned below to show what is possible in the mining industry.

Mt Cattlin, Australia

Mt Cattlin lithium mine in Australia generates 226MWh of renewable electricity each year - approximately 17% of the mines power requirements – from 14 solar panel arrays (figure 6.2) and two wind turbines. It is the first mining operation in Australia to incorporate solar panels on a solar tracker which follows the sun throughout the day and provides 15% more solar electricity than fixed systems. Galaxy Resources, the owner of Mt Cattlin, received the Energy Generation and Distribution Award from the Sustainable Energy Association of Australia in March 2011 in recognition of its pioneering work[21].

Lisheen, Ireland

A wind farm is being developed at Lisheen lead and zinc mine in county Tipperary in Ireland. It will produce 36MW of electricity – enough to power the mine and two nearby towns – and will feed directly

Figure 6.2: Solar tracking at Mt Cattlin mine[22]

into the national grid. It is expected to reduce national carbon dioxide emissions by 100,000 tonnes per annum. The site was selected due to the high wind speeds but also as there is an existing sub-station, an overhead connection to the national power grid and attendant infrastructure [23].

Anglo American, South Africa

Anglo American has publicly committed to reducing its energy consumption and CO2 emissions per unit of production by 15% and 10% respectively of the 2004 baseline year by 2014. Their strategy includes use of renewable energy and Anglo Platinum started using solar power in 2008. Solar water heaters were installed at the Mototolo Concentrator and the Brakfontein shaft at the Bokoni Platinum Mine Joint Venture change-houses, where miners shower and change after shifts. The Brakfontein change-houses boast one of the largest centralised solar water heating installations to date in South Africa with a capacity of 42,000 litres from 270 flat plate solar thermal collectors distributed over 3 separate roofs. The solar system is sized to provide hot water needs for 1,500 miners for a full day, with the backup system being designed to heat the required amount of water between shifts in the event of bad weather[24]. The benefit of the system is significant cost savings as well as saving ~446t of GHG emissions per year.

Rwanda has huge potential for small-scale solar power for heating and electricity due to its location at the equator and it already has a 250kW solar farm near Kigali that feeds the national grid. A recent study showed very limited potential for wind power in Rwanda[25]. On-site generation of solar power is feasible for mines sites in Rwanda, which could support their operations and any excess power could feed the national grid.

Figure 6.3: Solar water heating installation at Anglo Platinum's Brakfontein change-houses [24]

6.3.3 Geothermal Energy

Plans are underway by Green Rock Energy to develop 400MWe geothermal power plant near BHP Billiton's Olympic Dam copper and uranium mine in South Australia. The power could supply the mine and feed into the East Australian grid for the next 30 years[26]. Green Rock Energy holds 2,233 km^2 of Geothermal Exploration Licences over buried hot granites 10km from the mine site. Olympic Dam is in the process of applying for government

approval to expand their operations six-fold. The Australian Conservation Foundation claimed that the expansion of the mine would increase South Australia's GHG emissions by 12% and called for the expansion to only be allowed if the energy used was 100% renewable, citing local solar, wind and geothermal resources[27]. If the Green Rock Energy geothermal energy project is successful, the mine will be able to significantly reduce its emissions and gain approval for expansion.

This case study shows the increasing pressure on mining companies to reduce their emissions and play a leading role in clean energy production. Rwanda, with its large geothermal resources, could also investigate powering mines and processing plants with geothermal energy.

6.3.4 Biodiesel

Transport is essential in the mining industry for moving materials both within the internal operations and to and from suppliers and buyers. Unfortunately transport requires diesel and therefore it significantly contributes to GHG emissions. Efficiency measures can be implemented, as mentioned before, but the only option at the moment for replacing diesel is biodiesel. This is still a controversial solution as it has land use and food security implications. Some mining companies have started to develop biodiesel as a serious alternative but it is still a long way from becoming common practice.

Carajas, Brazil

Vale S.A., the large iron ore mining company in Brazil, plans to produce its own biodiesel by 2014 to be used in its operations. 500,000t of palm oil will be produced by a consortium between Vale (41%) and Biopalma da Amazônia S.A. (59%) but Vale will build and operate its own biodiesel plant which will aim to produce 160,000t of biodiesel per year. Vale plans to use the B20 mix (20% biodiesel and 80% ordinary diesel) to supply its fleet of locomotives in the Carajás railroad and bulk equipment of Carajas mines. It is a proactive response to the Brazilian regulation which requires the use of B20 by 2020 [28].

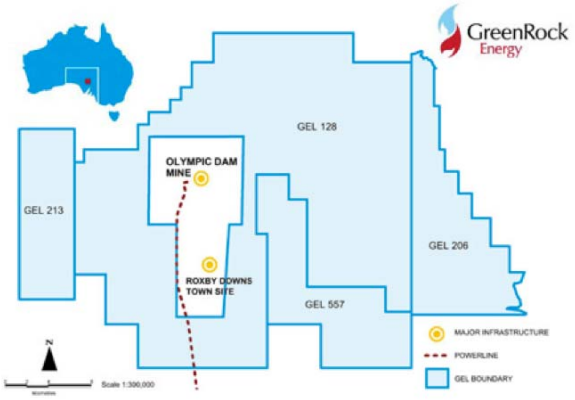

Figure 6.4: Green Rock Energy geothermal exploration areas and Olympic Dam mine location

Bulyanhulu, Tanzania

Land surrounding Barrick Gold's Bulyanhulu gold mine in Tanzania had historically been used by farmers for crops and livestock grazing but chronic overgrazing and subsistence farming techniques had made the land unproductive. In early 2007, Barrick decided to plant jatropha to rehabilitate mine property and help local farmers and residents move beyond subsistence farming (figure 6.5). A partnership was established with the Export Trading Company, a Tanzanian firm specialising in biofuel plantation development, and in December 2007 11ha were planted with seedlings. Local farmers received agricultural training and are now growing seedlings on 300ha of land which are harvested every two years. Barrick Gold has established a mini biofuel plant capable of processing 800 litres of biofuel per day and has pledged that 10% of its diesel consumption will be replaced by biofuel processed at its plant. Aware of the negative reports of biofuel production in Africa, Barrick's commercial contract with growers stipulated that the goal is to create a sustainable agribusiness, building on the existing base of local farming in a way that serves the community's needs and interests[29].

Rwanda's Institute for Science and Technological Research (IRST) has been investigating biofuels for the last three years and a large jatropha farm is under development near Akagera Park which aims to produce 20 million litres of biofuels each year.

