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A quantitative method for selecting renewable energy projects in the mining industry based on sustainability

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A QUANTITATIVE METHOD FOR SELECTING RENEWABLE ENERGY PROJECTS IN THE MINING INDUSTRY BASED ON SUSTAINABILITY

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A research report submitted to the Faculty of Engineering and the Built Environment, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Science in Engineering.

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Abstract:

Mining companies sponsor a range of non-core, corporate social responsibility projects to adhere to social and labour plans and environmental management prerequisites that form part of a mining licence application. Some companies go above and beyond such projects, sponsoring initiatives that generate renewable energy through solar power, wind energy, natural gas, etc. The challenge for the company is to choose between a variety of projects to ensure maximum value for the company, especially in times when the economic climate might be less favourable for such projects. The focus of this research was to analyse the concept of sustainability as it exists today, and to apply that to the triple bottom line accounting method in an attempt to quantify the sustainability of a project and compare it with another project. A case study was done on the methane burn-off project at Sibanye Gold's (previously Gold Fields') Beatrix Mine to establish how such projects are planned and financed in the industry, and what impact they have on the triple bottom line of a

company. The financial bottom line is by definition one that executives understand. A quantitative method of also defining the social and environmental bottom lines is now proposed. By considering the financial, social and environmental values obtained, a monetary value is established for a sustainable renewable energy project. This monetary value can be compared to similar values obtained for other sustainable renewable energy projects under consideration. Monetary value alone is not enough to base a sustainable decision on and qualitative measures are suggested for use in conjunction with quantitative methods. The proposed method will permit the board of a mining company to choose the most sustainable option and the project that will add the greatest value to the company across all three bottom lines. It will also provide increased justification for such renewable energy projects, even in periods of harsh or uncertain economic climates.

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ABBREVIATIONS AND ACRONYMS

BAR	Basic assessment report
CDM	Clean Development Mechanism
CEO	Chief executive officer
CER	Carbon-emission reduction
CFC	Chlorofluorocarbon
CFO	Chief financial officer
CGE	Computable general equilibrium
CPI	Consumer price index
CSI	Corporate social investment
CSP	Concentrated solar power
CSR	Corporate social responsibility
CSV	Creating shared value
DCF	Discounted Cash Flow
DMR	Department of Mineral Resources
DRC	Democratic Republic of Congo
EIA	Environmental impact assessment
EAP	Environmental assessment practitioner
EMP	Environmental management plan
ETF	Exchange traded funds
EVA	Economic value added
GEF	Global environmental facility
GHG	Greenhouse gas
GRI	Global Reporting Initiatives Sustainable Reporting Framework
IAR	Integrated annual report
ICMM	International Council on Mining and Metals
IIRC	International Integrated Reporting Committee
IRR	Internal rate of return
JSE	Johannesburg Stock Exchange

KDC	Kloof-Driefontein complex of Gold Fields
KING III	Third King Committee report on governance principles for SA
LED	Local economic development
MAC	Marginal abatement cost
MACC	Marginal abatement cost curve
MCC	Marginal cost curve
MSV	Monetary shared value
NEMA	National Environmental Management Act, 1998
NPV	Net present value
PES	Payment for ecosystems services
PPI	Producer price index
PV	Present value
RET	Renewable energy technology
ROI	Return on investment
SA	South Africa
SAICA	South African Institute of Chartered Accountants
SANBI	South African National Biodiversity Institute
SMV	Shared monetary value
SLP	Social and Labour plan
TBL	Triple bottom line (also referred to as 3BL)
UN	United Nations
UNCLOS	UN Convention on the Law of the Sea
UNFCC	United Nations Framework for Climate Change
WACC	Weighted average cost of capital
WEF	World Economic Forum

1. INTRODUCTION

The mining industry is fundamentally unsustainable. The very store of goods that a mining house sells starts to run out the minute the first load of ore reaches the beneficiation plant. There is no way in which a mine can replenish the resources it ultimately sells, but there are ways of lessening the impact of this fatal flaw. With the aid of new technology mines can reach ore bodies that were inaccessible before, and by continuously exploring for new ore bodies mining companies attempt to keep themselves from going out of existence by retaining a viable asset base.

The mining industry does not operate in isolation. It plays a major role in the global economy and thus it impacts on the lives of millions of people. As the saying goes, 'If it cannot be grown it has to be mined'. Mining is, however, particularly unfriendly to the environment and thus often has negative consequences, not only on the society within it operates, but on global society as well. It can be argued that mining, in some shape or form, impacts on all people on the planet. Mining companies globally have woken up to the fact that profits alone cannot be the only driving force when it comes to decision–making, and in this lies one of the core truths of sustainability.

In this paper the core concepts of sustainability will be examined to identify the principles mining companies should understand and practice so as to fit into the world it operates. Mining will be with us for a very long time to come and a huge amount of damage can still be done to society and the environment. Similarly, however, a large amount of good can still be done by mining for society in the future. The real eye-opener to the uninitiated is that mines are not expected to be totally self-sacrificing in order to be sustainable. All models of sustainability require the industry to make a profit. It is the way it goes about making that profit and how that profit is spent that dictate a company's sustainability. All models of sustainability show that financial returns are but one of the pillars of a sustainable company. Some company management models even provide for more than one kind of 'capital'.

One of the best known and most widely used criteria is the triple bottom line (TBL) method of accounting for factors other than finance. This method had subsequently been expanded to encompass a large array of elements.

The idea of defining and accounting for more than one type of capital arose with Jonathon Porritt and a group called the Forum for the Future. Porritt argues that capitalism is the driving economic force on the planet and will be so for the foreseeable future. In his book, *Capitalism as if the World Matters* (Porritt, 2007), he describes, apart from financial capital, four additional types of capital, namely manufactured capital, social capital, human capital and natural capital. All these forms of capital need to be accounted for if a fully sustainable project, or indeed a sustainable company, is to be achieved.

The biggest challenge lies not in describing these types of capital but in measuring them. Normal accounting methods will not suffice as these concepts are simply too different in nature from financial capital. In this paper the various methods of identifying and measuring the different types of capital will be discussed. The value theory is used to examine the various views stakeholders may have about the value of a project as measured by the five types of capital. Sustainability is defined as a value to which to aspire to.

A mining company answers to its shareholders who, like most people, see themselves as benevolent, well-meaning people. However, their aim of investing in the company is to make money. In this paper it is accepted that the first priority of a board of directors of a mining company is growing the company and adding to shareholder value. Gold Fields Limited (Gold Fields) is one of the many mining companies that has realised that it is not operating in a vacuum. As such, sustainability is entrenched in its core values. Various reporting methods are used to describe the company's commitment to sustainability and good corporate governance.

Like many other mining companies Goldfields sets aside funds for corporate social responsibility projects. Mostly these projects target only one specific type of capital. Projects aimed at uplifting the community are aimed at increasing social capital. Renewable energy projects are designed to increase natural capital etc. Such projects do not necessarily add to the bottom line and one gets the feeling that the board writes off their cost as goodwill. In the TBL approach the bottom line is a concept far removed from the traditional, financial bottom line and that it makes the company 'look good' to the outside world, something mining companies can always do with. The Beatrix Gold Mine methane burn-off project, which is situated in the Orange Free State province of South Africa, near the town of Welkom, serves as a clear example of the sustainable thinking of the executive management of Gold Fields, even though Beatrix is now owned by Sibanye Gold after an unbundling process.

It is expected of companies to go above and beyond the letter of the law in terms of good governance. Improving on previous years' corporate social responsibility is the desired aim. As with all financial decisions, the initiatives are planned and the results measured meticulously. However, sustainable projects can only be afforded when the company is making a profit, which brings the process back full circle to financial capital and Porritt's premise of capitalism. The way in which mining companies spend their capital is first and foremost a question of return on investment. If the company is not profitable the idea of sustainability becomes a test of discipline. Only the bravest and most ethical of companies will adhere to a philosophy of sustainability in financially trying times.

How do companies choose the most sustainable Renewable Energy Technology (RET) project to spend funds on? This is the main question of this work. Gold Fields has many sustainable projects globally. I have chosen to focus on the renewable energy technology (RET) projects that Gold Fields has decided to implement, in particular the methane burn-off project at Beatrix goldmine. How is the money allotted? What criteria are used to decide between projects? The design of a logical,

mining-specific decision tool for choosing between renewable energy technology projects could benefit all stakeholders in a mining company.

Not all RETs are immediately profitable, if ever. Neither do they, for example, promise to generate cheaper electricity than what is obtainable through the local power grid. But mining company boards set aside money for sustainability projects anyway − choosing the wisest manner in which the money is spent is the challenge.

It is hoped that the research described here will improve the viability of RET projects. Once weighed across all five types of capital, or measured against the TBL, a project might be feasible and generate an overall 'profit'. At the very least a proper decision-making tool that incorporates the full spectrum of sustainability factors will show clearly which project makes the most investment sense.

Although many sustainability models will be discussed, the TBL is used to derive three questions and touch on all five types of capital, as follows:

1. Financial – Is the RET project financially viable?
    a. Financial capital – Is the technology proven? Manufactured capital.
2. Social – Is it good for the community? Social and human capital.
3. How will it impact the environment? – Natural capital.

These priorities cascade down to feed into one another and for testing against the principles of sustainability. The first step is financial capital. Without generating a profit through its core business the company's sustainability soon disappears – there will be no company left. From this logic flows the first test, namely is the proposed RET project financially viable?

The most advantageous would be an answer in the affirmative. If a RET project were to generate positive cash flow for the company it would be accepted automatically. Unfortunately very few RET projects actually turn a profit. The second question, one that forms an integral part of the first, is whether or not the technology actually

works and can be built. Many ideas look good on paper but if the technology is not physically viable it will not render the project financially viable and destroy any possibility of the project being sustainable. The mining industry is very good at rating projects against their inherent net present value (NPV), return on investment (ROI) and the internal rate of return (IRR). These are standard measures when evaluating the financial viability of a project and will be discussed at length in the section that deals with the financial question.

The second question looks at society and social impacts of RET projects. Simply put, the question is, 'Is it good for society?' The question is, however, vastly more complicated than may appear at first glance. What society is to be impacted by the RET project, local or global? Is it fair to test a local RET project against the impact it has on the mine's labour-sending areas? In this instance, local society residing around a mining project is considered to have priority over the demands of global society. Mines impact on society because they are such massive contributors to the tax revenue of a government and also through the wages that are paid to a large workforce. Social impact is only placed second to financial capital because the RET project would not be financed if the mine were not to make a profit.

The difficulty in this regard is that social value is comparatively difficult to measure. Concepts like corporate social responsibility (CSR) and creating shared value (CSV) are discussed to determine if they should be used to gauge social impact and society's attitude towards the project and the company. The initial sense is that these criteria fall under the ambit of marketing the company and to a large extent it does. The question is not what the company or the community sees as valuable, but what is seen as valuable to all stakeholders. It is well understood that society's opposition to a mining project can ultimately render it unfeasible. The reverse should then also be true: if society is in favour of a project does that not improve its viability? The premise of measuring social impact is a field of study in its own right and it was necessary to comment only on the most relevant ideas in this paper.

The third question revolves around the project's impact on the environment. It can be argued that the environment is a lot more robust than human life. Nature will find a way to survive. Even in the face of a massive environmental disaster like the Chernobyl nuclear explosion, nature has found a way to survive. It can be argued that humans, in their quest for sustainability, are simply trying to ensure their continued existence. We are, as a species, slowly killing the planet that is our only habitat. If the earth does not support human life anymore we would cease to exist, but nature will continue. These are difficult concepts to convey to shareholders at an AGM and that is the reason why this question is placed last.

The mining industry is quite adept at doing environmental impact assessments (EIAs) and researching the impact of a project on the environment. EIAs provide a clear picture of what to expect in terms of the impact of a project on the environment. Thereafter, the financial cost of the environmental damage can be determined.

There are a number of ways to account for environmental impact. A rather comprehensive way is to measure a project's impact on the quantity of carbon it releases. The marginal abatement cost curve is a widely used tool in carbon trading calculations. By directly fixing a cost to the marginal abatement of carbon in the atmosphere, the overall financial impact of a project's carbon footprint can be calculated. This is a figure that would be easily understood by company directors. The development, history and application of the marginal cost curve (MCC) will be discussed, as well as the reasons why use of the MCC is advocated.

When reviewing all three aspects it becomes clear that financial capital is the easiest of the capital types to measure. The mining industry is good at doing so and company directors understand this aspect best. For this reason a qualitative method of evaluating and choosing between RET projects is suggested. When it comes to the 'softer' issues of measuring the social and environmental impacts it is more difficult to translate this into terms that make sense to the investor. In the interest of

substance over form a qualitative approach is added in the form of a comments column to ensure that decision makers have all the information necessary to make the correct choice.

2. METHODOLOGY

This paper is a research project into methods of accounting for renewable energy projects in the mining industry. The aim of the paper is to find a quantitative method of choosing the most sustainable renewable energy project from a range of possible options. The research encompasses various fields of study. In the first part the financial aspect, also known as the financial bottom line, which allows for a controlled research methodology, is addressed. In the next part, the natural, human and social aspects are discussed. As with the financial aspect, the environmental sciences permit a controlled approach. It is only when investigating the social aspect of renewable energy projects that the research methodology has a decidedly uncontrolled dimension.

This research arises from of the various renewable energy projects the mining industry has launched in the recent past. The opportunity exists to generate electricity from wind turbines, through bio-mass or concentrated solar plants, etc. Another example is that of natural gas burn-off to generate electricity. This development gives rise to the following questions:

- How does the mining operation select the project that is the most sustainable?
- What does sustainability entail in this regard?

The research results discussed in this paper are meant to assist policy formulation in the mining industry and can thus be classified as applied research. Various classification methods have over time been used to describe the sustainability of a project or a company. These methods have been investigated and drawn upon to describe exactly what sustainability is. One of these methods is the triple bottom line (TBL) accounting method. It is one of the first attempts to quantify the sustainability of a company and is one of the main methods for sustainability indexing. I have expanded on this method in my research.

TBL accounting comprises three distinct fields of study, namely financial, social and environmental. The interaction between these fields of study has allowed for this research to have a combination of objectives. The research can be defined as descriptive in that it attempts to describe the challenges that a mining company faces when attempting to find the most suitable “green” energy investment for its money. Because the research also investigates the interdependence between the three aspects of the TBL accounting method, it can also be described as having a correlational objective. Lastly, the research has an explanatory objective in that it not only attempts to clarify the relationship between the different bottom lines but also attempts to quantify that relationship.

The approach to the research is decidedly unstructured in that the environmental and social bottom lines necessitate a qualitative methodology. An attempt is made in the latter half of this work to give a quantitative value not only to the qualitative aspects of the environmental and social bottom lines, but also to quantify the interdependence that enables one singular monetary value to be calculated for all three bottom lines of the TBL accounting method.

The process flow allows for a project to be tested against the accepted financial criteria of the net present value (NPV) and the internal rate of return (IRR) before it is tested for social acceptance and then environmental viability. The first stage of the testing process is financial viability, which dictates today’s capitalist business. As the driving force for mining operations, financial viability is the ’language’ that a mining company’s board of directors understands best.

However, even if a project is not fully financially viable it may still be allowed to be tested against the second criteria, namely social value. Various concepts of social value are investigated and the principle of creating shared value is identified and built on to arrive at the concept of shared monetary value (SMV). The shared

monetary value might be of such magnitude and importance to the mining company that it makes the project as a whole viable.

Finally, the impact the project will have on the environment is investigated. Various methods of quantifying the environmental impact are researched. Care was taken to allow for a qualitative approach in addition to the quantitative results. If the SMV is a positive order of magnitude larger than the environmental impact it will skew the final decision in favour of going ahead with the project whilst ignoring the much smaller environmental impact. The concept of "substance over form" is investigated and a comments column is added to the final checklist to allow for the qualitative inputs.

The researcher was, at time of writing, an employee of Gold Fields Limited (Gold Fields). Because of this he had relatively easy access to the company's decision-makers as well as first-hand experience of the modus operandi of the company, and can thus be described as a participant observer.

The sequence in which the investigation is done, namely to test firstly for financial viability, then for social value and lastly for environmental impact, is not meant to be considered as a hierarchy of importance. The financial impact should, in theory, not be regarded as more important than the other two aspects. The sequence of the tests is purely based on the observed workflow in the mining industry. In practice the very first question asked about a project in the mining industry is whether or not it will turn a profit. This does not make it the most important question from the viewpoint of sustainable development, but it does make sense to answer this question first. It is through the lens of capitalism that funds will be raised for non-core, i.e. non-mining projects. That is why the financial bottom line should be investigated first.

The process is designed to be rigorous and must be relevant, appropriate and justified. It must also be valid, verifiable and reproducible. The final product is a

checklist designed to assist a mining company in making an informed choice between an array of renewable energy projects.

3. RESEARCH OBJECTIVE AND KEY QUESTIONS

The purpose of this research is to develop a methodology to assist in decision making within mining companies when choosing between possible RET projects based on sustainability. Sustainability, as a value, must be defined. The decision making tool should ensure that all three the bottom lines are accounted for by adequately considering the social, environmental and financial issues pertaining to the proposed project. This can be achieved through asking the three main questions at the heart of this paper:

- Is the RET project financially viable? – Profit
- Is it good for the community? – People
- How will it impact the environment? – Planet

These three questions also form the foundation of the Triple Bottom Line (TBL) approach. In essence the goal is to ensure that sustainability becomes a major focus of the mining industry and inherent in decision making processes for RET projects.

This can be achieved through considering the overarching framework of the 5 Capitals Model and the triple bottom line accounting approach. Towards this goal the following was done:

- A case study of the Beatrix methane burn-off project;
- Research into existing decision tools and applicable literature.

The most applicable methodology for each of the triple bottom lines was identified and then combined into a new decision tool that encompasses the “whole”, i.e. all three the bottom lines and all five capitals. The connection between the TBL and the five Capitals model is also discussed.

The derived decision tool was not applied for the purposes of this paper. Each of the proposed methods are applied in practice but for the scope of this project, i.e. a research report for a MSc consisting of only 50% research, the report would have

been much larger than the prescribed requirement. However, much of the decision tool was developed while the writer was working for Goldfields and with the kind assistance of Goldfields personnel.