Figure 6.5: Barrick Gold's jatropha farm in Tanzania [29]

6.4 Water Management

Water is vital for the operation of the mining industry. It is used for operating equipment (e.g. drilling, milling, flotation, smelting) and for health and safety (dust suppression, hydration) and can have a significant demand on a local resource. Traditionally mining companies have chiefly considered water management of the internal operation but there is a move towards looking beyond the mine boundaries to the impacts of pollution and water table drawdown on the local community and water catchment. More attention is being paid to water use efficiency and water security under conditions of variable climate and climate change scenarios. The majority of research has focused on engineering and technical solutions to reducing water consumption, increasing water reuse and improving water treatment. The lack of sufficient water monitoring, agreed language and standards, and formal water accounting hinder enacting, demonstrating and reporting on improvements[30].

Moran[31] proposed a hierarchical model for assessing water in mining operations, which was adapted by Slatter *et al*.[32] to five levels shown in table 6.2. Moran *et al* [30] developed a conceptual framework for the true value of water on a mining operation. It has monetary and non-monetary value. Monetary value includes the cost to buy the water, to utilise it, treat it, store it and discharge it – which relate to levels 1 and 2. Non-monetary value involves maintaining or enhancing ecosystem services and social needs as well as reputation of the user. These relate to levels 3, 4 and 5.

Water is a cross-cutting issue within a mining company and each of these levels needs to be assessed by different departments over different timeframes. These are shown in table 6.3.

Major mining companies recognise that water security is crucial to their business and work closely with governments and communities in ensuring secure water supply. As an example of what major mining companies are doing regarding water, Anglo

Table 6.2: Hierarchical levels in a mining company

Level	Scope	Focus Area
Level 5	Global and national	Water Supply
Level 4	Regions	Water Catchment management
Level 3	Sections	Local impacts of operations
Level 2	Operations	Reduce, reuse, recycle
Level 1	Individual units	Water efficiency

Table 6.3: Roles and responsibility for water management in a mining company

Department	Time frame	Level	Chief Roles & Responsibility
Strategic Long Term Planning	60 years	5	Scenario planning
Bulk water supply	20 years	4	Long term plan; Contracts
Environmental	LOM, closure	3	Facilitate compliance; reporting; monitoring; risk analysis
Occupational Health	annual	3	Clean water & sanitation
Engineering	daily/5 years	3	Infrastructure; metering
Sustainable Development	LOM, closure	3	Principles applied
Geology	annual	3	Hydrological models
Mining	daily	2	Planning; optimisation of use
Process	daily	2	Planning; optimisation of use
Research & Development	20 years	1	New technology

Platinum has developed a 'vision for water' with 5 pillars:

1. Strive to zero discharge
2. Protect water quality
3. Strive to zero use of potable water for operations
4. Strive to zero sectoral competition for water
5. Dedicated social obligations

This is within a framework of country specific legislation. Mining is particularly sensitive as it often uses the same water resource as a rural community and the direct impacts of its water use can be seen. Although operations have dams for recycling water, much of the water is locked up in the waste products from mineral processing and difficult and costly to recover. Some water evaporates and some seeps into the ground. The latter does not affect the water balance of the area but it does require the mining company to pump in more water which requires energy and therefore has a cost attached. A simplified water balance for a mining company's operations is illustrated in figure 6.6.

6.4.1 Mine Water Treatment and Reuse

Water encountered in mining operations can become contaminated by the ore body which can hamper both underground and opencast mining methods. Mining disturbs underground aquifers and large volumes of water can accumulate in mines

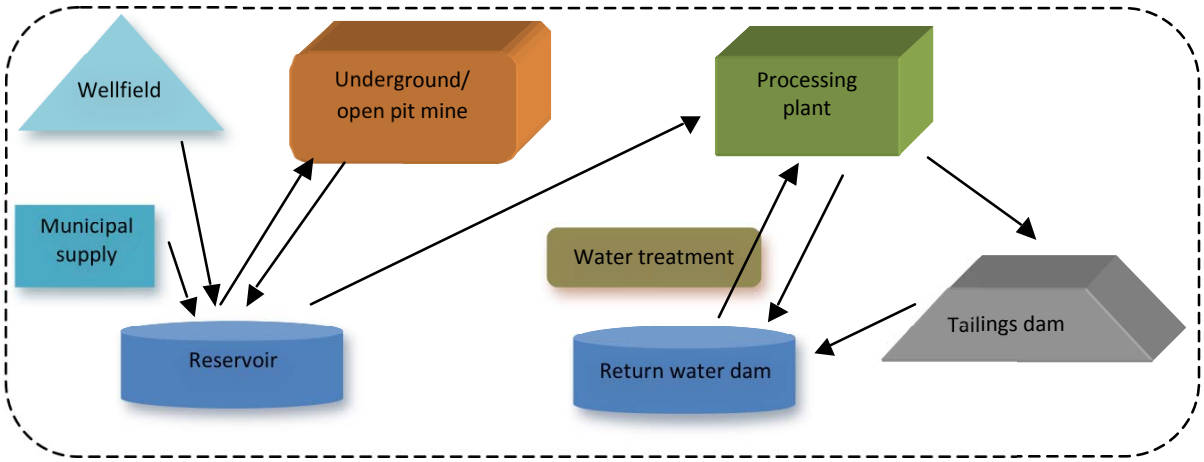

Figure 6.6: Simplified water balance on a mine site

over time. Polluted waters can often be re-used in mine operations and processing plants, as different water qualities have different effects[33]. The acidic nature of polluted water can produce high levels of corrosion to coal processing operations however, and treating mine waters can be a tool to assist with the overall water management on a mine[32]. The eMalahleni Water Reclamation Plant (EWRP) is a pioneering water management project in the Mpumalanga coalfields in South Africa, described as a 'world class initiative and an exemplary model for development'[34].

This public-private partnership (PPP) between the Anglo Coal South Africa and BHP Billiton Energy Coal South Africa and the eMalahleni Local Municipality was developed in 2005. Polluted underground mine water is treated at the EWRP and supplies the municipality with 18 Ml of potable water per day and mine process operations with 7Ml of process water per day. The dewatering of the underground mines enables mining to continue and protects the environment by preventing decants and seepage of polluted mine water. The municipality, located in a water-stressed region, benefits from a cheap secure water supply which will continue after the mining operations have closed. EWRP supplies 20% of the municipality's water and has made a number of the nearby coal mines and collieries self-sufficient. The project also created employment with between 650 and 700 temporary jobs created during the construction phase, and 40 permanent positions created for the running of the plant. In 2007, the plant won two Mail & Guardian Greening the Future Awards and the sustainability category of Nedbank Capital's Green Mining Awards.

Two initiatives have also developed from this project. In 2007, Anglo Zimele, Anglo American's enterprise development and empowerment arm, created the White River Beverage Company, a black empowered enterprise that utilises some of the plant's water for the retail bottling industry. Known as 4Life, it has an annual turnover in excess of R850 million using less than 0.01% of the water produced at EWRP[35].

Figure 6.7: Emalahleni Water Reclamation Plant [29]

The second initiative is the aim for the plant to be 'zero waste'. The waste from the plant is separated and dewatered, allowing it to be declassified to general waste. Research is underway on the production of by-products from the 100 tonnes of solid gypsum waste that is generated every day. Potential products are sulphur, limestone, magnesium carbonate and building and mining products. As part of the study, Anglo Coal has built a three-bedroom house constructed almost entirely out of gypsum-based building products. If these products can be produced from the waste it will significantly reduce disposal costs and provide an additional revenue stream for the PPP. The Emalahleni plant has embarked on its second phase, which will increase its capacity to 33Ml of potable water per day. Investigations to implement similar projects in the Witbank-Middelburg coalfields in collaboration with the other major mining houses and the South African power utility, Eskom, are in progress[35].

With the limited water infrastructure in Rwanda, water treatment facilities need to be installed at mining and processing operations around the country. In fact, companies are required by law to source and treat their water supply. This case study shows that companies can also support the government in its goal of providing access to potable water for communities. The GoR seeks to

develop PPPs in Rwanda and water treatment at mine sites could provide suitable projects for this.

6.4.2 Best Practice Guidelines for Water Resource Protection in Mining

In 2008 the Department of Water Affairs and Forestry in South Africa, now known as the Department of Water Affairs (DWA), completed the development of a series of 15 Best Practice Guidelines for Water Resource Protection in the South African Mining Industry. These guidelines are based upon the water resource protection and waste management hierarchy and the concept of Integrated Water Resource Management (IWRM). These Best Practice Guidelines are not directly enforceable on the mining industry but rather assist mines in meeting the requirements of the regulations, in Government Notice 704 (GN704) in June 1999[36], as part of the National Water Act of 1998. The regulations specify what needs to be done but not how it must be done, leaving compliance subject to interpretation. The guidelines were written by technical specialist with input from stakeholder workshops, including industry, government, technical experts and other interested parties[37]. The guidelines are used by DWA officials to perform their mandate, and by industry, in negotiations and in compilation of water management plans and water use licence applications. The guidelines can best be applied to new mining ventures, as best practice can be applied from the start. The level of adherence to best practice is dependent on the scale of the mine and its impact on water resources as there is financial cost to implementing the guidelines. Ongoing training and capacity building is required to facilitate decision making by the regulator on the authorisation of water uses at mines.

Three series of Best Practice Guidelines were developed:

- A Hierarchy series based upon the water resource protection and waste management hierarchy
- A General series of guidelines for general water management strategies, techniques and tools
- An Activity series for specific mining related activities

The individual guidelines are shown in table 6.4.

The guidelines focus on the implementation of integrated water and waste management at mines and the DWA Resource Protection and Waste Management hierarchy of decision-taking. This hierarchy is based on the precautionary approach and sets the order of priority for mine water and waste management decisions and/or actions as shown in table 6.5.

Table 6.4: DWA Best Practice Guidelines for the South African Mining Industry

Hierarchy	General	Activities
H1 Integrated mine water management	G1 Storm water management	A1 Small scale mining
H2 Pollution prevention and minimisation of impacts	G2 Water and salt balances	A2 Water management for mine residue deposits
H3 Water reuse and reclamation	G3 Water monitoring systems	A3 Water management in hydrometallurgical plants
H4 Water treatment	G4 Impact prediction	A4 Pollution control dams
	G5 Water management aspects for mine closure	A5 Water management for surface mines
		A6 Water management for underground mines

Table 6.5: DWA Resource Protection and Waste Management hierarchy of decision-taking	
Hierarchy of decision-taking	1. Prevent or minimise pollution/contamination of water used by implementing necessary management measures or strategies
	2. Reuse or Reclaim contaminated water in cases where complete pollution prevention was not possible
	3. Treat water that cannot be reused or reclaimed
	4. Reuse treated water
	5. Discharge or Disposal of excess Water

These Best Practice Guidelines could provide an excellent starting point for Rwanda to develop its own guidelines to enable mining companies to comply with Rwanda's Mining Ministerial Orders[38].

6.5 Capacity Building

The boom and bust nature of the mining industry often makes it difficult to develop capacity and plan for future training needs. The industry has been through periods of severe skills shortages but also periods of large lay-offs and unemployment. Most major mining companies have recruitment and talent management programmes to find and retain staff. There are also more short courses and training programmes on offer to develop competence at a range of levels and professionals can join national and regional societies and institutes to learn from others. Rwanda's Revised Mining Policy addresses capacity building and has plans in place to educate and train students and to set up institutes within the country. Extra training will be needed however to implement energy efficiency, water management and climate resilience. These skills are likely to be found in other industries but there will be mining specific training, particularly for environmental officers, long term planners and engineers.

6.5.1 Regional Institutes, Societies and Councils

Most of the major mining regions in the world have institutes that support the mining industry in a variety of ways – technical knowledge, publications, standards and guidelines, professional networking and career development. These institutes help develop capacity in the industry and contribute to its success. As an example, the Southern African Institute of Mining and Metallurgy (SAIMM) was established in 1894 with the aim of helping its members to source news and views about technological developments in the mining, metallurgical and related sectors. It has a professional code of ethics and seeks to bring together the mining and metallurgical fraternity in terms of research, shared-experiences, education, personnel and students. It has branches in South Africa, Zimbabwe, Namibia, Botswana and Zambia and over 1,000 members[39].

There are also institutes and societies for the different disciplines within mining and metallurgy, such as rock engineering, geology, mining engineering, mechanical engineering, chemical engineering, surveying, chemistry, metallurgy and safety. They support the industry by developing the capacity of the professionals and certify them to work in particular roles. They organise conferences and events and produce publications to increase knowledge sharing and development of their members and the industry.

As climate change and low carbon development are new areas, these regional councils and institutes can support the mining industry to tackle the new challenges. Rwanda would benefit greatly from being linked to a regional institute of mining and metallurgy. As there is not one currently operating in the region, it could propose and aid in its establishment.