4. GOLD FIELDS – A BRIEF HISTORY

The history of Gold Fields starts in 1887 when the company was formed by Cecil John Rhodes and Charles Rudd. Over time, which saw various mergers and acquisitions, Gold Fields Limited (Gold Fields) came into being in 1998 as a result of the merger of Gencor and Gold Fields of SA. In 2003 Gold Fields enacted its first black economic empowerment transaction to comply with the South African Mining Charter of 2010.

In February 2013, Gold Fields unbundled certain of its South African operations, namely the Kloof-Driefontein Complex (KDC) and Beatrix Gold Mine into a separately listed but wholly owned subsidiary company called Sibanye Gold Limited. The unbundling process was completed during the time this paper was written.

Following the unbundling, Gold Fields is a large unhedged producer of gold with an attributable annual production of approximately two million ounces of gold from six operating mines in Australia, Peru, Ghana and South Africa (Gold Fields Ltd, 2012, p.13). Gold Fields has a total reported gold mineral reserve of 54,9 million ounces and gold resources of 125,5 million ounces. The company is primarily listed on the Johannesburg Stock Exchange and has secondary listings on the New York Stock Exchange, NASDAQ, Dubai Limited, Euronext in Brussels and the Swiss Exchange (Gold Fields Ltd, 2012, p.13)

4.1.Gold Fields and sustainability

Gold Fields invests heavily in CSR projects. It is through this on-going investment in social and environmental projects that its goal of sustainability in all business aspects is reached. In its sustainable development framework Gold Fields is guided by the sustainability framework of the International Council on Mining and Metals (ICMM) (Gold Fields 2012, p.93). Gold Fields also seeks to align its operations to the ten principles of the United Nations (UN) Global Compact (Gold Fields, 2012, p.93) in the areas of human rights, labour, environment and anti-corruption. This has resulted in

the following “eight pillars of sustainable development”, which have been refined to meet Gold Field’s operational needs (Gold Fields, 2012, p.92):

- Occupational health and safety
- Human rights
- Ethics and corporate governance
- Risk management
- Environment
- Material stewardship and supply chain management
- Community and indigenous people
- Stakeholder engagement

The sustainability policy has also been informed by the Sustainable Reporting Framework of the Global Reporting Initiative (GRI) (Gold Fields, 2012, p.114). It is this GRI framework that guides reporting on TBL issues by companies that subscribe to it.

4.1.1. People

In South Africa Gold Fields’ sustainability spending is fully integrated into the operational budgets of the South African mines. The money is spent on projects that benefit employees, their families and the communities in which they live (Gold Fields Ltd, 2011, p.124). In 2012, R42 million was invested by the South Africa region in community development and skills-training projects. Gold Fields operations also contribute towards the Business Trust and the National Business Initiative. (Gold Fields Ltd, 2011, p.123). In 2010 Gold Field’s West African operations invested US$ 2 million in community development projects at its mines in Ghana (Gold Fields Ltd, 2012, p.124) and in 2012 the company invested US$ 3,5 million in health, education, skills development and training programmes at its South American projects (Gold Fields Ltd, 2012, p.125). Through the Gold Fields Australia Foundation the company invests in community development around the St Ives and Agnew mines in that country (Gold Fields Ltd, 2012, p.125).

4.1.2. Planet

Gold Fields' water usage for the year 2012 amounted to 63 million kl, while a total of 77 million kl were discharged (Gold Fields, 2010, p.95). The company's water strategy identifies acid mine drainage as the most pressing environmental risk. As with most mining companies on the Witwatersrand, Gold Field's strategy therefore provides for the testing of groundwater, the separation of clean and dirty water, and the mapping of underground water structures.

Gold Fields is the first mining company to trade in carbon emission reductions, otherwise known as carbon credits (Gold Fields, 2010, p.95). The Beatrix methane burn-off project is an example of what is possible when capitalism meets science in the drive towards a sustainable future.

5. MORAL RESPONSIBILITY

A large part of the reason mining companies undertake sustainable, non-mining projects are to demonstrate moral and social responsibility. Demonstrating this responsibility is vital in obtaining a "social license" to mine, i.e. the agreement of society to allow a mining project. Moral responsibility is not a new concept. Aristotle (384−323 BC) seems to have been the first to draw up a theory on moral responsibility (Echenique, 2012).

According to Eshleman (Eshleman, 2009), moral responsibility means having to be worthy of a particular kind of reaction, whether it be praise or blame, for having performed a certain action. He argues that to judge responsibility entails that the behaviour or deed of the protagonist is governed by an 'interpersonal normative standard of conduct that creates expectations between members of the shared community', and that moral responsibility is an inherently social notion (Eshleman 2009). This means holding someone responsible means addressing a fellow member of a certain moral community (Stern, 1974).

Holding someone responsible, be it through blame or praise, holds inherent consequences for the person or, for that matter, the company being held responsible. Considering the literature on the nature of moral responsibility, the reader could be at risk of oversimplifying the nature of corporate social responsibility and the investment required in this regard as simply being the causal relationship of fearing negative social impact. In other words companies will only do good out of fear of negative social reaction, i.e. of obtaining bad publicity with all associated negativity and losing its social license to mine.

Whatever the reason for the force that drives companies to increase their moral responsibility is not the question here. The fact remains that through social pressure industry has taken increasing moral responsibility for its actions. Today's large

industries have certainly woken up to what philosophers have known for ages: industry is responsible and accountable to society.

6. VALUE THEORY

According to Schroeder (2012), value theory describes the area of moral philosophy that is concerned with questions of value and goodness of all varieties. He defines value theory as 'a catch-all label used to encompass all branches of moral philosophy, social and political philosophy, aesthetics, and sometimes feminist philosophy and the philosophy of religion − whatever areas of philosophy are deemed to encompass some "evaluative aspect"'. In other words, this is different to the concept of 'axiology', which is primarily concerned with classifying things as being good and rating how good they are.

The first step in value theory is to define the subject. It is important to delineate what the criteria are against which one wishes to measure good and bad. Schroeder uses the analogy of two sprinters. Both sprinters, 'Jon' and 'Jan', are deemed good sprinters. Both sprinters are above average, the average being described by a socially acceptable norm. It is easy to compare the two sprinters because one will inevitably be faster than the other. This means that one sprinter has more of something − Schroeder calls this a value − that we describe as speed. Not all values are so succinctly described. To borrow another of Schroeder's analogies: the value that makes one horror movie scarier than another is difficult to pinpoint and might be described as 'scariness'. Even if this 'scariness' value holds true it is difficult to describe.

The value of the financial bottom line in a mining project is well understood and the value of money is generally accepted. The challenge lies in finding some sort of socially acceptable and understood value for a company's social responsibility and investment, and its environmental impact, taking into consideration the risk of

oversimplification when a monetary value is assigned to unknown quantities like social and environmental capital.

It is hoped that this research can introduce these concepts to the board of a mining company in such a way that it is easier for the members to understand the advantages of and quantify the financial cost of renewable energy projects. This requires the assignment of monetary value systems to social and human capital, as well as environmental capital. It is an attempt to find ways of putting these issues into words that will make the mining investor more comfortable with spending valuable funds on projects that are not the core business of the company.

The value by which RET projects will be measured in this paper is “sustainability”. This sustainability value is an RET project’s version of “scariness” as discussed above – a hard to define value that takes into consideration all three the bottom lines (People, Profit, Planet) as well as the five capitals to compare different RET projects with one another. By finding a way to value social, environmental and human capital in terms of financial capital it may be possible to persuade the investor that sustainability is not just the domain of the philanthropist, but also of the hard-core businessman.

7. UNDERSTANDING SUSTAINABILITY: THE TRIPLE BOTTOM LINE

Sustainability is part of today's business jargon. Most companies give attention to sustainability in their annual integrated reports. Some companies, however, see sustainability as non-core and do therefore not give it the attention it deserves. As a concept, though, sustainability is not new. The TBL accounting method has been the point of departure for most business intending to make sustainability part of their corporate landscape.

In the mid 1990's Elkington (1994) strove to measure sustainability in a framework of his design. This framework incorporated social and environmental factors in the typical dimensions of business success (Taylor et al, 2006). By focusing on comprehensive investment results with respect to performance along the interrelated dimensions of profits, people and the planet, TBL line reporting can be an important tool to support sustainability goals.

The TBL approach can be defined as an accounting framework that incorporates three dimensions of performance: social, environmental and financial. This differs from traditional reporting frameworks since it includes ecological (or environmental) and social measures to which it can be difficult to assign appropriate means of measurement (Slaper and Hall, 2011). The TBL principles are also commonly referred to as the three Ps: Profit, People and Planet. Savitz defines TBL as 'captur[ing] the essence of sustainability by measuring the impact of an organisation's activities on the world ... including both its profitability and shareholder values and its social, human and environmental capital' (Savitz, 2006, p.13).

For the purposes of this paper the TBL approach is used as the foundation. Other advances in this field are also researched and studied. It is the TBL approach that leads to the three main questions at the heart of this paper:

- Is the RET project financially viable? – Profit
- Is it good for the community? – People

- How will it impact the environment? – Planet

The three matrices of the TBL do not have a unit of measure in common. Some commentators (Rogers and Hudson, 2011), (Roe, 1984) and (Laszlo, 2008) argue that there are harmonies along the TBL elements and that an impact or investment in a specific bottom line may influence the others. When profits are measured in dollars, how can social capital and environmental or ecological health be measured? Finding a common unit of measurement is the challenge here. Accountants might advocate monetising the dimensions, which are, after all, sometimes referred to as types of capital. It can be argued that a cost can be allocated to factors like social welfare or environmental damage. Many try putting a dollar value on 'green' or social factors. Another challenge is to find a way to assign an objective value to aspects such as lost wetlands or extinct species. Human emotion, like with so many other things, seems to add intrinsic value to these dimensions even before the balance sheet is done.

Another solution might be to calculate the three Ps in terms of an index. As long as there is a universally accepted accounting method allowing for comparison between entities this could be a way of reporting on 'People' and 'Planet'. Slaper and Hall refer to the *Indiana Business Review's* 'Innovation Index' (Slaper and Hall, 2011), but the authors admit that there is some subjectivity to the process, which presents itself especially in the weighting of the indexes. They comment: 'Would each "P" get equal weighting? What about the sub-components within each "P"? Do they each get equal weighting? Is the people category more important than the planet? Who decides?' (Slaper and Hall, 2011, p.1)

Slaper and Hall give excellent examples drawn from their work with various companies, as well as different indices constructed for measuring and reporting TBL, which is a method widely used by them. Addendum A describes TBL reporting laws applicable in various countries (Musikanski, 2012). Graafland (2002) describes four perspectives on profits versus principles drawn from a Shell report from 1988. He

places the environment and the social bottom lines under the heading of principles (Graafland, 2002). From examples in the Shell report (Shell, 1998, p.4) it is clear that the multinational oil company feels that there "does not have to be a choice between profits and principles…".

Although the TBL method is used widely, it undeniably has a strong subjective element. However, it does fulfil a purpose in reporting and as such is a good start for sustainable reporting. Subsequent experts have developed the TBL approach, as discussed in Chapter 8.

8. FIVE CAPITALS MODEL

The idea of using capitals other than financial capital was first explored by Forum for the Future (2012). The premise is that there are five types of sustainable capital from which the goods and services we need to improve the quality of our lives are derived.

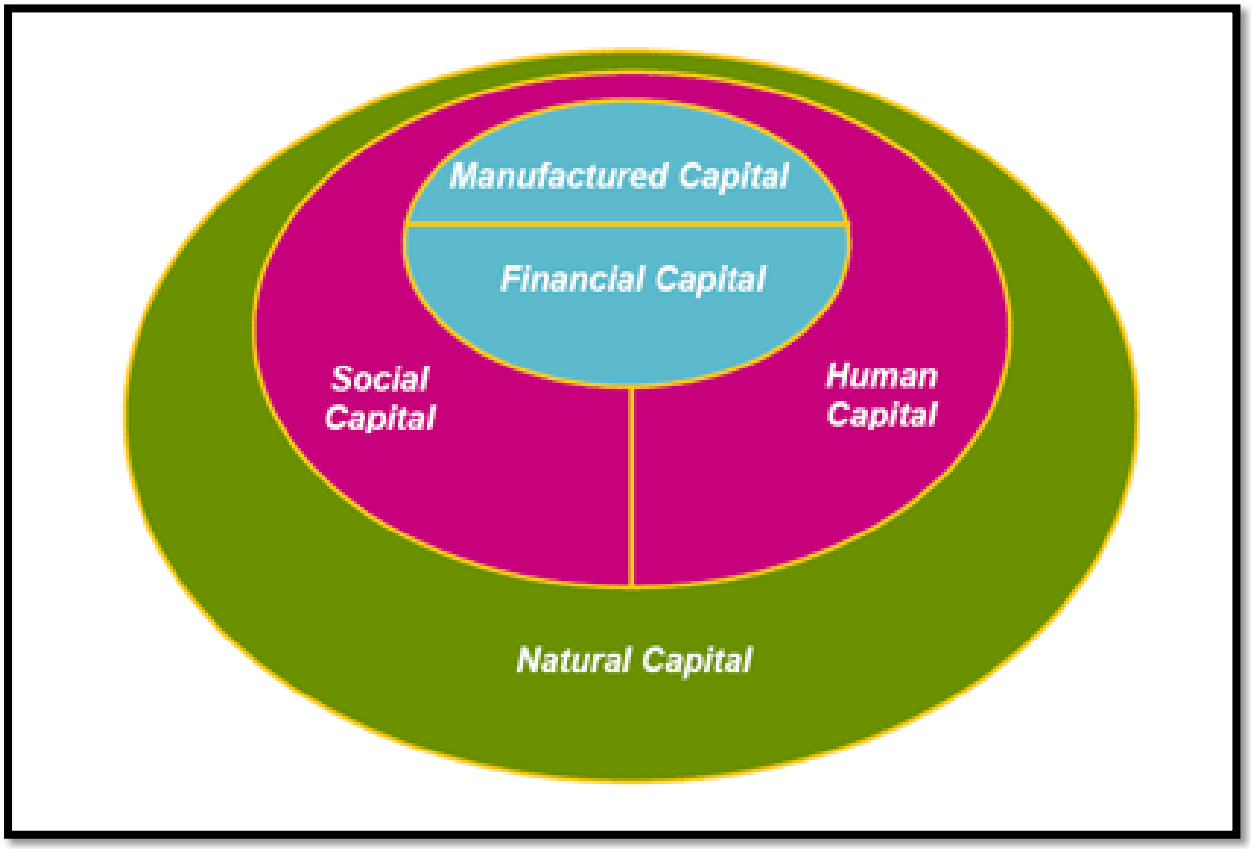


Fig. 1: The Five Capitals Model (Forum for the Future, 2012)

This model shows that there are five main capitals, or values, to consider in a sustainable society. If the manufactured and financial capitals were to be removed, the social, human and natural capitals would continue to exist. However, if the natural capital was to be removed i.e. destroyed, the other capitals would cease to exist. As such it is necessary to view the entire system holistically when a decision is made that affects mankind.

Man has realised the value of operating sustainably. Porritt (2007) argues that capitalism is and will for the foreseeable future be the world's driving economic

principle. Rather than fighting this, it is better to harness the power and momentum of capitalism to secure a sustainable future, he maintains. It follows that the mining industry should apply some of its wealth to create a sustainable future.

Forum for the Future and Keele University described 12 criteria with which to measure the sustainability of a sustainable society (Forum for the Future, 2012). Many of these criteria pertain to a company's actions as well. The italicised quotations below are from the Forum for the Future website, to which I have added my comments.

8.1.Natural capital

8.1.1. *In their extraction and use, substances taken from the earth do not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment).*

This is the crux of the matter for mining. The industry needs to test whether or not the processes of mining are so damaging to the environment as to render self-healing impossible. The environment, and indeed life itself, are quite robust. The planet has shown itself highly capable of ensuring that life goes on and a variety of life forms can be found in the most inhospitable of environments. It can be argued that when there is significant human intervention, entire species seem to die out. However, many metalliferous mines do not extract harmful substances. Gold and platinum are hardly harmful to the planet. However, coal is a substance that adversely affects the environment if its use is not managed properly. The same can be said for radioactive ores. The test here is to ensure that the mined ore does not do more harm above than below ground, and if it does so to manage the impact to ensure that the negative impacts are reduced.

8.1.2. *In their manufacture and use, artificial substances do not exceed the environment's capacity to disperse, absorb, recycle or otherwise neutralise their harmful effects (to humans and/or the environment).*

CFC's are organic compounds that contain only fluorine, chlorine and carbon. The manufacture and use of CFC's have gradually been phased out due to their contribution to ozone depletion but were widely used as propellant in aerosol applications, as solvents and as refrigerants. CFC's are man-made, artificial substances that do enormous harm to the ozone layer and directly endangered life on earth. The environment cannot counteract the damage done and so it became necessary to phase out the use of CFC's. Humans, being the creators of these artificial, harmful substances, have a moral obligation to manage the threat these substances pose.

8.1.3. *The capacity of the environment to provide ecological system integrity, biological diversity and productivity is protected or enhanced.*

Those very systems of the planet that ensure that life goes on can be impacted so severely that they become ineffective and life ceases. Humans have a clear understanding of the life and environmental cycles on the planet. We also research the impact our activities have on those cycles. The mining industry needs to measure and manage the impact it has on the environment.

The issue the Forum for the Future addresses is not what the impact is, but rather how that impact can be decreased or removed. The greatest test for society is whether it can improve on the three factors above rather than just manage them.

8.2.Human capital

8.2.1. *At all ages, individuals enjoy a high standard of health*.

This statement is subjective. What constitutes a 'high standard of health'? The huge variance in economic prosperity and standards of living between the

third and first worlds make this difficult to gauge. The large income disparities between people in a country as reflected by the Gini[1] index illustrate the difficulty. As health is directly dependent on the quality of health care received, the state of a country's economy is a significant factor in the national standard of health since it impacts on the quality of health care that can be provided. The Forum for the Future states that good health is a quality of a sustainable society. One needs to ask if the mining industry is responsible for the welfare of the people of a country. Surely not, since this is government's role. Even so, it is imperative that the mining industry realises that it can reduce its negative impact on the health of society. Mining is known for building schools and clinics in the areas in which it operates. This makes economic sense because a healthy worker performs better. However, this is a by-product of a mining operation and should therefore never be used to improve the feasibility of a RET project as they are mutually exclusive projects.