6.6 Research

Research has traditionally played a small role in the mining industry, with only the major companies

investing in research at fractions of total spend. In recent years, the focus of mining research has shifted to energy and water efficiency as costs increase and pressure to be good corporate citizens mounts. Some of the research is collaborative, with the major mining companies pooling resource to address key challenges. In the early 1990s, the Australian government developed Cooperative Research Centres (CRCs) to improve collaboration between industry and the research community. CRCs undertake research driven by the needs of industry and then transfer the resulting knowledge and technology to industry. The CRCs also have a significant role in postgraduate research training and industry-related education. There are a number of CRCs working to keep the mining industry sector at the cutting edge of technology. The Centre for Sustainable Resource Processing (CSRP) and the COREX are two notable CRCs. Although Rwanda is unlikely to engage in cutting edge research, technology transfer will be available through the UNFCCC and therefore Rwanda should be aware of outcomes from current research that may be relevant for the local industry.

6.6.1 Centre for Sustainable Resource Processing

The Cooperative Research Centre for Sustainable Resource Processing (CSRP) commenced in 2003 in and concluded in October 2010. Its main focus was to undertake a significant research effort to find technical solutions for progressively eliminating waste and emissions in the minerals cycle. The CSRP provided a holistic perspective across the industry sectors and brought together companies to achieve the common goal of reduced costs and environmental footprints and improving community-industry interactions and understanding. Over 300 researchers and collaborators from over 50 organisations participated in CSRP activities. It was supported by many major mining companies, consultancy firms and research organisations. Some of the main achievements of the 7-year programme are [40]:

- SUSOP® – a developing management tool for incorporating sustainability principles into plant design and operation.
- Publically available 'issues papers' that identify the critical future aspects for water and energy in the minerals industry.
- Development of an internationally renowned SD-focussed regional synergies program in the Kwinana Industrial Area of Western Australia.
- Database of information on sustainable development indicators (e.g. cost, efficiency, emissions) on Australian electricity generation and transportation.
- A guide to publically available tools for analysing sustainable development in the minerals industry.
- Preparation and production of a Minerals, Metals and Sustainability textbook, to be published in 2011 by CSIRO Publications.

6.6.2 CRC ORE

In mid-2010 a new Cooperative Research Centre, Optimising Resource Extraction (CRC ORE), was set up in mid-2010 with support from all the major mining companies. The primary goal of CRC ORE is to 'develop the capability to comprehensively characterise and evaluate the economic and environmental impact of various mineral-extraction methods'. CRC ORE also researches individual technologies with the potential to increase mineral resources and decrease environmental impact. CRC ORE has three work areas – Resource Characterisation, Resource Extraction and Resource Evaluation. Under the Resource Extraction theme, the focus is on process optimisation and integrated analysis and aims at extending the traditional mine-to-mill model into a holistic analysis of energy consumption and the environmental footprint of mining operations. The research seeks to develop fundamentally new ways of extracting ore bodies that are efficient and environmentally sensitive that will result in energy savings of 30% [41]. One of the most relevant projects that the CRC ORE is working on is Sustainability and Extraction Efficiency (SEE) which aims at integrating energy, water and emissions into design, planning and operations[42].

Options Analysis

The review of best practice and case studies shows the many opportunities that the mining industry in Rwanda has. This chapter will look briefly at the options for each of the four focus areas determined in chapter 5, namely energy efficiency, renewable energy, water management and capacity building. These options will be assessed for suitability, feasibility and acceptability, the criteria used in the Rwanda Revised Mining Policy.

7.1 Energy Efficiency

There are four options for implementing energy efficiency in the mining industry in Rwanda. Energy efficiency has the advantage of reducing operating costs for companies and therefore is an attractive approach to addressing climate change. Energy efficiency is covered in more detail in the Energy Sector Working Paper.

7.1.1 Measuring and Reporting

The first option is for the companies to measure and report their energy use on a monthly basis. This enables the mining companies to manage their energy use and enables the government to determine current and energy future demand and GHG emissions. This information would aid MININFRA in its planning of energy supply and distribution over the coming years. The data could also be used in the Third National Communication to the UNFCCC and improve on the GHG emissions inventory. The Global Reporting Initiative (GRI) provides a comprehensive standardised approach to reporting and can be incorporated into current monthly reports to MINIRENA. As the reports are collated, a database can be developed of energy use for mining which can be managed by MINIRENA. This option is described in more detail in chapter 8.

7.1.2 Targets

The second option is to implement energy and emissions intensity reduction targets for the industry. This is only possible once the measuring and reporting is in place and a baseline can be developed. If reporting starts in the next 6 months and continues throughout 2012, then 2012 could be the baseline year. It may take a while for the companies to learn to use the new monthly report however which would delay the process. It would be wise to pilot the reporting on larger companies to refine it before sending it to the smaller companies and cooperatives. Targets for major mining companies are around 10% to 15% CO_2 emissions intensity reduction over a 10 year period. It is important to note that the targets are for reduction of intensity and not absolute emissions, to allow for growth in production. This is illustrated in figure 7.1 which plots greenhouse gas emissions over time, assuming increased production will increase energy use and emissions. Business as Usual (BAU) is the scenario if nothing is done to reduce emissions, while the Low Carbon Development (LCD) path assumes that energy efficiency is employed and renewable energy is used. Targets are therefore measured in energy use or emissions per tonne or per kilogram of production. The mining companies in Rwanda are small and use much less energy and have lower GHG emissions than large international companies. They are also in an expansion phase which should

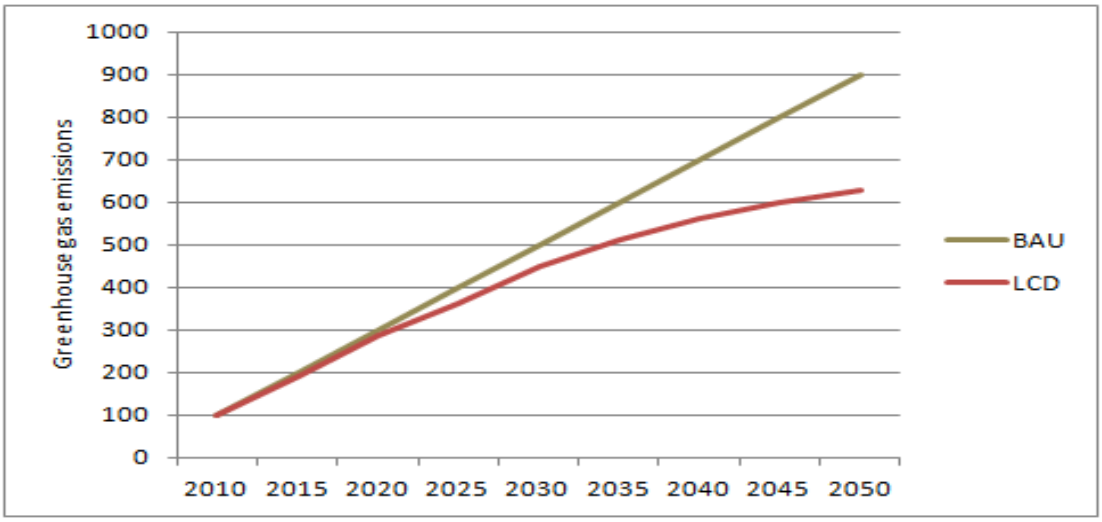

Figure 7.1: Illustration of Business as Usual (BAU) vs Low Carbon Development (LCD) for the Mining sector in Rwanda

not be hindered by targets as they support the socio-economic development of Rwanda. The targets should start off as voluntary targets for a few large companies who want to be seen as good corporate citizens. This would start to focus the industry on energy efficiency and emissions reduction and would lay the foundation for entrenching these principles into the industry before it develops into a large emitter.

7.1.3 Technology

The third option is the use of energy efficient technology. This can range from simple cheap technology like energy efficient light bulbs to more complicated expensive technology like replacing compressed air drills with water rock drills. The opportunities available will depend on mining method, current technology, skills available to operate the new technology, access to electricity and water and available finance. Each operation would need to be assessed individually and options developed and costed to suit the conditions. It would be invaluable for the mining industry in Rwanda to tap into the research and development that is on-going in this area around the world.

Although there are no figures on energy used for transport in mining, it is likely to be one of the largest sources of emissions for the industry. Current transport is all done by road vehicles and there is an opportunity to use rail instead which is more efficient. This will depend on the government developing a rail network in Rwanda and the mines producing sufficient ore to make it economic. This is covered in the Transport Sector Working Paper.

7.1.4 Electricity Tariffs

The fourth option is to implement variable electricity tariffs that encourage demand-side management. Mines and processing plants usually operate 24 hours a day and therefore use much of their electricity in off-peak hours. The tariff for this electricity should be lower and it would encourage companies to manage their electricity demand to reduce costs. Although the mines in Rwanda currently do not operate 24 hours a day, many run 12 hour days and if the industry grows, they will move to 24 hour operations.

These four options are summarised in the table 7.1 against the three criteria of suitability, feasibility and acceptability. This shows that Measuring and Reporting is the best option and should be implemented first. The analysis shows that the other options are also feasible and should also be implemented.

Table 7.1: Options analysis for Energy Efficiency

Criteria	Measuring and Reporting	Setting targets	Technological solutions	Electricity tariffs
Suitability	High. GoR requires the info for energy planning and reporting to UNFCCC.	Medium. Mining is a high energy demand industry, yet still small in Rwanda.	Medium. Depends on the technology. This is more applicable to the future.	Medium. Low cost electricity needed to grow the industry, but must not hinder social development.
Feasibility	High. Monthly reports already submitted.	Medium. Requires data collection first, and commitment from mining companies.	Medium. Depends on the technology and funding available.	High. Recent tariff study recommended variable tariffs.
Acceptability	Medium. Depends on communication from GoR – benefits need to be explained.	Low. Restrictions may put off investors.	Medium. If funded, will benefit industry, but may require new skills.	Medium. High for industry but may face resistance from NGOs.

7.2 Renewable Energy

There are two options for implementing clean renewable energy at mine sites across Rwanda. As this provides security of energy supply to a mine site, this is also an attractive option for a mining company. Renewable energy is covered in more detail in the Energy Sector Working Paper.

7.2.1 National Grid

The first is for the sector to lobby the government to develop clean energy for the national grid. This is currently a realistic option as over 50% of electricity is from hydropower and work is being done to develop large geothermal resources, which are clean, renewable and easy to operate. Electricity from methane in Lake Kivu would also reduce emissions if it were to replace current oil-fuelled electricity generation. The full range of small and large scale energy options are discussed in detail in the Energy Sector Working Paper and include hydro, geothermal, methane, peat, solar power, biogas and micro- and pico-hydro. A recent report indicated that there is insufficient potential for wind power[35] so it is not considered. Mining companies can act as anchor customers for new large scale renewable energy projects in Rwanda. Electricity from the grid needs to be reliable as interruptions to processing and refining plants can damage equipment and result in large financial losses.

7.2.2 On-site Generation

Rwanda has high potential for off-grid renewable energy with many sunshine hours for solar power, high rainfall and numerous rivers for micro-hydro power and large geothermal resources. The government already has plans in place to develop off-grid electricity throughout the country. The same opportunity is available to mining operations which need large amounts of reliable, steady electricity to operate. Case studies in chapter 6 show that mining companies are already investigating and implementing on-site renewable energy generation. Mining operations in Rwanda could install solar panels on building roofs for electricity and water heating. Micro-hydro plants can be installed on nearby rivers to provide electricity for a range of needs. Small-scale geothermal plants can be developed in the west of the country where possible to provide power to mines in that area. The main barrier to these installations would be finances and technical skills. This advantage that mining companies have over government is they have access to capital and they have in-house technical skills. There is potential for funding through the CDM for renewable energy, which is discussed further in chapter 8.

These two options are summarised in table 7.2 against the three criteria of suitability, feasibility and

Table 7.2: Options analysis for Renewable Energy

Criteria	National grid uses clean energy	On-site renewable energy generation
Suitability	High. MININFRA already has plans underway for geothermal, hydro and solar.	High. Current electricity supply insecure. Will enable operations to expand and work 24hrs a day.
Feasibility	Medium. Requires funding.	Medium. Requires funding and some new skills – industry better places then GoR.
Acceptability	High. Clean sources have least impact on environment and society.	Medium. Will vary from site to site. Large sites may prefer national grid. Small sites won't have capacity.

acceptability. This shows that both options are good and should be implemented.

7.3 Water Management

There are four options for water management in the mining industry in Rwanda, which serve to benefit both mining companies and local communities.

7.3.1 Measuring and Reporting

The first option is measuring and reporting water use on each operation on a monthly basis. This enables the mining companies to manage their water use and enables the government to determine current and future water demand. As with energy, the GRI indicators can be used and included in the monthly reports for MINIRENA and RNRA. As the reports are collated, a database can be developed of energy use for mining which can be managed by MINIRENA. This should include types of water quality used (potable, treated or grey), water source (villages, river or wellfield) and water discharge. Ideally each operation should have a water balance with inputs and outputs, including evaporation and seepage. Software such as GoldSim could be used to develop and manage site water balances. The information that is received from the operations can be used for water management in the relevant catchment areas and local communities. It will also inform government planning of water infrastructure such as pipelines and dams. It is likely that public-private partnerships could be entered into for the design and implementation of water infrastructure.