8.2.2. *Individuals are adept at relationships and social participation, and throughout life set and achieve high personal standards of their development and learning*.

8.2.3. *There is access to varied and satisfying opportunities for work, personal creativity, and recreation.*

The mining industry is well versed with regard to these two criteria. Many programmes are offered that allow individuals to better themselves. To a large extent RET projects also afford employees an opportunity to improve themselves. A few jobs might be created as well. This is a criterion against

[1] The Gini index measures the extent to which the distribution of income or consumption expenditure among individuals or households within an economy deviates from a perfectly equal distribution. A Gini index of 0 represents perfect equality, while an index of 100 implies perfect inequality. South Africa's Gini index in 2009 was 63,1 (World Bank Group 2012)

which the mining industry should measure itself. However, care must again be taken not to account for an RET project's value through the value of its job creation as this increase in jobs cannot be ring-fenced from the other projects the mine might launch, i.e. the labour could be shared with other projects, thereby skewing the value of the RET project.

8.3.Social capital

8.3.1. There are trusted and accessible systems of governance and justice.

8.3.2. *Communities and society at large share key positive values and a sense of purpose.*

The concept of creating shared value will be discussed below. Suffice it to say that only values that are shared by both the company and the community will build a sustainable future.

8.3.3. The structures and institutions of society promote stewardship of natural resources and development of people.

8.3.4. *Homes, communities and society at large provide safe, supportive living and working environments of Manufactured Capital.*

8.3.5. *All infrastructure, technologies and processes make minimum use of natural resources and maximum use of human innovation and skills.*

8.4.Financial and Manufactured Capital

8.4.1. *Financial capital accurately represents the value of natural, human, social and manufactured capital*

If natural resources can be used in such a way that they are replenished over time through the employment of technology (or by a natural process) so that the net effect is neutral, then surely that technology is either positive or has no discernible negative impact. When the resource in question is so abundant, such as sunlight, the opportunity cost of not harnessing that resource is

incredibly high. The advantages of renewable energy technologies speak for themselves (Abdelhamid and Bahmed, 2011).

8.5.Comment on the five capitals model

The five capitals model is an extension of the TBL accounting format. The criteria set out in the 12 features of a sustainable society provide a comprehensive foundation for a sustainable society and can be used by industry to gauge its compatibility with well-established norms and standards. However, the criteria need to be chosen carefully to ensure a realistic and sensible test, and they should also fall within the sphere of a company's influence. A mining company and the projects it owns must not be gauged against factors that are the responsibility of government.

The 12 criteria are highly subjective. Many questions can be asked about the exact meaning of a statement. For example, to what degree must '*The capacity of the environment to provide ecological system integrity, biological diversity and productivity' be* protected or enhanced? The burden of determining these factors rests on the company that wants to incorporate the values into its management style. This subjectivity is characteristic of many of the value systems in use for measuring sustainability. Although matrices and indices like these are useful they pose the same problem as TBL in that it is difficult to objectively quantify the factors and put their value on the balance sheet.

9. BENEFIT CORPORATIONS – THE OTHER END OF THE SPECTRUM

Like business in general, mines are inherently for-profit organisations. The main aim of a mining corporation is to generate a profit for its shareholders. In contrast to this, there are also not-for-profit, non-profit or charitable organisation. These organisations have a distinct tax structure, benefitting from significant tax advantages. If mines are at the one end of the spectrum and the other end of the spectrum is represented by non-profit organisations, then the social benefit corporation, otherwise known as benefit corporations, fits snugly into the middle of that spectrum.

Social benefit corporations seek the tax benefits of a non-profit corporation within a business structure that harnesses the profit motive. The benefit corporation is a hybrid business model that is currently seen as a legal entity in some states in the US, such as California. It has a TBL approach at the core of its business model.

Consider the case of Ben and Jerry's, an American ice cream shop that listed publicly in the year 2000. The company had started in a renovated gas station in Vermont and was true to the ideals of sustainability: management was fair to employees, the dairy products used were sustainably harvested, the cows were well looked after and the business was used as a vehicle to raise awareness about social and environmental issues. When Unilever offered to buy the company in what is colloquially referred to as a 'godfather' offer, Ben and Jerry's directors had no choice but to agree to the sale (Szaky, 2013,p.16).

A 'godfather offer' is a takeover technique where such a large offer is made to the target company that the directors of the target company cannot refuse the proposal. If the board was to refuse, the shareholders might file lawsuits claiming that directors did not do what was best for the investor. The term is derived from Mario Puzo's Godfather trilogy of movies (Investorwords.com, 2013). According to the King III Report, company directors have distinct roles and responsibilities. For instance,

they are bound by very specific fiduciary duty to the company as a legal persona in its own right. In this fiduciary capacity the director has two roles. The first is that of an agent acting on behalf of the company. The other is that of a trustee in control of company assets.

This has many implications for directors in their personal capacity. One of the most interesting of these is that this gives a 'back door' to companies planning a takeover. If a takeover bid is made and the proposed price offered per share is so advantageous that shareholders will be better off financially, it is the duty of the directors, in the interest of shareholders, to accept the offer. It can be argued that a "godfather offer" is an unfair abuse of the responsibilities of directors.

The 'Ben and Jerry' scenario can be avoided by the benefit corporation company structure. A benefit corporation states clearly in its articles of incorporation that its goals are the improvement of corporate social responsibility, social entrepreneurship and socially responsible investing. This provides far greater protection to the directors should they decide to reject an offer to purchase. Since a TBL approach is firmly ensconced in the mission statement of the company, the directors have a duty to the legal entity, the company, to protect those values. The directors are therefore not forced to sell the company purely on the basis of the profit motive.

Although benefit corporations have only been passed into law in 14 US states, there is hope that the rest of the world will follow suit.

10. QUESTION 1: IS THE PROJECT GOOD FOR THE BOTTOM LINE?

10.1. Financial capital

The financial capital criterion has traditionally been the test of whether a project is viable. By placing a project's future cash flows and its promise of growth against the company's internal hurdle rates determines whether a project is viable or not. New techniques for capital budgeting have been developed. These are, *inter alia*: strategic options (Kester, 1986), scoring methods (Nelson, 1986), fuzzy logic approaches (Zimmerman, 1991) and discounted cash flow (DCF) modified methods (Azzone and Bertele, 1991). Traditionally, however, the two main criteria for financial viability have been net present value (NPV) and its counterpart, the internal rate of return (IRR) as part of the DCF process (Maccarrone, 1996).

It is imperative to test a project against these criteria. However, the essence of sustainable development and the accounting thereof lies not in financial viability alone, but also in its impact on society [its social capital], as well as it impact on the environment (Burritt and Schaltegger, 2010). If we accept that capitalism is currently the main driving force in our society, then we have to accept that it is the financial viability of a project that will make a board of directors view it in a favourable light. The aim of this paper is not to argue for a change in the nature of capitalism, but to find a way of adding to it to ensure that sustainability becomes a major focus of the mining industry and inherent in decision making processes for RET projects.

Hence the first question revolves around the financial viability of a project: does the project add to the bottom line. It is worth a cursory investigation into the metrics used for financial viability.

10.2. Net present value

Financial capital speaks to the question of money and its value over time. The classical methods for valuing a project are essential tools to calculate the viability of

a capital-intensive, long-term project. By its very nature a project that is hoped to be sustainable should be a long-term project.

The time-value of money is magnified over the life of a sustainable project. NPV is defined as the sum of the present value of the individual cash flows of an undertaking, both incoming and outgoing. NPV is the present value of all future cash flows, adjusted for the effect of time, of a project.

$$\mathrm{NPV}(i,N) = \sum_{t=1}^{N} \frac{R_t}{(1+i)^t}$$

Where:

i = the opportunity cost of capital

N = the number of periods of cash flows

R = the amount of cash (inflow minus outflow) in period *t*

A project with a negative NPV will not add financial value to the company and vice versa. A project with a NPV of zero is looked at indifferently as it will neither add nor detract value from a company. In financial theory, the project with the highest NPV should be chosen. Arguably, this makes NPV one of the best tools for choosing the financial viability of one project over another.

10.3. Internal rate of return

IRR is the rate of interest *i* that will result in a NPV of zero. In other words, IRR is the opportunity cost of capital that will result in an exact breakeven for the project over its life cycle.

IRR value leads to a go/no-go decision on a project under evaluation. If the IRR is greater than the cost of capital the project should be accepted. If the IRR is lower

than the cost of capital the project will not add value and the project should be discarded.

Using IRR and NPV measurements to evaluate a project often leads to the same conclusion. There are, however, a number of projects for which using IRR is not as effective as using NPV to discount cash flows. The major limitation to IRR is also its greatest strength: it uses one single, assumed, discount rate to evaluate every investment. Discount rates usually change substantially over time. IRR does not account for changing discount rates if the necessary allowances are not made, and IRR is therefore not an adequate tool for longer-term projects with discount rates that are expected to vary. However, for a long-term project multiple IRRs may be calculated to overcome this problem.

Gitman (Gitman, 2006, p.424) states that NPV is easier to calculate by hand than IRR, but that modern technology has made calculating the IRR of a project relatively simple. NPV gives an indication of the magnitude of money to be gained or lost on a project over time, while IRR is an indication of the return on an investment. As such many financial managers prefer IRR as it is more intuitive to them. When the NPV and IRR methods are inconsistent due to the long life of the project or varying discount rates NPV is the preferred method.

In the Gold Fields methane burn-off project both IRR and NPV were used to demonstrate the feasibility of the project.

10.4. Project risk

NPV is a forward looking statement of the current value of the future cash flows of a project. The risk of the project is inherent in the NPV calculation. The future cash flow is calculated with a risk of the project borne in mind (Brookfield, 1998). The IRR however, needs to be higher than what is commonly referred to as the internal hurdle rate of the company. This is the rate of return that a company expects from

invested funds before it would invest in that project. As such the risk involved in the project plays a major role in the go/no-go decision.

In a personal interview with Mr Derek Beytell (2012) the internal hurdle rate for Gold Fields as a company was quoted to be 'around 25%', nominal rate. This means that Gold Fields will not invest in a project with a return on investment of less than 25%. Comparatively speaking this is a very high required rate of return. The inherent risks in the mining industry call for a higher hurdle rate. When these inherent risks are viewed in conjunction with the long lead times of mining projects it becomes increasingly important to offset the risks with high rewards.

The first step is to set a higher required rate of return to offset the higher risks. In the integrated annual report for the year ended December 2012, Gold Fields, in its strategic analysis, lists six external environmental issues that impacts on the company. These issues can be seen as common to all mining companies. The six issues listed are (Gold Fields, 2012, p.39) as the following.

10.4.1. Industrial action in the South African mining sector

From August 2012 to November 2012 the South African mining industry was affected by a wave of illegal industrial actions and associated violence. The impact on the South African mining sector resulted in increasing international alarm. The Marikana disaster where 34 miners were killed after police had to intervene during violent strikes not only cost Lonmin millions in lost revenue and made international headlines. The strikes subsequently spread to mines operated by Anglo American, Gold Fields, Gold One, Kumba and Harmony. The loss of revenue added insult to injury as mass retrenchments of workers by some of these operators followed. Gold Fields lists the drivers of the growing industrial action to be the following:

- Widespread frustration with the lack of meaningful economic transformation after the apartheid era except for that which is increasingly seen as an economic transformation to a 'black economic empowerment elite'.

- An unreformed migrant labour system. Not only do workers leave families behind in the distant, poorly developed labour sending areas, but they tend to establish second households near the mining operations that increase the pressure on their wages
- Frustration amongst rock drill operators who carry out the most physically challenging work but have very limiting career advancement opportunities.
- The failure of existing labour structures. The extent of the widespread strikes indicates a significant failure of the mining sector to establish a more relevant labour negotiation framework.

10.4.2. Resource nationalism

Resource nationalism can occur in a number of ways, ranging from the outright expropriation of mining operations to special taxes being levied on the mining industry. The risk of resource nationalisation has been identified by the following companies:

- Ernst and Young (2012) who have identified resource nationalisation as the number one risk facing the mining sector.
- Deloitte (2013) who rated this the fifth most serious risk facing the mining sector in 2013.
- KPMG (2011) who rated this the second most serious risk facing the mining industry in 2012.

Gold Fields identifies the following drivers of this issue:

- Consistently high mineral prices
- Misperceptions around costs: the mining industry has in the past not reported on the full cost of a unit of ore.
- Macro-economic difficulties: the mining sector represents a potential source of additional income to the national coffers in times of macro-economic shocks

- Politics: populist politics focus on the redistribution of wealth from mining operators to citizens without considering the long-term implications.

10.4.3. Recruitment and retention

The recruitment and retention of skills is a challenge for mining companies and there is strong competition for scarce skills. Gold Fields identifies the drivers as the following:

- High commodity prices
- Demographic challenges: the most skilled and experienced managers and technical specialists are getting closer to retirement with no equivalent influx of the necessary younger workers to replace them.

10.4.4. Cost pressures

Deutsche Bank has estimated that cost inflation averaged between 5% and 7% a year over the last 10 years but accelerated to between 10% and 15% in 2011 (Gold Fields 2012, p 42). Gold Fields considers the drivers for this process to be the following:

- Global mining and engineering skills shortages as discussed above
- Cost inflation for energy, steel and other inputs
- Global currency volatility relative to the US dollar

10.4.5. Challenging new growth environments

Mining companies are increasingly hunting for growth opportunities in areas that do not have an established history of mining. These new frontiers introduce the following challenges:

- The effective management of social and political risks and opportunities
- Addressing the additional operational and technical risks associated with infrastructurally underdeveloped areas such as insufficient water and energy supply, and under-explored geological environments.

The following drivers have been identified by Gold Fields:

- The depletion or unsustainability of high grade deposits
- The increasing high costs of merger and acquisitions activity in more established mining locations
- The high price of minerals that increases the reward function in the risk vs. reward equation

10.4.6. Gold trends

Gold prices have risen strongly from less than US$300/oz in 2001 to an average of US$1 669/oz in 2012 (Gold Fields 2012, p 46). Current indications are that the trend may be stabilising, but even so the average gold price in 2012 was 91% higher than in 2008 (Gold Fields 2012, p 46).

Despite this trend, gold miners have not been able to deliver optimal leverage of this gold price to investors. As a result investors are increasingly turning away from investing directly in gold mining companies to buying exchange traded funds (ETF), which give straightforward access to a gold price upside. The move to gold ETF investment has also impacted on companies mining other minerals and metals, reducing direct investment in these companies.

10.5. The IRR of a sustainable project

The required IRR of a company is usually set by the decision-makers, i.e. the board. In a mining company the required IRR for a mining project might very well be much higher than that for a 'green' project. This might be because the company is willing to spend money on a specific sustainability project that is perceived or have distinct advantages. The difficulty with this approach is that as long as the economy and the business are doing well there will in all likelihood be spare cash flow for a sustainable project. However, the real test comes when cash flow is low and the business is under pressure. In this case the required IRR may have to be weighed up against the social value and the environmental impact of a project.

Even when the IRR of a sustainable project is not high enough it may still be worth taking on when the increase in the other types of capital is calculated and added to the TBL.

10.6. The NPV of a RET project

The same can be said for the NPV of a RET project. Even if a project has a negative cash flow, its inherent value to society and advantages to the environment may make the project viable in terms of sustainability.

It is essential to weigh up the various projects against each other in order to ensure investment in the most efficient project. Such a project is the one with the best impact on all five types of capitals.

10.7. Weighted average cost of capital

The weighted average cost of capital (WACC) is the expected average future cost of funds over the long term (Gitman, 2006, p.137). Businesses often discount cash flows at the WACC to determine the NPV of a project, using the formula:

NPV = Present Value (PV) of cash flows discounted at the WACC

The WACC is in fact the discounted rate of cash flow over time. In the calculation of the NPV for the Beatrix Methane project the WACC was not used as a discount rate because the WACC within Goldfields would be the same for all projects under review. Instead the same rate of inflation was used for all projects to ensure fairness honesty and simplicity.

10.8. Answering question 1 – Is the project financially viable?

A full NPV and IRR calculation must be done for the project in order to compare the project with others vying for funding. The IRR is the initial hurdle. If there are two or more projects that clear the required rate of return set by the company the NPV of those projects should be used to select the most profitable one.

For RET project's, however, the impact on the other four capitals should be considered. RET projects might not show profitable returns when financial capital is considered. When the other two bottom lines are considered, i.e. the other two questions are answered the true value of the project in terms of a sustainability value (Section6) is considered and this value might make the project viable.

10.9. Manufactured capital

The concept of manufactured capital has been defined by the Forum for the Future (2012) as the physical, built machinery and infrastructure related to a project. The value of manufactured capital lies in its efficiency and effectiveness. It is in this area that the expertise of various players is needed to ensure that the project is successful. The methane burn-off project at Beatrix goldmine is a case study that illustrates how the first question can be answered.

Mining, electrical, mechanical and civil engineers are all part of the array of engineering expertise that is found on a mine. It is only through collaboration between these disciplines that a large mining project can be sustained. When venturing into the realm of RET projects this engineering expertise needs to be complimented and amplified by the pure sciences, especially where the project is ground-breaking or just new to the mining environment. In the case of the methane burn-off project it quickly became clear that the applicable manufactured capital was assured of viability and value only in close collaboration with various science disciplines.

Manufactured capital adds a new dimension to the concept of the TBL. Not only is the financial viability of a project paramount to it sustainability, but so is the value and quality of the manufactured capital. It is in this sense that the Forum for the Future expands on the concept of the TBL. Instead of the first bottom line being purely a financial question, this is now expanded to incorporate manufactured capital.

The data for the methane burn-off project at the Beatrix gold mine was supplied by Gold Fields.

10.9.1. The Beatrix methane burn-off project

Beatrix gold mine is a deep-level mine in the Free State Province of South Africa. The mine has the highest methane emission rate of any gold mine in the country (Du Plessis and Van Greuning, 2011, p.2). Mining operations liberate this methane from underground sources, from where it dissipates in the atmosphere. The total methane emission rate for the entire mine is reported to be in the order of 1600 l/s. Beatrix has a history of gas accumulation that has led to a number of underground explosions, which are devastating. Following the last explosion in 2001, a number of recommendations were made. One of these was to consider extracting the methane from the mine in order to render the mine atmosphere safe. This is the crux of a project that has resulted in an ingenious method for not only improving safety at Beatrix, but also generating electricity.