7.3.2 Water Efficiency

The second option is to implement water efficiency in the industry. This includes reducing water use, reusing water, with or without treatment, and recycling water within a mine or processing plant. Water use can be reduced by improved management practices or by installing water efficient technology. As with energy, this can range from simple cheap devices such as water efficient shower heads, to changing smelter technology form wet to dry smelt. This will depend on the current technology and the availability of skills and finance. Water efficiency has the benefit of reducing both cost of water and cost of energy for water use.

7.3.3 Water Treatment

The third option is for operations to install their own water treatment facilities. Water quality is very important in mineral processing as different contaminants can affect the recovery of desired minerals. For some processes, water can be reused or recycled without treatment, or with minimal treatment, but other processes require higher quality, or even potable water to operate best. Water also needs to be treated before it is discharged to ensure that it does not pollute the water resource that Rwanda requires for sustainable development. Water treatment options vary from simple, cheap methods such as filtration, to more complicated expensive methods like reverse osmosis.

7.3.4 Flood Water Management

The fourth option is for operations to implement flood and storm water management programmes. These need to be prepared in consultation with

local communities and local government, who may already have or be planning disaster risk reduction (DRR) measures in the area. The risk management programmes could include rainfall monitoring, storm water drainage, pumping systems, early warning systems, hazard mapping, risk assessments and siting of infastructure in low risk areas.

These four options are summarised in the table 7.3 against the three criteria of suitability, feasibility and acceptability. This shows that flood water management is the best option but all four options should be implemented.

Table 7.3: Options analysis for Water Management

Criteria	Measuring and Reporting	Water Efficiency	Water Treatment	Flood management
Suitability	High. Will help GoR plan for water demand and supply.	Medium. Depends on water supply and energy is requires – currently very suitable.	High. This should be done regardless of climate change.	High. The high rainfall in Rwanda and likely increase in intensity makes this crucial.
Feasibility	Medium. Monthly reports already submitted. May be difficult to measure inputs and outputs.	Medium. Will save costs, though requires skills and effort.	Medium. Depends on funding available.	High. Activities range from simple to expensive but can be done in partnership with local government.
Acceptability	Low. Mindset in Rwanda is that water is abundant.	Low. Mindset in Rwanda is that water is abundant.	Medium. Industry understands their responsibility but resists added costs.	High. Most people have all experienced flooding and its negative impacts. This helps them.

7.4 Capacity Building

There is already a need for Rwanda to develop capacity for the mining industry and this is highlighted and addressed in the Revised Mining Policy[1]. There are four options for addressing capacity building for climate compatible development in the mining industry.

7.4.1 Education and Training

The first option is to develop and run relevant training courses at Rwandan universities and technical colleges. The country has a very low base at the moment and foundation courses needed for the industry to grow. For it to develop in a low carbon way, training for engineers should include energy efficiency and renewable energy. Hydrologists will be needed to model the water resource in the area and to advise on sustainable water management. Environmental scientists who understand sustainable development principles will be needed to manage environmental departments on sites. Often mining companies have their own clinics and employ health workers. They should be trained in the impacts of climate change to human health and be prepared for greater incidences of heat stroke and vector-borne diseases. And finally, mining companies should support research and development of better practices on their operations.

7.4.2 Employee Awareness

A fairly simple way for the mining industry to address climate change, both adaptation and mitigation, is for it to raise awareness amongst its employees. Mining companies often run in-house courses and these can include the principles discussed above. Good practice can be modelled in the work place and provide on-the-job training in sustainable development. The training that a mining company gives its employees will have a cost attached but is likely to produce much larger returns. Employees who understand the need to use energy and water efficiently will help the business achieve their efficiency targets. Employees who are understand the danger of extreme weather events and know how to adapt to them, can help

raise awareness in their families and communities, thus improving their resilience. Employees who are aware of the health impacts of an increasing temperature can take precautionary measures, and reduce absenteeism and sick leave. People are a company's best asset and business would do well to develop their understanding of climate change.

7.4.3 Engage in Regional and International Forums

As outlined in the chapter 5, there is much work being done at an international level on sustainable development. Although climate change and low carbon development is a new area of work, more and more will done on this in the future. It would be invaluable for Rwanda to be linked into global and regional initiatives to ensure the country is aware of the latest in best practice and can learn from what other countries are doing. The IGF would be the first place to start as it is a forum for governments to engage on sustainable development for the mining industry. Other countries in East Africa are already members and this would provide an opportunity for networking with them. Rwanda could also initiate the formation of regional organisations that could support the mining industry, such as an East Africa Council for Mining and Metallurgy, similar to the SAIMM which serves Southern Africa.

7.4.4 Expert Technical Assistance

A key success factor in achieving low carbon development in the mining sector in Rwanda is the ability of the government to develop policy and strategies and to enforce regulations. A programme has recently been approved for technical staff to undergo training to build capacity in the mining sector. This training should incorporate the focus areas mentioned in this working paper and expose staff to best practice and to the evolving thinking on the subject. This National Strategy on Climate Change and Low Carbon Development is a dynamic document that needs to be reviewed regularly. The mining stakeholders will need to provide input into this process and therefore need to receive the relevant training to do so.

These four options are summarised in the table 7.4 against the three criteria of suitability, feasibility and acceptability. This shows that engaging in regional and international forums is the easiest option, but it will require all four approaches to fully address capacity building.

Table 7.4: Options analysis for Capacity Building

Criteria	Education and Training	Employee Awareness	Engage in regional and international forums	Technical assistance
Suitability	High. Will help GoR plan for water demand and supply.	Medium. Depends on water supply and energy is requires – currently very suitable.	High. Rwanda has good relations with other countries and seeks to be a leader in climate compatible development.	Medium. Will enable GoR to implement strategy and to evolve it.
Feasibility	Medium. Monthly reports already submitted. May be difficult to measure inputs and outputs.	Medium. Will save costs, though requires skills and effort.	High. Becoming a member of the IGF is fairly simple. Setting up new bodies would be more difficult and require funding, but is quite possible.	High. Funding provided by World Bank and AfDB for technical assistance.
Acceptability	Low. Viewpoint in Rwanda is that water is abundant.	Low. Viewpoint in Rwanda is that water is abundant.	High. Rwanda is already a member of a number of regional bodies such as the EAC and COMESA.	High. Staff eager to attend training.