Methane gas is a potent greenhouse gas. Its contribution to global warming and climate change is estimated at 20 times higher than that of carbon dioxide. The Beatrix methane burn-off project is in fact a carbon project under the CDM of the Kyoto Protocol.

As a study in sustainable development, the methane burn-off project is well worth investigating to discover the manner in which the mining industry adopts technology in the search for a greener tomorrow. The feasibility study for the project provides invaluable insight into how Gold Fields scopes its sustainable projects. The study documents detail the results of the IRR and the NPV, and clarify the thinking behind the project finances. Access to a large amount of technical data and personal interviews with the mechanical engineer involved in the project also helped to provide a clear understanding of the manufactured capital.

It is necessary to have an understanding of the project's manufactured capital and the processes involved to obtain an understanding of the financial capital requirements.

10.9.2. Technical aspects of the methane burn-off project

Professor J.L.L. du Plessis and Mr D. van Greuning are the champions of the methane burn-off project. The idea is to capture and extract the underground gas and use it in a sustainable manner to generate electricity. Through this process the atmospheric conditions underground will be vastly improved, as will the financial bottom line of the mine owing to the generation of cheap electricity.

Beatrix gold mine is situated 40 km south of the city of Welkom and 280 km south of Johannesburg. Fig. 3 shows the geographical location of the mine.



Fig. 2: Geographical location of Beatrix gold mine (Du Plessis and Van Greuning, 2011)

Beatrix comprises three sections, namely the north, south and west sections. Production from stoping operations amounts to 225 000 t/m. Airflow of 1 826 kg/s and 60 MW of refrigeration are required to maintain acceptable environmental conditions. The methane gas emits from deep-seated sources through geological features such as faults, fissures and dykes. The concentration of methane emitted varies between 82 per cent, but can be as much as 90 per cent (Du Plessis and Van Greuning, 2011, p.4).

It is impossible to extract all the methane because of the layout of the stoping operations and the widely spread methane intersections. It was therefore decided to target high-emission areas. The project has two phases, the first one being the destruction of methane emitting from the mining operations by capturing the gas and piping it to the surface, where it is flared. The second phase is the installation of Jenbacher electrical generation plants that will convert the methane gas to electricity. Any excess methane is flared.

10.9.3. Jenbacher generator sets

The Jenbacher generators are essential to the success of the Beatrix methane burn-off project phase two. Some technical aspects of the generators are described below due to the importance of their technical viability in the feasibility studies.

'GE Energy's gas engines division is a manufacturer of gas-fuelled engines, generator sets, Combines Heat and Power modules, Organic Rankine Cycle systems and auxiliaries. With a legacy of technological innovation … including Jenbacher engines …' (GE Jenbacher GmbH and Co).

'GE's Jenbacher gas engines range in power from 0,25 to 3,0 MW and run on either natural gas or a variety of other gases (e.g. biogas, landfill gas, coal mine gas, sewage gas, combustible industrial waste gases). A broad range of commercial, industrial, and municipal customers use Jenbacher products for on-site generation of power, heating and cooling. Patented combustion systems, engine controls, and monitoring

enable its power generation plants to meet stringent emission standards, while offering high levels of efficiency, durability, and reliability. GE's Jenbacher product team has its headquarters, production facilities and 1 200 of its more than 1 500 worldwide employees in Jenbach, Austria' (G-Energy.com).

In the case of Beatrix, the Jenbacher engines will generate electricity that is fed back into the power grid. Methane emitting from exploration boreholes is not piped to the Jenbacher plant as this is not deemed to be financially viable.



Fig. 3: The Jenbacher J624 GS gas engine (GE Jenbacher GmbH and Co)

A peer review was ordered through a professional engineering company before the commencement of the project. This review resulted in the following recommendations:

- The extraction system must have a hazardous area classification
- A physical audit must done of all ignition sources along the route
- A flexibility analysis of the piping must be undertaken to address expansion, support and stiffness issues.
- Leak detection is to be carried out after installation.

The methane gas is to be captured from three old sealed-off mining areas that collectively emit 400 l/s of CH_4 gas (Du Plessis and Van Greuning, 2011, p.5). Beytell (2012) determined that the gas would be vacuumed out of the stopes. Initially the natural pressure of the gas was deemed sufficient, but Beytell considered it risky to assume adequate pressure to ensure constant flow to the Jenbacher units. The quality and quantity of methane in the system is monitored continuously and the information is relayed to the Jenbacher sites.

10.9.4. Financial capital – Following the money

In the planning stages, a project goes through various feasibility studies. One of the vital checks is to make sure that the project is technologically viable, i.e. does the technology work? This was proven, in concept, by means of a technical feasibility study and the solid performance record of the Jenbacher engines.

The next question to be answered is, 'Is the project financially viable?' For obvious reasons, manufactured capital goes hand in hand with financial feasibility. If the technology is not viable the entire project will fail, financial feasibility notwithstanding. However, if the project is technologically viable it will need funding to see the light of day. It is vital then that the methods of financial viability testing are understood and applied to the project.

In a project such as the Beatrix methane burn-off project, with its long life and factors that change over time, it is necessary to make certain assumptions. One of the most interesting characteristics of the project is that the CEO is adamant that forecasts are kept to an absolute minimum. The logic behind this is that when a range of assumptions are made it is easy to manipulate the figures in such a way that the project makes financial sense. On the other hand, it is easier to make mistakes and arrive at incorrect assumptions leading to an unrealistic forecast for the project.

Among the inputs and assumptions for the original financial model, quite a number of factors stay constant over time. The inputs into the original model can be found in

Addendum B. Factors that remained the same were the methane emission from the shaft, borehole methane and the total carbon emission reduction (CER)'s produced. In the 'indices' column, the consumer price index (CPI), which was used to calculate the rand vs. euro ratio for the duration of the project, was kept constant at 4,5 per cent. The producer price index (PPI) was also kept at 5,0 per cent, while the European inflation rate remained at 2,5 per cent. The euro price of a CER was left as an input. The exact origin of these figures was not divulged. The grid-emissions factor stayed constant, i.e. the time of carbon dioxide emitted per megawatt hour stayed at 1,02. The cost of engine oil and associated running costs of the Jenbacher engines was adjusted according to CPI and PPI inflation rates.

One factor that was not kept constant was the Eskom price escalation. At the time of the feasibility study Eskom announced that the price of electricity would be escalating by 33 per cent per annum. However, the financial model for the methane burn-off project allowed for 25 per cent per annum, which, in hindsight, was closer to the actual. The Eskom reference price was calculated accordingly.

The technical inputs were easily calculated from the Jenbacher information. Factors such as unit size, number of units and associated parasitic load are all inherent characteristics of the Jenbacher plants. The availability factor of the plants was estimated rather high at 90 per cent. According to Beytell (2012) the 90 per cent factor was realistic not only because of the simplicity of the process, but also the trustworthy record of Jenbacher plants.

As the operating costs were well understood, they were a direct input into the model. These costs were inflated at South African CPI.

The financial model had two phases associated with it. Both phases were dependent on the revenue received from CER sales. Carbon-emission reduction units, also known as carbon credits, are traded as commodities through the Clean Development Mechanism (CDM). The UN Framework for Climate Change [UNFCC] approved the

project design document for registration under the CDM in October 2008 (Du Plessis and Van Greuning, 2011, p.4). The CDM, as well as the calculation of the value of CERs will be discussed under environmental capital below. Suffice it to say that CERs are tradable commodities on the open market. Gold Fields was fortunate enough to find a buyer for the CERs very early on in the project design. The value of the CERs make up an invaluable part of the bottom line of the project. However, the carbon credits are hedged, which carries with it a risk as well as a reward. The buyer is willing to pay Gold Fields for the carbon credits at the beginning of the year. However, if the planned reduction in carbon does not materialise, the project is in debt to the buyer. Gold Fields management understands the hedging process very well. Although Gold Fields is currently one of the largest unhedged gold miners in the world, it was not always so, and understanding the risks and managing them is thus an easy enough process. Until 2016, Gold Fields will sell 1,7 million CERs to the European energy trading company Mercuria Energy Trading SA under forward contracts.

10.9.5. Phase one of the project – flaring only

The first phase of the project consisted only of methane burn-off through flaring. This is a relatively simple process. As methane has a notoriously bad name as a greenhouse gas, the burning off of the gas results in a significant reduction in carbon emissions and, in turn, to significant revenue through carbon credits sales.

In Addendum B the phase one financial model can be seen. Capital expenditure for phase 1 amounts to R54.14m. Net cash generation for the project ramps up to R31 million per annum, resulting in a NPV of R229 million over 21 years. An IRR of 45,66 per cent is generated in the first phase. This is 20 per cent higher than the required hurdle rate for a mining project. Bearing in mind that this project does not necessarily carry the same risks as a long-term mining project, the IRR is incredibly high.

10.9.6. Phase two of the project – electricity generation

The second phase of the project consists of electricity generation through the Jenbacher plants. Compared with phase one of the project, the emission reductions are not as high in this phase, with the result that the carbon emission sales are lower and CER revenue is less. However, there is a cost saving on Eskom electricity and this is added to project revenues. Electricity revenues are calculated at R27 million per annum. Added to the R20 million revenue from carbon credits sales, total project revenues exceed R47 million per annum. Capital expenditure for phase2 is R38.33m.

This results in an NPV of R325 million over 21 years, with an IRR of 54,12 per cent being achieved. This is 10 per cent higher than the phase one IRR and proves the financial feasibility of the phase two addition. The phase two model can be found in Addendum C.

10.10. Concluding question 1 – Financial and manufactured capital

In section (10.8) the importance of financial viability was discussed. A crucial part of financial viability is the technical viability of the RET technology. An in depth study and thorough research must be done to ascertain whether or not the technology in the project will actually work as planned. Only when the viability of the manufactured capital (the effectiveness of the technology) is considered in addition to the financial viability of the project (in terms of IRR and NPV) can the first question truly be answered.

An RET project is good for the bottom line of the company when the technology works, the IRR is above the internal hurdle rate and the NPV favourable.

11. QUESTION 2: IS THE PROJECT GOOD FOR THE COMMUNITY?

11.1. Corporate social investment and responsibility

For some time now the corporate world has invested in what is referred to as Corporate Social Investment (CSI) or Corporate Social Responsibility (CSR). CSI can be seen as encompassing all projects that are external to the normal business activities of a company and not directly for the purpose of increasing company profit. It is thus non-core business. CSR projects utilise company resources to benefit and uplift communities and are not primarily driven as marketing initiatives. In essence, it is the process whereby a company takes some of it profits and 'gives back' to the community.

CSI stems from philanthropy and the value it adds to the organisation is well recognised, i.e. reputation improvement, compliance with government regulations, competitive advantage, stakeholder appeasement (Hall and Vredenburg, 2004), (Kassinis and Vafeas, 2006). CSR is an umbrella concept that refers to an organisation's total responsibility towards the business environment in which it operates (Moir, 2001). It describes the broader approach of the 3Ps of TBL, namely profit, people and planet. CSI is one of the components of CSR and has the aim of uplifting the community in such a manner that its quality of life is improved. As such the CSI/CSR concepts plug nicely into the TBL framework. But there is no consensus on the value added to shareholders by CSR/CSI initiatives.

A report by McKinsey and Company (2009, p.3) states clearly that 'no consensus has emerged to define whether and how such programs create shareholder value, how to measure that value, or how to benchmark financial performance from company to company'. The report remarks that there are notable differences between Chief Financial Officers (CFOs) and investors as to how much value these programmes create, which specific environmental, social, and governance activities create value, and whether such programs are a proxy for good management. It is anticipated that

environmental, social and governance programmes will create more and more value over time. This potential highlights the importance of developing a better matrix and resolving the gap in understanding between CFOs and investors.

Two-thirds of CFOs and three-quarters of investment professionals who contributed to the McKinsey survey agreed that environmental, social and governance activities do create value for their shareholders in normal economic times. They did not agree on the level of value, however. The most troubling part, according to the report, is that CSR professionals themselves appear to be the uncertain about putting a number on the value added by environmental, social, and governance activities.

'Respondents to this survey are split over whether putting a financial value on social programmes would reduce the reputational benefits to companies: slightly more believe stakeholders view financial value creation as important than those who believe it's a distraction.' (McKinsey, 2009, p.3). In other words, many respondents believe that 'bragging' with what their companies are doing might be bad for business, but more believe that it is good for business to publish what they do and that this process creates shareholder value.

The problem with the CSR/CSI approach is that measuring the value of a project in terms of its social value is highly subjective. 'When doing a valuation, CFOs and investors alike say they count the effects on some stakeholders much more than effects on others; further, different stakeholders matter to the two groups . Most CFOs and investment professionals who don't integrate environmental, social, and governance considerations into their evaluations of corporate projects − or who don't do so fully − agree that the contributions are either too indirect to value or that the available data are insufficient. Indeed, few CFOs or investment professionals found value in external rating, ranking, or reporting standards or guidelines to assess the effects of environmental, social, and governance programs, with the exception of certain certification or accreditation standards' (McKinsey, 2009, p5).

Here, again, the problem lies in trying to achieve a single valuing system for the work that companies are doing to uplift communities. It also opens up another issue: the question needs to be asked whether or not the community finds as much value in a project as the company does. It is entirely possible for a company to justify a project by claiming that it has a positive impact on the community when, in fact, the community does not share that value in the project. Especially in Africa, with its wide range of cultures and peoples, a project's value is in the eye of the beholder. A concentrated solar power plant supplied by a new investor may, for example, generate enough electricity to supply the community as a whole, but the loss of the grazing land used by the investor for his project's footprint may be a greater loss to the community than its gain in electricity. Just as beauty is in the eye of the beholder, so it seems, is value.

Michael Porter and Mark Kramer provide an interesting example. Michael Porter is Bishop William Lawrence University Professor at Harvard University and the originator of the value chain. Mark R Kramer co-founded FSG, a global-impact consulting firm, with Porter and is its managing director. He is also a senior fellow of the CSR initiative at Harvard's Kennedy School of Government. When these two academics came up with the idea of 'creating shared value (CSV)' (Porter and Kramer, 2011) it was something to take cognisance of.

Porter and Kramer start their report by saying that the capitalist system, in its current form, is under siege. Many commentators agree with them and literature abounds with various re-thinks of the current capitalist system (Barnes, 2006), (Young, 2003), (Pirson and Lawrence, 2009) and (Porritt, 2007). Porter is of the opinion that the legitimacy of business has in recent years fallen to levels not seen before and that a large part of the problem seems to be an out dated approach to value creation. Companies take a short-term view of value creation and in so doing miss customer needs, overlook the well-being of their customers, and ignore the depletion of natural resources and the economic distress of the communities they operate in.

According to Porter and Kramer, 'Companies must take the lead in bringing business and society back together. Yet we still lack an overall framework for guiding these efforts and most companies remain stuck in a "social responsibility" mind-set in which societal issues are at the periphery, not the core. The solution lies in the principle of shared value, which involves creating economic value in a way that also creates value for society by addressing its needs and challenges.'

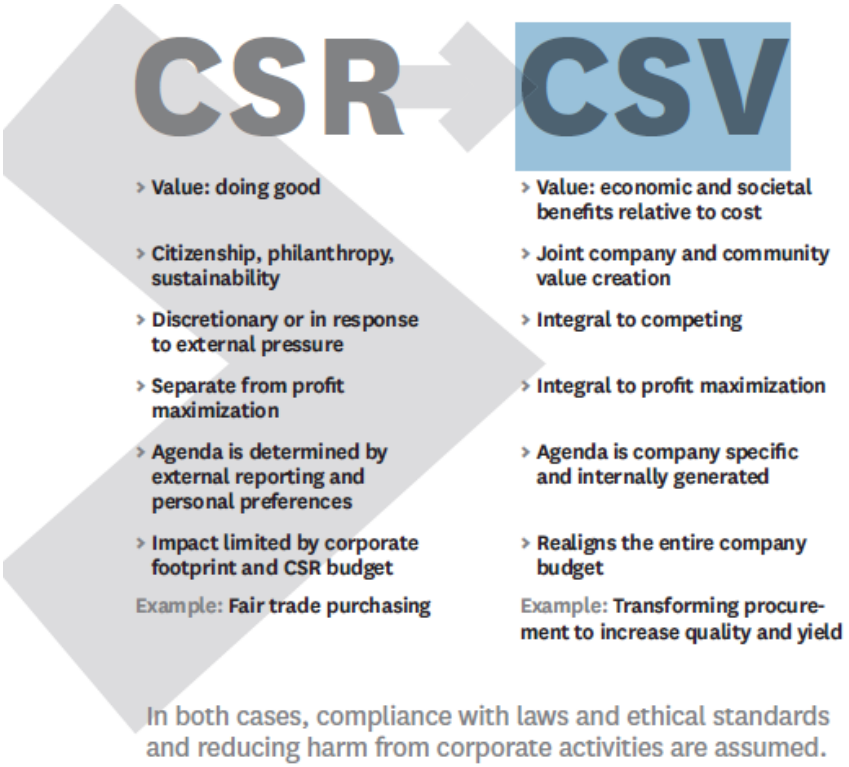
The idea of creating shared value transcends CSR, philanthropy and even sustainability. It should, in Porter and Kramer's opinion, not be at the periphery of what companies do but at the heart. They argue that the CSV approach calls for a re-imagining of the lines between society and corporate performance. This is supported by Michelini and Fiorentino (2011) and Yunus (2010) and Yunus (2008). Porritt feels that 'Capitalism is an unparalleled vehicle for meeting human needs, improving efficiency, creating jobs and building wealth. But a narrow conception of capitalism has prevented business from harnessing its full potential to meet society's broader challenges.'

At the root of CSV is the idea that the competitiveness of a company and the well-being of the surrounding community are closely intertwined. It should be a symbiotic relationship. According to Porter and Kramer, there are three ways a company can create shared value:

1. Reconceiving products and markets
2. Redefining productivity in the value chain
3. Building supportive industry clusters at the company's locations

They are at pains to explain the difference between CSV and CSR (Table 1). 'CSV should supersede CSR in guiding the investments of companies in their communities. CSR programmes focus mostly on reputation and have only a limited connection to the business, making them hard to justify and maintain over the long run. In contrast, CSV is integral to a company's profitability and competitive position.'

Table 1: CVS vs. CSR (Porter, 2012)



Good work has been done by adherents of the CSV concept. Companies like Nestle, Google, BASF Brazil (Spitzek and Chapman, 2012) and IBM, to name a few, have made significant strides in creating CSV.