Action Plan

Based on the focus areas and options discussed in the previous chapter, a number of policies and actions can be recommended. These are summarised in the action plan in table 8.1 and explained in more detail below. Each action has a timescale (expected date of first delivery – most actions will be ongoing), a list of key stakeholders who will be responsible for implementation, key measurables which indicate success, and sources of finance, which will make the action possible. The policies and actions ideally would be included in an updated Mining Policy and the key principles incorporated into EDPRS II and Vision 2020 when they are updated in the coming two years.

Table 8.1: Action Plan for the Mining Sector

Focus Areas WHY	Policies and Actions WHAT	Timescale WHEN	Stakeholders WHO	Measurables HOW	Sources of Finance
Energy Efficiency	Measuring and Reporting	Q4 2011	MINIRENA, RNRA	Database	-
	Set Intensity Reduction Targets	2014	industry	Plan v actual	-
	Technology Transfer	2013	MININFRA, academia EWSA, RURA	Efficiencies	CDM
	Electricity Tariffs	Q2 2012		Investment	-
Renewable Energy	Access to grid	2014	EWSA, RURA	% access	Budget support
	On-site power generation	H2 2012	industry, MININFRA	MW capacity	CDM
Water Management	Measuring and Reporting	Q4 2012	MINIRENA, RNRA	Database	-
	Water Efficiency	2013	RNRA, industry	Usage	CDM
	Water Treatment Flood management	2014 Q4 2012	RNRA, industry RNRA, MIDIMAR, industry, MINALOC	Plan v Actual Reports Hazard plans and risk assessments	Private
Capacity Building	Education and Training	2012-2017	Academia, RNRA	No. Courses & students	Budget support
	Employee Awareness	2013			
	Join forum		industry	Behaviour change	Private
	Regional council	Q4 2011 2013	MINIRENA	Documents	AfDB
	Technical Assistance		MINIRENA, RNRA	Council	AfDB
		2012	MINIRENA	Courses attended	World Bank

Table 8.2: Five pillars of the Rwanda Revised Mining Policy and proposed sixth pillar for climate change and low carbon development

Pillar 1	Pillar 2	Pillar 3	Pillar 4	Pillar 5	Pillar 6
Strengthen the enabling legal, regulatory and institutional environment	**Develop competitive investment and fiscal policies for mining**	**Improve mining sector knowledge, skills and use of best practices**	**Raise productivity and establish new mines**	**Diversify into new products and increase value addition**	**Establish climate resilient and low carbon development practices**
a. Streamline regulatory framework b. Institutionalise standards enforcement c. Address mining sector regulatory skills gaps d. Build capacity in policy development	a. Put in place fiscal strategy b. Introduce royalties c. Create mining development fund d. Create hedging instruments e. Improve price information and forecasts	a. Consolidate existing information on mineral deposit potential b. Develop program of geological surveying c. Build human capacity and expertise d. Promote the EITI & corporate social responsibility	a. Establish a financing mechanism for artisans b. Raise productivity of artisanal miners c. Reform licensing for mineral traders d. Produce mining investment opportunities e. Promote mining based on proper estimation of value of deposits	a. Develop new product investment opportunities b. Develop value addition investment opportunities c. Provide improved electricity supply for smelters d. Finalise plans to establish Kigali Mining Campus	a. Establish energy efficiency practices b. Promote renewable energy usage and development c. Promote good water management on operations

8.1 Policies

Rwanda recently developed a Revised Mining Policy[1] which although a comprehensive document, does not address climate change or low carbon development. The policy has five pillars, shown in table 8.2, which are essential for the development of the industry.

This working paper proposes that a sixth pillar is added to the policy, with three key policy areas, also shown in table 8.2, to address the additional challenge posed by climate change. This would ensure that the responsibility for implementing the policy remains with MINRENA and RNRA. Capacity building is not included in Pillar 6 as it already exists in Pillar 3.

The following policies are recommended for inclusion into a revised Rwanda Mining Policy. Some of these policies may already exist:

1. All mining companies submit reports on energy use and energy source according to the GRI reporting standard.
2. All mining companies with a concession must submit energy efficiency targets and emissions reduction plans to MINIRENA.
3. MINIRENA will work with MININFRA, EWSA, academia and the private sector to transfer energy efficient technologies to the mining industry in Rwanda.
4. MINIRENA will continue to work with MININFRA, EWSA and RURA to ensure that electricity tariffs do not hinder the development of the mining industry, or the development of the people of Rwanda.
5. The Government of Rwanda will support the development of on-site renewable energy at mine operations across Rwanda.

6. All mining companies submit reports on water use and water sources according to the adapted GRI reporting standard.
7. All mining companies must endeavour to develop mine water balances to enable mine water management on operations.
8. MINIRENA will work with MININFRA, EWSA, academia and the private sector to transfer water efficient technologies to the mining industry in Rwanda.
9. MINIRENA and RNRA will continue to work with MINEDUC and academia to develop the necessary university degrees and technical training to support the mining industry in Rwanda, but will include a focus on energy efficiency and water management.
10. The Government of Rwanda will seek to join the relevant forums on mining and metallurgy that would facilitate knowledge sharing.
11. MINIRENA and RNRA will seek to initiate the development of a regional council for mining and metallurgy in the East Africa region to facilitate capacity building and knowledge sharing.

8.2 Actions

All of the 12 policies listed above can be acted upon to initiate implementation in the medium term, to align with EDPRS II. Two key actions can start immediately to provide 'quick wins' for the government are briefly discussed below.

8.2.1 Measuring and Reporting

The current monthly reports submitted to MINIRENA can be edited to include energy and water use and sources. Monthly Reports currently have the following sections:

A. Identification of mining operator
B. Quantity of minerals exploited
C. Monthly output
D. Employees and Safety
E. Mine exploitation and exploration (methods and geology)
F. Tools used in mining
G. Sales
H. Research done (exploration)
I. Environment
J. Problems encountered during mining operations

The 'environment' section, I, covers environmental damage and rehabilitation. This would focus on water pollution, soil erosion etc., and not on climate change related issues. Another section, K, could be added, called Energy and Water Use. This would start off fairly simple but could be made more detailed as mines become more sophisticated. The section could include table 8.3, based on GRI, and collated data could be inputted into a database.