However, in researching how CSV is valued, it is clear that a hard-line value cannot be put on shared value. Once the CSV concept has been entrenched in a company's ethics and business model it is easy to calculate the value of the shared value. However, it is purely a retrospective exercise that tallies the advantage of the principle. In a presentation to the Shared Leadership Summit in 2012, Prof. Porter (2012) demonstrated the link between business and social value leading to shared value in the diagram shown in Fig. 5. From this illustration it is evident that CSV is created in the overlap between business and social value.

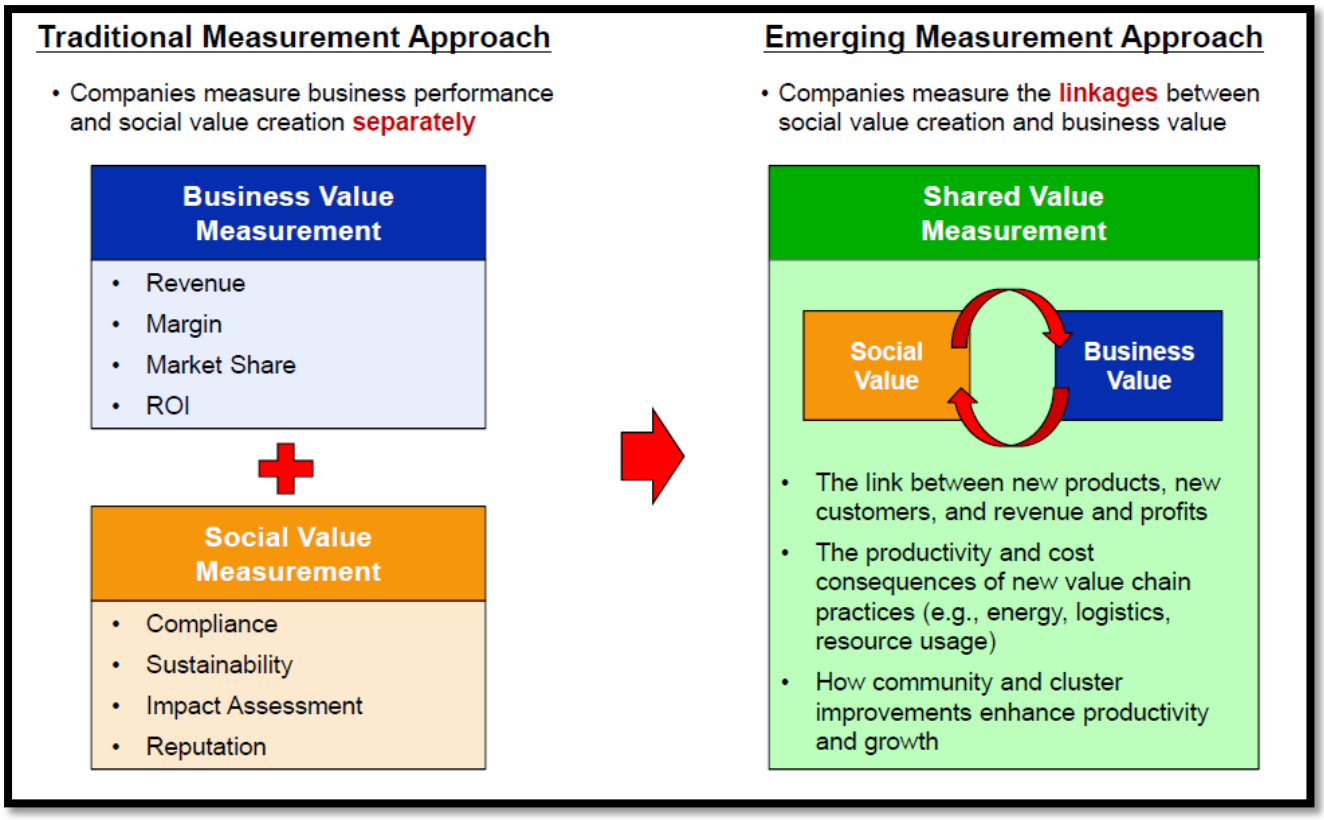


Fig. 4: Measuring shared value (Porter, 2012)

It seems that Prof. Porter's schematic can be reduced as shown in Fig. 6. This simplified diagram clarifies the domain of shared value. Only where business and society both agree on the value of a project can there possibly be shared value.

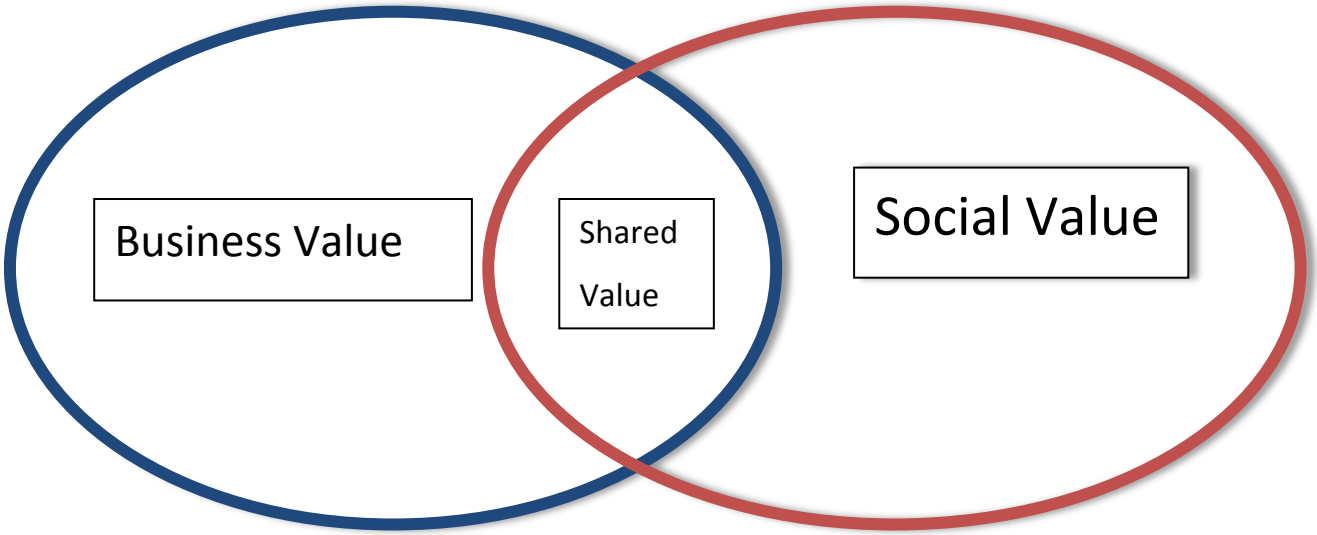


Fig. 5: Shared value (Mostert after Porter, 2012)

It is this shared value that best describes the social and communal aspects of a project.

A hypothetical RET project at Gold Fields' successful mining operation in Ghana, will put the topic in perspective. The mine owns large tracts of land that are unused. If the company was to build a Concentrated Solar Power (CSP) plant on this land, the energy generated could be used not only to assist the mine in combating the rise in electricity costs, but also supply electricity to the village nearby. Such a project would significantly reduce the carbon footprint of the mining operation as well. On the face of it, the project would seem to have a large shared value. However, it is difficult to ensure that the value will be truly shared. It is entirely possible that the community may find more value in the land for cattle grazing than in obtaining electricity. If so, the value would fall only within the company's circle and have no shared portion.

A slightly more dramatic, but equally hypothetical example, would be if Gold Fields planned to build a nuclear pebble bed reactor next to its South Deep Gold Mine to the west of Johannesburg. The mine has a reported life of around 70 years. In a financial sense that makes an investment in such a power plant entirely feasible. However, the community at large would arguably not be in favour of having a nuclear power plant a couple of kilometres from the financial powerhouse of Africa, the bustling metropolis of Johannesburg.

This brings us full circle to the question of valuing shared value. How does a company like Gold Fields go about assigning a value to the shared value it wishes to create if it cannot even establish that shared value exists?

In a sense, our society has been measuring a form of shared value for some time already. The very brands of the products we buy are a measure of the shared value between the manufacturer and the consumer. If a company wants to establish shared value it simply has to ask, that is engage with stakeholders about what is of value to that stakeholder.

Gold Fields subscribes to the AA1000 Stakeholder Engagement Standard 2011 (AA1000SES) and uses its principles to recognise the needs of all stakeholders in a specific area. It is necessary to get an overview of this stakeholder engagement process.

11.2. AA1000 Stakeholder Engagement Standard 2011

Stakeholder engagement is by no means a new concept. It is, in fact, considered crucial to the sustainability and success of an operation (Ayuso et al, 2011). Stakeholder engagement can be defined as: 'The process used by an organisation to engage relevant stakeholders for a clear purpose to achieve accepted outcomes' (AccountAbility, 2011).

AccountAbility is a global organisation that provides innovative solutions to challenges in corporate responsibility and sustainable development. According to AccountAbility (AccountAbility, 2011), quality stakeholder engagement must, inter alia, comprise the following:

- Clearly define the scope
- Have an agreed decision-making process
- Focus on issues material to the organisation and/or its stakeholders
- Create opportunities for dialogue
- Be integral to organisational governance
- Be transparent
- Have a process appropriate to the stakeholders engaged
- Be timely
- Be flexible and responsive

Quality stakeholder engagement can have the following outcomes:

- More efficient social development by giving all stakeholders the opportunity to be considered in decision making processes
- Enable better management of risk and reputation
- Allow for the pooling of resources (knowledge, people, money and technology)
- Enable understanding of complex operating environments
- Inform, educate and influence stakeholders to improve decisions and actions that will have an impact on the organisation and on society
- Contribute to the development of trust-based and transparent stakeholder relationships

In SA, as in other parts of the world, stakeholder engagement is a sensitive issue. It is essential that mining operations inform all stakeholders in detail about what it is going on in the operation and how proposed developments may affect stakeholders' lives. A RET project fits the criteria listed above. It has the potential of significantly impacting on the daily lives of the communities in the area and mine employees, and on shareholders and government.

At its origin, stakeholder engagement lies in crisis resolution. To address external pressures, companies have come to realise that engagement, transparency and quick responses to stakeholder concerns are vital. Once companies understand this concept, the process of being proactive rather than reactive becomes embedded in management style. A better understanding of the needs of stakeholders results in an easier and more receptive operating environment. This is key to 'winning over' stakeholders and ensuring social acceptance of a new project.

For quality stakeholder engagement to be successful the three accountability principles, namely inclusivity, materiality and responsiveness, must be honoured.

Inclusivity is defined as 'the participation of stakeholders in developing and achieving an accountable and strategic response to sustainability. It is also a commitment to be accountable to those on whom the organisation has an impact and who have an impact on it, and to enable their participation in identifying issues and finding solutions.' (AccountAbility, 2011)

Inclusivity is integral to achieving the other two accountability principals of materiality and responsiveness. Materiality is the process that determines the most relevant and significant issues for an organisation and its stakeholders. It recognises that certain issues are stakeholder specific. What is important to the local community in a South American mining village may not necessarily be as important to a mining village in rural Ghana. AccountAbility (2011) continues: 'Responsiveness is the decisions, actions, performance and communications related to those material issues.' In other words, responsiveness is the company's reaction to materiality.

Before attempting the stakeholder engagement process it is necessary to define the purpose, the scope and the stakeholders involved. AccountAbility (2011) lists the following steps for defining these criteria:

- Establish the purpose of engagement
- Establish the scope of the engagement having regard to the following:
    a. This speaks to the subject matter, the divisions of the organisation and the timeframe of the process.
    b. Companies should consider the 'target market', i.e. the specific stakeholders that are being engaged with.
    c. Stakeholders might have a say in the scope of the engagement process. For the purpose of materiality it is important that stakeholders be

empowered to add to the scope of the engagement process that which they think is important.

- Determine the mandate, ownership and stakeholders of the engagement. The following criteria should apply:
    a) The ownership of the engagement lies with those parties that organise the engagement.
    b) It is the owners of the engagement who shall identify relevant stakeholders, who may have the following attributes:
        i. Dependency – people, groups or individuals, who are dependent on the company's activities.
        ii. Responsibility – those to whom the organisation has legal, commercial, ethical or moral responsibilities.
        iii. Tension – those with whom the organisation might have strained relations.
        iv. Influence – groups or individuals who might impact on the organisation.
        v. Diverse perspectives – those who have a different view than the owners of the process.

The stakeholder engagement process consists of four main steps, namely a) planning, b) preparing, c) implementation and d) acting, reviewing and improvement. These four steps form a continuous cycle in order to improve the engagement process.

11.2.1. Planning

The first step is to profile and the stakeholders. A methodology for profiling should be established. The profiling should be reviewed and revised throughout the process. The identification of even small differences and an understanding of the uniqueness of stakeholders are vital to ensuring that the correct avenue to successful engagement is followed. It is vital that the mining company understands exactly who

the stakeholders are, both as a group and as individuals. Only in this way can the company ensure that it identifies with the issues that are important to stakeholders.

Mining companies should seek to obtain an understanding of the following aspects of each stakeholder (AccountAbility, 2011):

- Knowledge of the issues associated with the purpose and scope of the engagement
- Expectations of the engagement
- Existing relationship with the organisation (close or distant; formal or informal; positive or negative)
  Dependence (or otherwise) on the organisation (it is essential that the stakeholder group is able to express its views independently of management in order to contribute freely)
- Willingness to engage
- Level of influence
- Type (civil society, government, consumer etc.)
- Cultural context
- Geographical scale of operation
- Capacity to engage (e.g. language barriers, IT literacy, disability)
- Legitimacy
- Relationships with other stakeholders

The mining company, the owner of the engagement, should determine the purpose and scope of the engagement, as well as the engagement level of various stakeholders before engagement commences.

AccountAbility (2011) lists the following three information finding activities before engagement commences:

- Receiving unsolicited information, such as protests, letters or claims possibly made by stakeholders in the media
- Tracking of information in the media, on the Internet, through social networks and via second-hand reports
- Creating awareness through the use of web sites, road shows, lobbying, etc.

Another important point to note is that boundaries of disclosure need to be communicated as soon as possible. This safeguards not only the company, but also in some cases the various stakeholders.

The next step is to draft an engagement plan. This plan must be made available to stakeholders to give them the opportunity to make input. At a minimum, the engagement plan should include the following (AccountAbility, 2011):

- The mandate for the engagement
- The purpose and scope of the engagement
- The owners of the engagement, their roles and responsibilities
- The methodology for and results of identifying stakeholders
- The methodology for and results of profiling stakeholders
- The pre-engagement activities
- The engagement level(s) and methods
- The boundaries of disclosure.

The last planning step is to establish indicators. As with the engagement plan, the stakeholders should have the opportunity to provide input. The indicators should be meaningful to both the organisation and the stakeholders, and allow for the measurement and evaluation of progress in the engagement process.

11.2.2. Preparation

The first step for proper preparation is to mobilise the human and technical resources of the engagement owner and the stakeholders. It is very important that the required resources are available for the process.

The next phase is to build capacity. This refers to the fact that not all stakeholders will be on an equal footing once engagements starts. This could be because of language, literacy, cultural barriers, problems of distance, etc. It may therefore be necessary to build capacity in terms of the following:

- Knowledge – creating awareness and understanding of the mining company, the issues, politics, etc.
- Skills – language and communication, technological understanding, motivation and creativity
- Opportunity – ensuring the availability of the necessary physical and financial resources, time to participate and access to information

Once the opportunity has been created it is necessary to identify and prepare for possible engagement risks. The following are possible risks to the engagement process (AccountAbility, 2011):

- Conflict between participating stakeholders
- Unwillingness to engage
- Participation fatigue
- Creating expectations of change that the organisation is unwilling or unable to fulfil
- Lack of balance between weak and strong stakeholders
- Disruptive stakeholders
- Uninformed stakeholders
- Disempowered stakeholders.

11.2.3. Implementation

The company should start off by inviting stakeholders to engage. It is good practice to send invitations to individuals and not just to their organisations. The arrangement of the engagement should revolve around the availability of key participants.

The next step is to brief all stakeholders. This ensures the readiness of stakeholders prior to the start of engagement.

The parties are now ready to engage. At the beginning of the process the owners and the stakeholders shall set procedural and behavioural ground rules for the participants of the engagement process.

A vital task of the owners of the engagement is to document the engagement and its outputs. This documentation should note the following (AccountAbility, 2011):

- The purpose and aims of the engagement
- The methods employed
- Who participated and who did not
- The timeframe
- A verbatim record of proceedings. This not always necessary but may be useful. Permission may be required from participants to keep a verbatim record.
- A summary of stakeholder concerns, expectations and perceptions
- A summary of key discussions and interventions
- Outputs of the engagement, e.g. queries, proposals, recommendations, agreed decisions and actions.

From these records an action plan is developed. This action plan should stay true to the letter and intent of the engagement and its outputs. This is a very important since it indicates the company's reliability and demonstrates that the engagement

process is more than window dressing. A thorough action plan will include aim to achieve the following (AccountAbility, 2011):

- Ensure that decisions and actions take into account stakeholder concerns, expectations and perceptions, as well as key discussions and interventions
- Ensure that roles and responsibilities are well-defined
- Incorporate realistic timelines for the completion of actions, which may include the development of or changes to the following:
  - Governance and management commitment
  - Relevant policies
  - Strategies, objectives, targets and performance indicators
  - Operational practices
  - The clear assignment of responsibility and the necessary competencies
  - Review, learning and improvement processes.

After the action plan and the engagement outputs have been created it is necessary to communicate these to the stakeholders in an appropriate and timely manner.

11.2.4. Acting, reviewing and improvement

As is the norm with all project management exercises, the monitoring and evaluation of the engagement is critical. The engagement must not only stay true to its aims, namely those that were laid down for the engagement process, but also the timelines and the criteria it imposed.

Engagements are an opportunity from which an organisation can learn. Subsequent engagements on similar topics can be sped up and be far more effortless through the observation of the lessons learned in the initial process. Continuous improvement of the process can only add value to the company.

The company must follow up on the action plan. This process will provide the opportunity to analyse the overall contribution of the engagement to the success of the company and the specific project at hand.

The final step is for the company to report publicly on the stakeholder engagement. This should form an integral part of the integrated report and demonstrate the contribution of engagement activities to the company's strategy and operations. Such a report will lend credibility to the report and to the company as a whole, which in turn leads to proper accountability, one of the mainstays of sustainability.

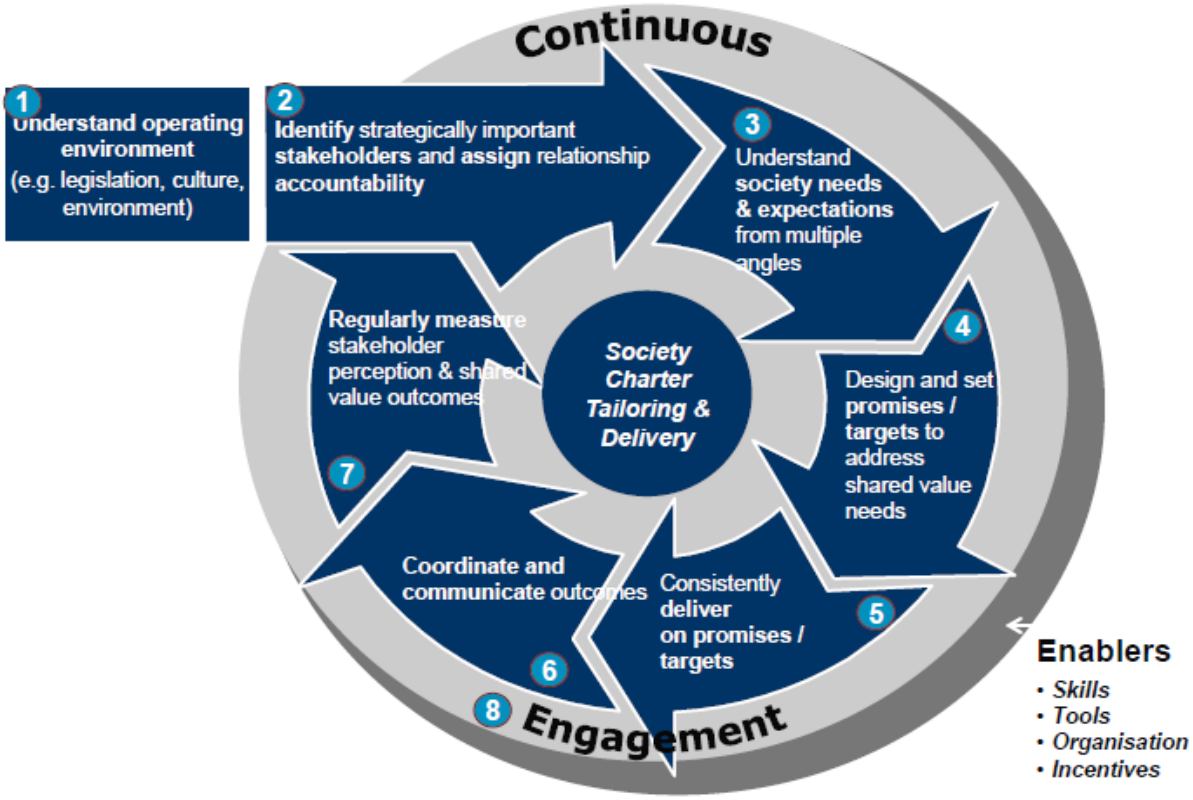


Fig. 6: Gold Fields' stakeholder engagement process (Goldfields , 2012, p.3)

11.3. Brand value

A process much like the stakeholder engagement process discussed above is what the marketing industry has been doing for decades to ascertain brand value, which is a measure of stakeholders' perceived value of a product. Testing brand value is exactly the same as testing a project's shared or stakeholder value. If brand value can be viewed as a measure of how much stakeholders 'like' an idea or a company, then it is also a useful measure for ascertaining a company's shared value.

According to Bick and Abratt (Bick and Abratt, 2003, p.2), ’brands … makes them [customers] feel confident of their purchase decision. Managers have also become aware of the fact that the brand has become an important company asset, and focus is needed on the creation of brand equity.’ The authors draw a comparison between shared and brand value: ’As capital becomes less of a constraint on businesses there will be far greater emphasis on how this capital is used to creatively differentiate the organisation. The point of differentiation (and the source of shareholder value) will flow from intangible assets’.

Shared value is an intangible asset or ’soft’ concept that, like brand value, is difficult to quantify in the balance sheet. And, like brand value, shared value is a concept that has intrinsic stakeholder value and is a long-term asset to the company. So, if a mining company wants to ’sell’ an idea to the community, this is exactly what they need to do, ’sell’ the project. If the community thereupon sees value in the project then, and only then, is shared value created.

Much work has been done on valuing brands. With the close link between shared value and brand value it makes sense to study the various methods of brand valuation, choose one that makes sense and then adapt it to quantify shared value.

Bick and Abratt (Bick and Abratt, 2003, p.3) identify that ’The benefit of ascertaining the correct brand value will ensure that resources are appropriately channelled to where they will deliver the greatest value …’ That is the crux of the matter for shared value as well: to identify the RET project that will have the most value and in which it will make the most sense to channel available funds.

11.3.1. Measuring brand value

Bick and Abratt(2003, p.4) quote Robbin (1991) in listing a number of reasons why brand value should be captured on the balance sheet:

1. It decreases the company’s gearing ratio because a larger asset base Is created
2. As an internally generated asset it increases shareholder equity

3. A larger premium for mergers and acquisitions can be justified

However Robbin (1991), also lists some reasons for not capturing brand value on the balance sheet:

4. Brand value decreases the return on assets as the company now has a larger capital base
5. Companies that have adopted the economic value added (EVA) would have to raise a capital charge against the asset.

In view of this, when applied to valuing shared value, points 4 and 5 are accepted more readily because the RET project is, by definition, an asset and does not constitute a 'soft' (i.e. difficult to value) asset as does brand value.

How does industry go about valuing brands? A wide range of methods produce widely varying results. Bick and Abratt (2003, p.4) list the following five main methods:

11.3.1.1. Cost-based approaches

a. Cost-based approaches consider the costs incurred when creating the brand or replacing the brand. Such costs include research and development of the product concept, market testing, promotion and product improvement.
b. The replacement-cost approach determines the cost that would be incurred to replace the asset if it were to be destroyed.
c. The accumulated cost approach will determine the value of the brand as the sum of accumulated costs expended on the brand to date.

11.3.1.2. Market-based approaches

Market-based approaches are based on the amount for which a brand can be sold, as determined by the 'willing buyer, willing seller' principle.

11.3.1.3. Economic use or income-based approaches

Economic use approaches consider the valuation of future net earnings directly attributable to the brand to determine the value of the brand in its current use.

11.3.1.4. Formulary approaches

Classed in a separate category because of its extensive use by consulting firms, this approach is similar to the cost-based approach but uses a range of criteria in the formulae.

11.3.1.5. Special situation approaches

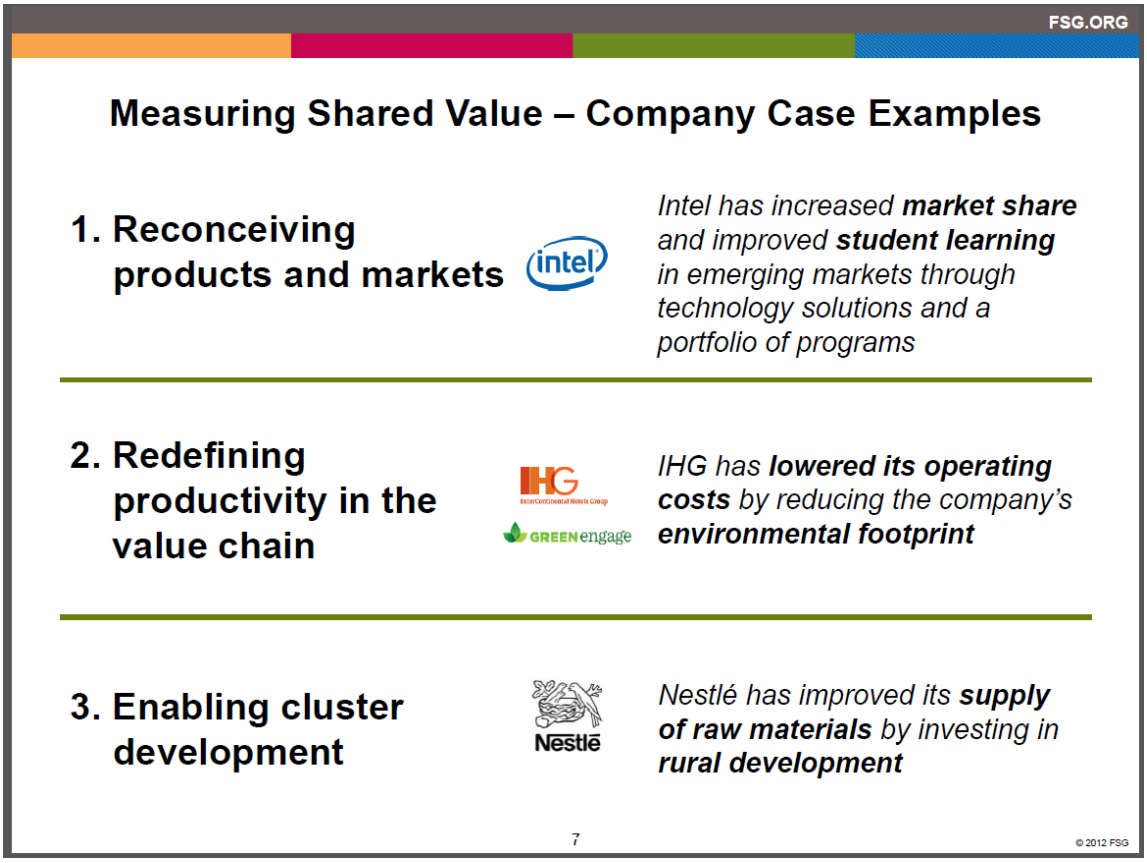
This approach recognises that the value of the brand can be affected by circumstances that do not fall within the ambit of other approaches.

Unfortunately this is where the similarities between valuing brands and shared value end. Brand value is intrinsically linked to sales and awareness of the product. The amount of product sold by a mining company does not depend as heavily on the brand value of the company as is the case for a textile retailer or a soft drink manufacturer. It can, however, be argued that membership of industry watchdog organisations, such as the Kimberley Process for diamonds and the World Gold Council's 'Conflict-free gold standard' for gold miners do affect brand value and therefore the sale of diamonds or gold. But membership of these organisations is a given for companies that adhere to sustainable mining practices and does therefore not given them a greater competitive edge.

11.3.2. Measuring shared value – a forward-looking approach

It is comparatively easy to measure the value created by the shared-value approach in retrospect. Table 2 gives examples of the value created for companies by the CSV approach (Porter, 2012, p 6).

Table 2: Measuring shared value (FSG Social Impact Consultants, 2012)



The challenge is to gauge the approach that will ensure the greatest shared value before the project is financed, unlike the trends of Table 2, which were determined retrospectively. To choose between possible projects before kick-off means valuing shared value in a forward-looking manner.

The most logical way of establishing shared value is by market research. Engagement with the community on proposed projects in order to gather society's input assists in establishing the shared value of different proposals. This is where stakeholder engagement, as discussed above, comes to the fore.

If, and only if, some measure of shared value can be established through the engagement process can the project be seen as having a shared value. There are three possible outcomes to community engagement:

1. Shared value is not something that can be explained to a community. If a project, such as the methane project described above, has inherent value to the company but is not perceived to have value to the affected community, then the project cannot be considered to have shared value.
2. A project might have value for the community by, for example, supplying electricity to the local village. However, if the community considers the project too disruptive in terms of aesthetics or the destruction of farmland for example, the value of the project is not shared.
3. If a project is considered advantageous by both the company and the community, a symbiotic relationship exists in which all stakeholders draw value from the project. The project is then in the realm of true shared value, as per the overlapping area in Fig. 7.

Replacement cost of project ($_{\text{if shared value has been established}}$) = Monetary shared value

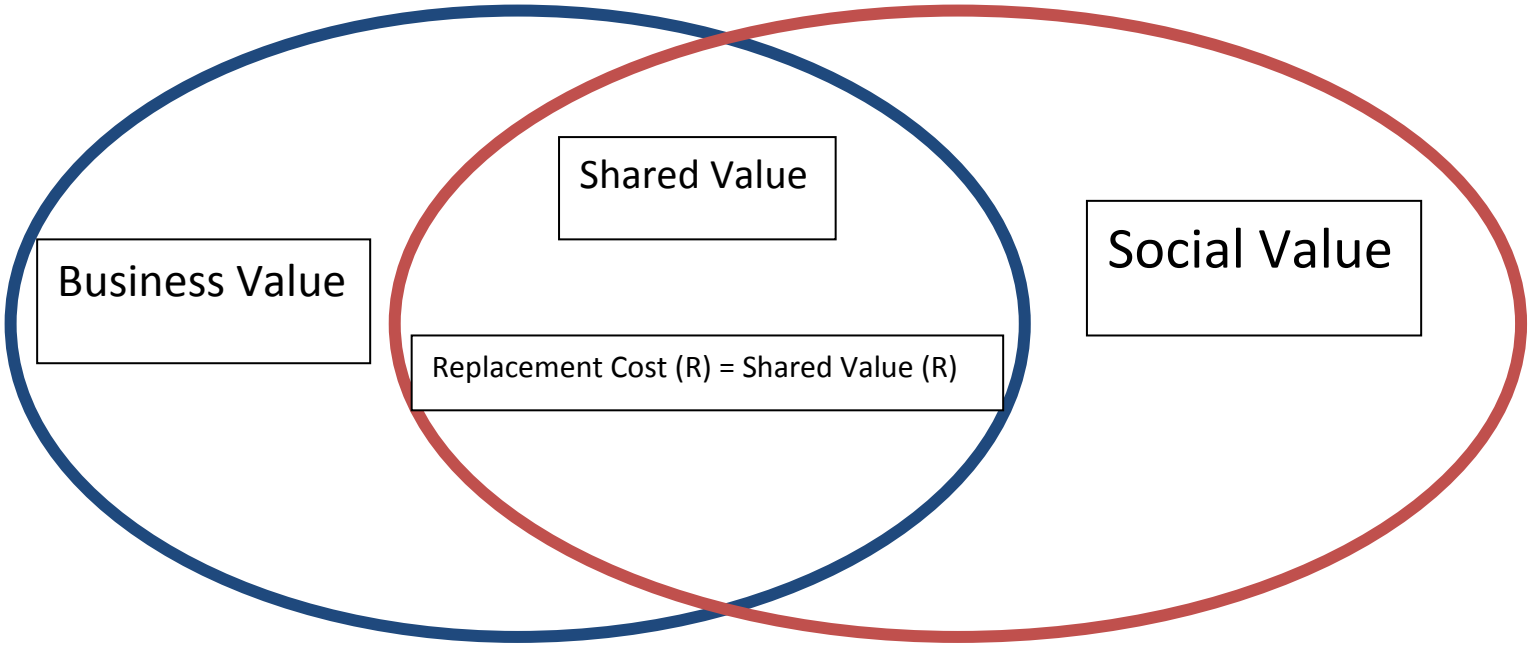


Fig. 7: Monetary shared value

11.4. Concluding question 2 – Human and social capital

If, and only if, point 3 (Section 11.3.2) holds true for the proposed project can the next phase of determining the shared value be proceeded with by applying the cost-based approach (Section 11.3.1) from brand value measurement. Simply put, if shared value is established, the project with the highest replacement cost, e.g. capital expenditure in monetary terms, is the project with the highest shared value. Comparing the cost of one project to that of another gives an unbiased, quantifiable measure of the shared value of that project and leads to a weighting metric (Fig. 7).

If the stakeholder engagement process is followed shareholders are assured when looking at the balance sheet that expenses reported under CSR strategies are creating shared value.

11.4.1. Social hurdle rate

Monetary Shared Value is expressed in terms of money. MSV defines human and social capital through the sustainability value (Section 6). The company could also set up internal hurdle rates for required MSV. In other words a monetary shared value that automatically places projects in one of two categories, either creating sufficient monetary shared value for the company to go ahead with the project or not. This "social" hurdle rate should only be a salient metric for comparing projects because even if a project does not clear the internal hurdle rate set for MSV it might be more valuable than a competing project when the financial and environmental bottom lines are considered. If a certain project's MSV is below the company's internal hurdle rate for MSV the project should be identified as a possible risk and extra care should be taken in comparison with other projects. When MSV is considered in conjunction with financial capital two of the three bottom lines are accounted for, i.e. Profit and People.

If, however, points 1 or 2 above hold true and the project does not have sufficient shared value this does not necessarily make it obsolete. It simply reduces the social value of the project to far below one that has a shared value. A project for which

shared value cannot be established can still be of such value to the company or the environment that it is worth going ahead with it. This is where the third question comes into play.

12. QUESTION 3: HOW WILL THE PROJECT IMPACT ON THE ENVIRONMENT?

Over time, many methods have been developed for evaluating the environmental impact of a project or industry. Three of these methods will be discussed and one will then be selected to evaluate the impact a mining project has on the environment. Other methods include Life Cycle Assessment (Sadiq and Khan, 2006) studies (also known as cradle-to-grave analysis), biodiversity offset studies and anthropogenic metabolism calculations etc. The fact that these other methods of environmental impact assessment are not discussed here does not detract from their validity or importance. The anticipated end result of this research is a decision checklist that is easy to use, not overly onerous to complete and also comparatively cheap. For this reason only the following three methods of environmental impact assessment are discussed.

The first method is the environmental impact assessment (EIA), which is widely used by the mining industry and heavy industry. The second method calculates the cost of replacing ecological infrastructure. The third method is used internationally to calculate carbon credits and the value of those credits. Each method has been designed to answer specific questions, and each one has its own and advantages and disadvantages. Often the methods are used in conjunction with one another. Usually an EIA is done to obtain a baseline assessment and is supplemented by other studies.

12.1. Environmental impact assessments

The National Environmental Management Act, 1998 (Act No. 107 of 1998) or (NEMA) governs the EIA regulations in South Africa. The purpose of the act, as stipulated in the *SA Government Gazette* (2010) is to 'regulate the procedure and criteria ... relating to the submission, processing and consideration of, and decision on,

applications for environmental authorisations for commencement of activities in order to avoid detrimental impacts on the environment, or where it cannot be avoided, ensure mitigation and management of impacts to acceptable levels, and to optimise positive environmental impacts ...'