8.2.2 Joining an International Forum

Rwanda would greatly benefit from becoming a member of the IGF. Membership implies no legal, contractual or financial commitment and any member state of the United Nations may join. In order for a country to become a member, that country needs to send a confirmation of acceptance of the Terms of Reference and Rules of Procedure to the Secretariat . Rwanda would need to designate one contact in MINIRENA as the national focal point for the Forum. More details on how to become a member can be found on the IGF website at http://www.globaldialogue.info/ms_e.htm

8.3 Timescale

Each of the 12 policies and actions has an associated expected date of achievement as listed in table 8.1. The timescales are mapped out in table 8.4.

Table 8.3: Table for reporting on water and energy for monthly reports

ENERGY

1. Record your energy consumption by primary energy source

Woodfuel:	Charcoal:
Electricity:	Diesel generators:
Diesel/petrol/oil:	
Other (please specify):	

2. Record energy saved due to conservation and efficiency improvements

3. Record any initiatives on energy-efficiency or renewable energy (e.g. solar, hydro)

WATER

1. Record your total water withdrawal by source

Government supply:	Wellfield:
Rivers:	Reservoir:
Other (please specify):	

2. Record percentage and total volume of water recycled and reused

3. Record your total water discharge by quality and destination

Storm water:	Mine drainage:
Process effluent:	Tailings/ leach pad drainage:
Other (please specify):	

8.4 Stakeholders

The key stakeholders for implementing the policy recommendations and actions are MINIRENA and OGMR, soon to be part of the new Rwanda Natural Resources Authority (RNRA). They will be supported by other government departments – EWSA, RURA, MINICOM, MINECOFIN, MININFRA, MINALOC, MINEDUC, RDB – by the private sector and PSF, FECOMIRWA and the Minerals Investors Forum – and by NGOs and communities. Mining contributes significantly to the economic growth of Rwanda and the various stakeholders therefore have good reason to support the low carbon development of the industry.

8.5 Sources of Finance

Although the mining sector has been bringing in significant foreign exchange into Rwanda in the last decade, there are limited funds available for exploration, expansion and environmental protection. For the industry to follow a low carbon development path, extra funding will be required. There are limited climate finance opportunities for the mining sector due to its profitable nature, but a number of mining companies have benefited from the Clean Development Mechanism (CDM). CDM opportunities in the mining sector exist in two areas:

- Employing demand-side energy efficiency measures
- Switching to less-carbon intensive fuels and renewable energy sources

A major barrier to implementing carbon projects is the initial investment costs. Project implementers will incur significant costs in project design and development before carbon revenues start to flow. To overcome these costs, a number of multilateral

Table 8.4: Simple roadmap for policies and actions

Focus Area	Policies and Actions	2011 Q3	2011 Q4	2012	2013	2014	2015	2016	2017
Energy Efficiency	Reporting								
	Targets								
	Technology								
	Tariffs								
Renewable Energy	Grid Access								
	On-site Generation								
Water Management	Reporting								
	Efficiency								
	Water treatment								
	Flood management								
Capacity building	Education & Training								
	Employee Awareness								
	Join forum								
	Regional council								
	Technical assistance								

funds have been established to support implementation carbon projects through upfront financing, and agreements to purchase a set amount of the generated carbon credits. These include:

- EIB-KfW Carbon Programme II
- World Bank Carbon Funds and Facilities
- UNDP/MDG Carbon Facility

If mining companies decide to pursue renewable energy and energy efficient alternatives, another interesting source of financing might be the Africa Enterprise Challenge Fund: Renewable Energy and Adaptation to Climate Technologies (REACT). REACT is a USD 100 million private sector fund hosted by the Alliance for a Green Revolution in Africa, and is open exclusively to applications from for-profit firms in the East African Community. It provides co-financing, grants, loans, and financial risk management products ranging from USD 250,000 to USD 1.5 million for business proposals that would contribute to climate change mitigation or adaptation, and demonstrate a positive impact on the rural poor[42].

Funding for climate change capacity building in the mining sector could likely come from the African Development Bank (AfDB). In 2005, the African Development Fund (ADF) of the AfDB provided funding to Uganda for a Mineral Resources Management Capacity Building project with the aim to expand private investment in mining in a socially and environmentally sustainable manner through improved governance, regulatory reform, and geological infrastructure development. The ongoing project, which will cost an estimated USD 44.49 million, received a USD 8.025 million grant from the ADF. The remainder was funded by the Ugandan government and a co-financier. A similar project in

Rwanda could fund training for key individuals in the mining sector on climate change and sustainable mining practices, participation in an international sustainable development forum, and the creation of a regional council for mining and metallurgy.

As a key player in the management of Rwanda's water resources, the mining sector could benefit from the climate finance available for water efficient technology, integrated water resource management and water treatment plants. Two multilateral funds are particularly applicable due to their focus on the private sector: the Private Infrastructure Development Group and the Public-Private Infrastructure Advisory Facility. Because water management featured so prominently in Rwanda's National Adaptation Programme of Action (NAPA), there should also be opportunities to receive grants from multilateral climate funds that offer support for NAPA implementation:

- Adaptation Fund
- Least Developed Country Fund
- Global Environmental Facility
- Global Climate Change Alliance

Other multilateral funds that support water management activities specifically include the following:

- International Climate Initiative
- Special Climate Change Fund
- UNDP/Spain MDG Achievement Fund
- International Development Association
- ClimDev-Africa Special Fund
- Nordic Climate Facility
- KfW Development & Climate Finance.

Finally, climate finance could be available from Rwanda's forthcoming environment fund, FONERWA. The Draft Law providing for FONERWA states that it has the mandate to award prizes to individuals, associations or model institutions involved in mining and quarry conservation as well as climate change adaptation and mitigation. Such competitions could be an effective incentivize to promote low carbon practices in mining and other industries.

Summary

This working paper has shown that there are many opportunities for the mining industry in Rwanda for addressing climate change and promoting low carbon development. Four focus areas were highlighted, Energy Efficiency, Renewable Energy, Water Management and Capacity Building. A review of best practice and case studies was done in these areas which will provide the foundation for the recommendations that follow. For each of these focus areas, options were proposed and analysed against the criteria of suitability, feasibility and acceptability. An action plan with policies, actions, stakeholders, timescales and sources of finance has been proposed, for discussion with relevant stakeholders in Rwanda in the coming weeks. These will be incorporated into the draft National Strategy on Climate Change and Low Carbon Development in mid-June. The paper shows that it is possible for the mining industry in Rwanda to grow in a low carbon, climate resilient way and contribute to the socio-economic development of the country without causing too much damage to the environment. As the largest earner of export earnings, it has a big role to play in the Strategy vision: For Rwanda to be an, climate-resilient, developed low-carbon economy by 2050, having led the way for other developing countries to do the same.

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