When an EIA is to be done, the first step is to appoint an environmental assessment practitioner (EAP). This is a person who is registered with an appointed registration authority has stipulated by the act. The interaction and the procedure to be followed between the EAP and a competent authority are detailed in the act.

The duties and responsibilities of a competent authority are clearly described in the act. The identification of a competent authority is, however, unclear. In chapter two of the act, section 3(2) of the act, it is stated that the competent authority '... must be determined with reference to the notice published under section 24D(1) of the Act'. However, section 24D relates to other issues and not to the identification of a competent authority. However, from section 4(1) to 4(4) it is clear that the competent authority shall be the Minister of Environmental and Water Affairs, the MEC or the Minister of Mineral Resources.

12.1.1. The role players

There are four core role players in an EIA, namely:

1. The applicant, i.e. the mining company
2. The environmental assessment practitioner
3. The competent authority
4. Interested and affected parties

Each of these role players has a host of rights and responsibilities. Condensed from the website of the Endangered Wildlife Trust (2013), these rights are the following:

12.1.1.1. The applicant

Must:

- Appoint and EAP to manage the application
- Provide the EAP and the competent authority with access to all available information relevant to the application
- Provide the EAP with accurate and true information regarding the proposed identified activity
- Pay any costs or fees applicable to the application

12.1.1.2. The EAP

Must:

- Decide whether a basic assessment, scoping study or EIA must be applied to the application
- Act independently of the applicant
- Be objective
- Have appropriate expertise in conducting the EIA
- Disclose any information that may affect the competent authority's decision
- Take into consideration national and/or provincial guidelines
- Manage the application process

12.1.1.3. Interested and affected parties

May:

- Participate in the application process
- Comment on any submission to the competent authority
- Appeal the final decision

Must:

- Comment within the specified time frames
- Provide copies of any comments submitted to the competent authority to the applicant or the EAP
- Disclose any vested interest in the application being granted or denied

12.1.1.4. Competent authority

Must:

- Comply with specified timeframes
- Enter into written agreements with organs of state with jurisdiction
- Request additional information or studies, if necessary
- Make decisions in an open and transparent manner
- Notify the applicant off decisions, conditions and repeal provisions
- Give written reasons four decisions
- Consider and respond to appeals
- May withdraw, suspend or amend an environmental organisation

NEMA requires an EAP to be, among other things, independent, experienced in EIAs and objective. He/she must also act transparently so that the applicant and the competent authority receive all the information pertaining to a decision (SA Government Gazette, 2010).

As mentioned above, it is the duty of the EAP to determine if a basic assessment or a scoping study must be applied to the application. The onus lies with the applicant to ensure that the competent authority is supplied with enough information to reach a conclusion about the project. If the EAP suggests a basic assessment and the applicant feels this is not adequate, the applicant must, in writing, apply to the competent authority for permission to do the scoping study and EIA instead of the basic assessment.

12.1.2. Content of basic assessment report

The competent authority will determine the format of the basic assessment report (BAR). The BAR needs to contain all relevant information necessary for the competent authority to reach a decision. The following information must be given in the BAR, according to NEMA (SA Government Gazette, 2010):

- Details of the EAP, the person who prepared the report and the expertise of the EAP that carried out the BAR
- A description of the proposed activity
- A description and a map of the property on which the activity is to be undertaken
- Identification of all legislation and guidelines that have been considered in the preparation of the BAR
- Details of the public participation process, including the steps that could be taken to involve interested and affected parties
- A description of the need for and desirability of the proposed activity
- A description of identified alternatives that are feasible and reasonable
- A description and assessment of the significance of any EIAs, including:
    a. Cumulative impacts that may occur as a result of the project
    b. The nature of the impact
    c. The extent and duration of the impact
    d. The probability of the impact of occurring
    e. The degree of possible reversal of the impact
    f. The degree to which the impact may cause an irreplaceable loss of resources
    g. The degree to which the impact can be mitigated
- Proposed environmental management and mitigation measures put forward by the EAP
- Any other recommendations made by specialists that may be relevant
- A draft environmental management programme (EMP) containing the aspects contemplated in the act
- A description of any assumptions, uncertainties and gaps in knowledge

- A reasoned opinion as to whether the activity should or should not be authorised and the conditions that should apply if the recommendation is positive
- Any representations or comments received in connection with the application
- The minutes of any meetings held by the EAP with interested and affected parties and other role players
- Any responses by the EAP to those representations
- Any specific information required by the competent authority
- In addition, the BAR should be taken into account with regard to the following:
    h. Relevant guidelines
    i. Departmental policies and upper decision-making instruments adopted by the competent authority in respect of the application
- The EAP must provide the competent authority with a detailed, written proof of an investigation.

The competent authority has 30 days in which to make a decision about the application. This period is automatically extended by an additional 60 days should the first time frame not been met.

The NEMA Act provides two listings from which it is possible to choose whether to do a BAR only, or to embark upon a scoping report and an EIA. In listing two, section 7, mining, exploration, reconnaissance and production as provided for in the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) is designated as an activity that requires full scoping and EIA reports.

12.1.3. Content of a scoping report

The scoping report, as with the BAR, needs to contain all the information that is needed by the competent authority to consider the application and make a decision. The report must also include the following (Endangered Wildlife Trust, 2013):

- Details of the EAP
- A description of the proposed project and of any reasonable and feasible alternatives projects
- A description of property on which the project is to be situated
- A description of the environment and all the applicable impacts of the project
- All legislation and policy guidelines considered in the preparation of the report
- A description of environmental issues and potential impacts
- The methodology that will be adopted to assess potential impacts, as well as the methodologies to be used in specialist studies or specialised processes
- Details of the public participation process
- The EIA study plan
- Any specific information required by the competent authority

In essence, the BAR and scoping report contain the same information. The difference is that a scoping report is purely a precursor to the EIA.

12.1.4. Contents of an EIA report

The final EIA report is a complete examination of all the relevant issues and impacts identified in the scoping report. In addition, it contains the applicant's EMP, namely the plan for managing the environmental impacts of the project from the planning and design phases through to closure/decommissioning.

Kong (2011, p8) describes an EIA as 'a democratic, scientific and public-participatory procedure that assesses the potential environmental impacts of a proposed activity, examines alternative plans, proposes measures to prevent, control or reduce relevant impacts, and monitors implementation of the assessment outcomes'. Kong maintains that an EIA as a particularly useful tool

when it comes to the resolution of cross-border EIA issues. The UN Convention on the Law of the Sea (UNCLOS) has its own rudimentary provisions for the creation of an EIA and although Kong criticises UNCLOS for being 'unelaborated and ambiguous' in the obligations for an EIA, it is clear that the strength of the EIA shines through in cross-border or international projects, which suits mining very much.

12.1.5. The cost of an EMP

NEMA clearly stipulates that an EIA must contain a detailed environmental management plan. From this flows a costing exercise that will lead to a detailed budget for the EIA.

The total cost, which includes the cost of the original EIA, the cost of rehabilitation or mitigating measures, and all other costs, should be seen as the monetary cost for protecting the environment. This financial value must not be regarded as being the final environmental cost, but should be regarded as possibly being the lowest environmental cost, since complications and further damage to the environment might occur over time. Such costs are difficult to foresee, but need to be added to the total environmental cost of the project once incurred.

If complete rehabilitation of the environment is not possible as foreseen in the EMP, the estimated cost of mitigating negative impacts on the environment is the closest value that can be derived. It is very difficult to ensure complete rehabilitation, especially in the light of the severe impact the mining industry has on the environment. The fact remains that the cost of mitigation does not fully reflect the total cost to the environment in monetary terms. Mitigating steps do just that: they mitigate the impact rather than nullify it.

12.1.6. Determining the significance of environmental impacts

It is necessary to determine and report the significance of environmental impacts so as to ensure that fully informed decisions are taken by the policy makers and final

users of the decision checklist. The *SA Government Gazette* (2010) states that "The assessment and evaluation of potential environmental impacts is probably the most important step in the EIA Phase, because it is concerned with predicting the potential consequences of the proposed development and the significance of these effects on the environment (biophysical and socio-economic) before and after mitigation".

NEMA also describes the key steps in assessing impact performance (*SA Government Gazette,* 2010):

Table 3: Key steps in assessing environmental impact significance

Step 1: Deciding whether the environmental effects are adverse	The quality of the existing environment is compared with the predicted quality of the environment once the project is in place. For example, negative effects on human health, well-being or quality of life.
Step 2: Deciding whether the adverse environmental effects are significant	Criteria used are: • Conformance with spatial plans, policies and guidelines, including the NEMA principles • Geographic context • Duration and frequency • Degree to which the adverse environmental effects are reversible or irreversible • Ecological context • Social structure and values • Internationally accepted health and safety standards
Step 3: Deciding whether the significant adverse environmental effects are likely	• Probability of occurrence • Scientific uncertainty
Step 4: Deciding whether proposed mitigation measures are adequate or no	Criteria used are: • Residual risk/impact • Scientific uncertainty • Internationally accepted standards • Environmental thresholds (e.g. water quality standards)

The EAP has the added responsibility to ensure that an appropriate methodology is used for determining the significance of impacts. NEMA gives the following examples of the definition of such impacts (*SA Government Gazette,* 2010):

- statistically (e.g. risk levels,% loss of a resource)
- by legal standards and guidelines;
- adopted plans and
- traditional and local knowledge;
- established *I* known good practices;
- public perceptions or values;
- authority views; and
- need and desirability factors.

The EMP is derived from these impacts.

L&W Environmental (2002) used the following metric to rate the significance of environmental impacts of a proposed toll road:

Table 4: Significance Matrix of Proposed Toll Road (L&W Environmental, 2002)

Probability:	**Duration:**
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term (impact ceases after the operational life
3 - Medium probability	3 – Medium term (5-15 years)
2 - Low probability	2 - Short-term (0-5 years)
1 - Improbable 1 - Immediate	
0 - None	
Scale:	**Magnitude:**
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

L&W Environmental then used the following formula to calculate a metric they referred to as "Significance Points" (SP) (L&W Environmental, 2002).

SP = (*magnitude* + *duration* + *scale*) x *probability*

The SP values were then rated according to the following basis as High, Medium or Low:
SP ≥ 60 indicated high environmental significance;
SP 30 ≥ 59 indicated moderate environmental significance;
SP < 30 indicated low environmental significance.

It can be argued that only the cost of actions that lead to full rehabilitation should be taken as the complete monetary cost to the environment. Another problem is that monetary value does not fully represent the total cost of a project to the environment. The inferred result of an EIA is due to the fuzzy logic of values subjectively assigned to impacts. Some have tried to remove the subjectivity of the EIA process with advanced mathematical equations (Tien et al, 2004). This process is called “defuzzifization” and attempts to convert the average, inferred values used in an EIA to actual value.

However, it is the aim of this paper to attempt to get to a baseline monetary value of the impact of a project on the environment. As such it is necessary to look for other methods that can be used to calculate the value of a project’s impact on the environment.

12.2. Payment for ecosystem services

Underlying the resources we use, the species we see and the food we eat are ecosystem processes or services. Ecosystem services can be defined as the biological, chemical and physical interactions between components of an ecosystem (Boyd and Banzhaf, 2007, p4). These processes produce benefits to humans in the form of carbon sequestration, erosion reduction, clean water production, and the removal of harmful gases and other toxins from the air, water and food. Ecosystem processes create our natural world (Goldman, 2010, p.2).

It is important to note the difference between ecosystem services and ecosystem goods. According to Goldman, ’ecosystem goods are created from processes and services and tangible, material products’, but ’ecosystems services are the link between this natural world and people, that is the specific processes that benefit people’ (Goldman, 2010, p2). In this way, ecosystem services can provide a method to evaluate human well-being in conservation projects. The human species needs to understand nature’s role in the products used. Because of our effect on the

environment is not always an inherent consideration in our decision-making processes. Some human activities disrupt the supply of ecosystem goods and services. When this occurs the human race need to find costly alternatives to what nature provides for free. It is necessary to incorporate all the costs and benefits of our actions in our decision-making. This full valuation is referred to as 'shadow pricing' (Goldman, 2010, p.6).

Goldman argues that a proper knowledge of shadow pricing will affect what we purchase at the supermarket, our choice of real estate, our longevity, as well as our knowledge of the water that we drink.

12.2.1. The shadow price of carbon

The website Investopedia (2013) defines shadow pricing as 'The actual market value of one share of a money market fund. In this case, shadow pricing refers to securities that are accounted for based on amortised costs rather than a market valuation assignment or the *assignment of dollar values to non-marketed goods such as production costs and intangible assets*. Shadow pricing is usually subject to various assumptions and is fairly subjective within certain guidelines' (emphasis added).

When performing different types of cost-benefit analyses, certain costs or benefits are intangible. In order to analyse a scenario fully, all the variables must be assigned values. For example, when performing a cost-benefit analysis on a mining operation, the lost intangible value associated with the scenic views must be priced and factored in as a cost (Investopdia, 2013).

It is imperative that large industry realises the value of incorporating the 'hard benefits' of shadow pricing. The environment is the foundation on which we build infrastructure, large projects and our very lives. Books such as *The New Economy of Nature* (Daily and Ellison, 2002) and interdisciplinary scholarly investigations such as the Millennium Ecosystem Assessment (Millennium Ecosystem Assessment, 2005) demonstrate the ecosystem alternatives to resource problems. The concept of the

Millennium Ecosystem Assessment has grown so popular that it is now been integrated into funding criteria by donor agencies such as the World Bank (Goldman, 2010). It is now possible for the mining industry to approach the World Bank's Global Environmental Facility (GEF) and its Scientific and Technical Advisory Panel to give guidance on the valuation of service projects that are seeking funding.

Gretchen C. Daily (1997, p.7) writes that 'it would be absurd to calculate the full value of a human being on the basis of his or her wage-earning power', as much as it would be absurd to attempt a comprehensive valuation of ecosystem services. Dr Carl Sagan, the noted American astronomer, writer and scientist, has been quoted as saying 'if you want to make an apple pie from scratch, you must first create the universe' (BrainyQuote 2013). In that light, it suddenly becomes tremendously difficult to calculate the full economic cost of a slice of apple pie. How does one go about calculating the financial value of the rain that watered the apple tree, the soil that housed the tree, the grain that supplied the flour for the crust, and the other multitude of factors that go into creating something as simple as apple pie?

It is nevertheless necessary to attempt gauging the economic opportunity cost of losing an ecosystem process. To borrow Daily's analogy: it is not the full value of the human being that is measured in his wage-earning power, but it is a good, objective beginning that might find equal value for all spectators. Similarly, it is an accepted fact that it is difficult to calculate the full value of an ecosystem service, but if a fair and equitable accounting system can be used it would go a long way towards demonstrating the advantages of a renewable energy technology project.

Perrot-Maitre (2006) found in a study that establishing payment for ecosystems services is a very complex undertaking. A detailed Payment for Ecosystem Services (PES) should consider not only scientific but also social, economic, political, institutional, and power relationships. Perrot-Maitre came to the conclusion that it is not always possible to calculate the costs and benefits of ecosystem services. It is

clear that a PES study needs to be complimented with additional approaches to address pollution. It is also clear that a PES study done in conjunction with a full EIA will result in a well-researched environmental cost for a project.

Wunder (2005) proposes five basic conditions to describe payment for ecosystem services −

- a voluntary transaction where
- a well-defined environmental service or a land use likely to secure that service
- is being bought by at least one buyer
- from a minimum of one environmental service provider
- if, and only if, the environmental service provider secures the environmental service provision.

The concept of buying an environmental service inherently requires the valuation of that service. This goes to show that the value of the environmental service that is substituted by a RET project is in fact the monetary value of that project in terms of environmental capital.

Perrot-Maitre (2006) discusses the case of the spring water producer Vittell in France, which faced certain economic destruction as a result of farming-related practices. High input farming promoted by European agricultural policy changed the chemical composition of the natural spring water Vittell was selling. Increased nitrates and pesticides in the underground source of the bottled water arose from new farming practices in the catchment area. The traditional hay-based cattle ranching system had been replaced by maze-based feeding.

Vittell considered various options but finally concluded that the best way forward was to offer incentives to the farmers to change their practices voluntarily. A full study was done on the cost of these changes.

Vittell was thus forced to calculate the cost of an ecosystem process in order to survive. This proves not only that is it possible to determine an acceptable monetary value for an ecosystem process, but also that industry, when forced to do so, can find a way to ensure survival. It is possible to argue that the Vittell value for the ecosystem process was not the full value of that process, but what is important is that a free-market price was determined for this ecosystem process by applying the common 'willing buyer, willing seller' principle.

12.2.2. Ecological infrastructure

The South African National Biodiversity Institute (SANBI) (2012) defines ecological infrastructure as functioning ecosystems that deliver valuable services to people. It is the nature-based equivalent of built or hard infrastructure. The investment in ecological infrastructure is equal to payment for ecosystem services. Such infrastructure already exists, being freely provided by the environment. Like all forms of infrastructure it needs to be maintained and managed, especially where it has been neglected.

Costanza et al (2011, p.4) give an intriguing definition of ecosystem services. Ecosystem services, according to them, are nothing more than natural capital. Such capital can only be realised when combined with other forms of capital that require human intervention such as built (manufactured) capital, human capital and social capital. Because an ecosystem service is a public good, it is difficult to exclude individuals from benefiting from the services. For this reason, it becomes necessary to value ecosystem services as a public good. Economists have developed a number of valuation methods that use monetary units for the value of an ecosystem, while ecologists have found various ways of expressing the value of ecosystem services in nonmonetary units, such as biophysical trade-offs and qualitative analyses.

Although there are many qualitative analyses and buzzwords, such as biodiversity offset and habitat banking to describe the value of ecological infrastructure, it is not

the aim here to delve too deeply into these valuing systems, nor to expand on them. It is important, however, to understand that there are proven methods for valuing the advantages that a RET project can bring to the environment. This value, expressed in monetary units, must be included in the feasibility study and the balance sheet of the project.

12.3. Marginal cost curves

A marginal abatement cost curve shows a schedule of abatement measures ordered by their specific costs per unit of carbon dioxide-equivalent abated. Certain abatement measures can be put into action at a lower unit cost than others. The marginal abatement cost curve is a valuable tool that illustrates either a cost-effectiveness or a cost-benefit assessment of measures where the benefits of avoiding carbon-emission damages are expressed by the shadow price of carbon (Moran et al, 2011, p.96).

The marginal abatement cost curve (MACC) analysis is a method of determining optimised levels of pollution control across a range of environmental media (McKitrick, 1999, p.306). MACC's are one of the favoured instruments to analyse the impacts of the implementation of the Kyoto Protocol and emissions trading (Klepper and Peterson, 2004). The marginal abatement cost represents either the marginal loss in profits from avoiding the lost unit of emission, or the marginal cost of achieving a certain emission target given some level of output (Klepper and Peterson, 2004). To put that in context for the mining industry would mean that the marginal abatement cost for one unit of carbon dioxide is either the cost associated with not mining a unit of ore, or the cost of mitigating that unit of carbon through the application of certain technology. One MACC method of derivation focuses on the cost of abatement technology, whereas the MACC data method focuses on a reduced production ratio to ensure a lower carbon emission ratio.

The MACC is widely used for climate policy analysis in the context of a general equilibrium framework. An economy, as a whole, can be treated like a production plant. Hence, a MACC curve can be applied to an entire region. For the purposes of this dissertation a specific RET project is scored against another. This means that the RET project is viewed in isolation and that the MACC is applied to that project alone. It should be noted that a marginal abatement cost curve can be applied analogously to the entire mining industry to calculate the cost of one unit of carbon dioxide abatement for the industry.

There are two basic variants of MACC derivation. The first is called top-down and is built on a foundation of micro-economic models, which are most often computer models that carry a detailed representation of the entire sector. In contrast to these, bottom-up models are based on an engineering approach that calculates and analyses the various technical options for emission reductions.

In constructing an MACC, the abatement measures are ordered in increasing cost per unit of carbon dioxide abatement. The horizontal axis denotes the actual volumes abated over the period of the implementation of the technology measure. Fig. 8 and Fig. 9 below are examples of MACC curves.

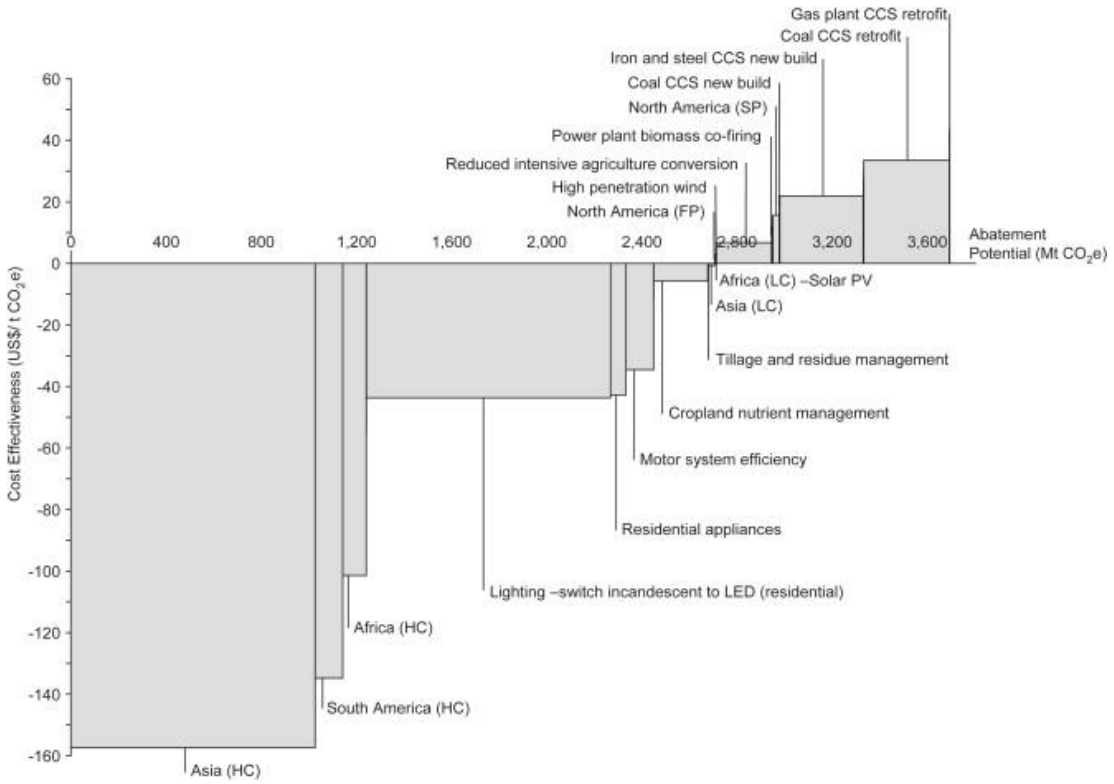


Fig. 8: The MACC of a range of carbon-abatement technologies and strategies for the world by 2030 (Pratt and Moran, 2010)

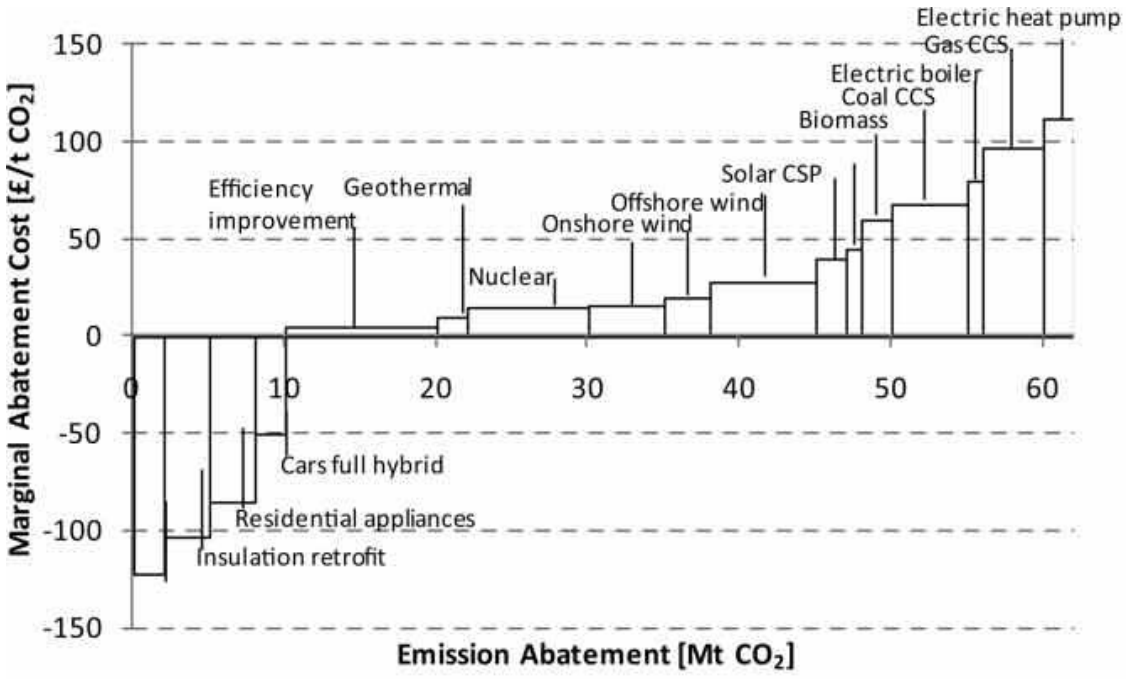


Fig. 9: Stylised example of a MACC curve (Kesicki and Ekins, 2011)

Klepper and Peterson (2004, p.4) maintain that 'In a computable general equilibrium (CGE) model the marginal abatement cost is defined as the shadow cost that is

produced by a constraint on the carbon emissions for a given region and a given time'. They go on to explain that this shadow cost is equal to the price of an emission permit in the case of emissions trading. This is the same cost that equals the price of one CER as sold by Gold Fields through Mercuria trading on the open market through the CDM of the Kyoto protocol. Through the use of a MACC it becomes possible to pin a direct cost to the abatement potential of a project. This abatement potential is in fact what is bartered on the open market. The relatively huge revenue that is generated by Gold Fields' Beatrix methane burn-off project is thus the sale of the carbon abatement potential of that project.

Since a MACC is a function of cost and energy prices, a regional MACC is dependent on macro-economic data such as worldwide abatement levels and the worldwide demand for CERs. This dependency on world markets is not new to the mining industry. RET projects might have a shorter lead time than a mining project, but it must nevertheless be managed in the same way as far as the possible advantages and the revenue stream that will result from the trading in carbon credits.

For a mining project, as is the case for any other plant, there are various ways to engineer carbon abatement. The first one is a reduction in output driven by a reduction in mining activities. Less machinery in operation equals the creation of less CO_2, but also a reduced ore yield. The second option is to find technology that will allow the mining of a unit of ore with less greenhouse gas (GHG) creation, but this technology will have a cost in itself. Another option is to mine more efficiently to obtain a higher yield with the same production of GHG volume. Each of these measures has a certain abatement level for greenhouse gas that is plotted on the horizontal axis and an associated cost for every abatement step that is plotted on the vertical axis (Fig. 10). The stepped changes and the associated cost is what is represented in a MACC.

UNFCC has encountered severe stumbling blocks because of the division between developing and industrialised countries on issues of financial burden-sharing and greenhouse gas emission reduction targets. The next step being considered is for industrialised countries that have adopted binding climate policies to introduce carbon tariffs as a policy option. This has led to a proposal for a two pronged approach. On the one hand, the imposition of an import tariff in proportion to the carbon content of an imported good would shift some of the financial burden to importing countries that do not have a binding climate policy. On the other hand, the introduction of carbon tariffs would level the playing field in terms of the competitiveness of domestic industries with regard to international imports by countries that do not have climate policies in place (Springmann, 2012, p.2).

However, Grubb (2011) argues that through the recycling of revenues from carbon tariffs, new source of climate finance could be negotiated. It is important to view the carbon-tariff aspects as a part of the whole when planning and designing a RET project in the mining sector. This is especially true for mining projects in developing countries.

A MACC is a powerful tool for calculating a financial cost for every abatement measure. The following are the steps necessary to calculate a MACC:

1. Conduct an energy audit to identify multiple projects or steps in the manufacturing process that can reduce greenhouse gas emissions
2. Assign an investment timeframe to the process
3. Calculate the net present value for each project or step in the manufacturing process
4. Calculate the marginal abatement cost for each project
5. For each project enter the marginal abatement cost into a MACC

This leads to:

MAC = NPV/GHG emissions saved from abatement measures during investment timeframe (Carbon Innovators Network 2011)

Or:

$$MAC = \frac{NPV}{GHG\ Abatement\ due\ to\ project\ during\ timeframe}$$

12.3.1. MACC critique

Certain commentators have cautioned against the use of MACCs because of their shortcomings. For instance, Kesicki (2011) argues that one of the major weaknesses of MACCs is the lack of transparency of assumptions. He is of the opinion that the assumptions concerning the baseline development and the cost of abatement technology is often not stated. It thus becomes necessary to publish key assumptions together with the MACCs generated. A second drawback in his opinion is that MACCs represent the abatement cost at only a single point in time. By the very nature the curves cannot capture differences in the mission pathway and are subject to shifting dynamics. The third issue that Kesicki (2011) raises is that by employing the curves it is accept that the project can start up any abatement process at any given time, ignoring the path dependency of the technological structure.

According to Kesicki(2011), the ancillary benefits of GHG emission reductions are not catered for in MACCs. This disregard of the ancillary benefits can lead to an overestimation of the actual MAC. Kesicki(2011) mentions a fifth shortcoming: as the time horizon for MACCs stretch into the future, so does the uncertainty of the assumptions increase. This necessitates not only a better presentation of uncertainties, but also for different MACCs to be generated for different temporal views.

Kesicki(2011) concludes that the creator of MACCs must understand clearly what the aim of the process is. Expert-based MACCs should be used only for the following functions:

- Assessment of the subsidy level for bio fuels
- Emission-reduction potential of building codes
- Level and scope of feed-in and tariffs

However, model-derived MACCs are, according to him, best used for:

- Implementation of a CO_2 tax
- Implementation of a cap-and-trade system

The author agrees with Kesicki on the points above but it does not reduce the value of MACC curves when the curves are applied correctly. It is in the implementation of a cap-and-trade system that the Beatrix methane burn-off project has found a use for MACCs. The curves are used to calculate the CER values of the methane project, which are then traded on the open market through a mechanism set up by the UNFCC.

12.4. Clean Development Mechanism

CDM allows a country with an emission-reduction or emission-limitation commitment under the Kyoto Protocol to implement an emission-reduction project in developing countries. Such projects then earn saleable certified CER credits, each equivalent to 1 t of CO_2, which count towards meeting Kyoto targets.

CDM is the first global environmental investment and credit scheme of its kind, providing a standardised emissions offset instrument, CER (UNFCC, 2013). The aim of CDM is to stimulate sustainable development and emission reductions, while at the same time giving industrialised countries a flexible tool with which to meet their emission reductions or carbon limitation targets. The Beatrix methane burn-off project is a typical CDM project.

12.4.1. Criteria for a CDM project

A CDM project must meet the following criteria:

- Provide emission reductions that are over and above to what would otherwise have occurred
- Qualify by means of a rigorous and public registration and issuance process
- Gain approval from the designated national authorities
- Not result in the diversion of official development assistance through the public funding for CDM project activities

The mechanism is overseen by the CDM executive board, which is ultimately answerable to the countries that have ratified the Kyoto Protocol (UNFCC, 2013)

12.4.2. Gold Fields' use of the CDM

The Beatrix methane burn-off project allows Gold Fields to access the CDM and create revenue through the significant reduction of greenhouse gas in the form of methane. Methane is considered a particularly aggressive greenhouse gas. The project allows Gold Fields to receive 21 CERs for each tonne of methane captured.

Gold Fields estimates its CER contract to be worth in the region of R200 million per year from sales of 166 805 CER's at an estimated value of R120.34 each. The R200m CER revenue stream is achieved at steady state of phase 2. This is enough of a revenue stream to allow the project to make an economic return. To quote from the Gold Fields annual report: 'This clearly has environmental benefits for the company, but the establishment of a viable global market in the trading of carbon credits derived from carbon emissions saved has also made it economically viable to become a greener company, as it will aid the funding at projects which otherwise may not have gotten off the ground' (Gold Fields, 2012)

Gold Fields has clearly grasped the concept that sustainability does not need to be a purely altruistic path. It has also realised that at the heart of successful sustainable development the financial, social and environmental spheres need to overlap.

12.5. Final selection of environmental valuation system with criteria

There are various methods of calculating what can only be described as a shadow cost, i.e. the intangible cost of what the environment means to the human race. When doing the feasibility or scoping study for a renewable energy project it becomes necessary to choose the most applicable tool. It is inevitable that some of the methods will be used in conjunction with each other, but it is the verifiable audit of the final value that is important.

It is very difficult to find one value that satisfies all commentators since the value assigned to the environment is highly subjective. It is useful, however, to be able to calculate a value, even if that value is only considered to be the 'at least' value. This 'foundation' value should be seen as the fairest and most logically calculated value that makes sense to all shareholders and on which there is agreement that more value can be added but that it cannot be decreased.

The mining industry is well versed in the use of EIAs, the requirements for which are written into law through NEMA. An EIA does not result in a final financial value for a project, but is a tool that solely identifies environmental hazards and the necessary mitigating projects. As such it is important that these projects, as well as the EMP are drawn up in such a manner that the cost of possible mitigation measures can be calculated. The EIA is only half of the process as it does not take into account the advantages a RET project can bring to the environment. An EIA should be undertaken in conjunction with either a PES study or a MACC, whichever is applicable.

The PES method is not as applicable to RET projects as is the MACC, but PES does give flexibility in the valuation of sustainable projects. It is in the search for the environmental value of an RET project that MACCs come into their own. The advantages of these curves have been discussed at length above. It is suggested therefore that for the full environmental valuation of a renewable energy project in

mining an EIA is done in conjunction with a MACC. These two values should then be added to give a foundation cost for an RET project.

For any given renewable energy project -

$$EMP + EIA + MAC = E_{BL}$$

where:

EMP = full financial cost of the environmental management plan

EIA = full financial cost of the environmental impact assessment

MAC = the marginal abatement cost of the project

E_{BL} = the full economic cost of the renewable energy project to the environment

12.6. Concluding question 3 – Natural capital

It is difficult to gauge the true cost of a project's environmental impact. Expressing environmental impact in monetary value terms does not give a true reflection of the full impact of the project. The problem lies with trying to give a quantitative value to qualitative measures. The value of animal and plant life, aesthetics, ecosystem services and clean air etc. is subjective and may change over time for each person as personal values change.

The challenge here was to find one common metric with which to compare different RET project. Financial capital is a well understood, verifiable and reproducible metric. By doing an EIA and finding the cost of the associated EMP a financial cost is determined for the rehabilitation of the environment. Calculating the cost of the reduction or gain in ecosystem services likewise gives a financial value to the environmental side of the project. Finally a MACC curve showing costs for the marginal abatement of carbon gives a cost for that metric as well.

By adding these three costs together as described in Section 12.5 one monetary value is obtained with which to compare one project's environmental impact against

another. The NPV calculation mentioned in Section 10.2 does include the cost of the EIA as well as the projected cost of the EMP. The fact that the natural capital calculation, as described above, as well as the NPV calculation both incorporates the EIA and EMP costs does not constitute double accounting. The NPV calculation reports under the Financial Capital "silo" and the EIA cost calculation reports to the Environmental Capital "silo" illustrating the fact that the two represent different metrics with which RET projects must be compared. If the EIA costs were only to be reported under the NPV calculation the risk is that the full impact of the damage to the environment, as illustrated by the magnitude of the EMP+EIA figures, might go unnoticed if the NPV is positive and above the required hurdle rates.

12.6.1. Environmental hurdle rate

As with the financial and social questions a hurdle rate can be set by the company to rate a project's environmental viability. The environmental hurdle rate should, just like the financial and social hurdle rates, be an indication of the company's appetite for environmental risk. If the E_{BL} is **higher** than the internally acceptable E_{BL} the company must not consider the project as an option or proceed with extreme caution.

Although the full environmental cost might not be accounted for in the E_{BL} it is clear that the project with the highest E_{BL} does the most harm to the environment as well as the financial bottom line. The project with the lowest E_{BL} is that project with the smallest impact on the environment and hence, from a purely environmental aspect, should be the favoured project.

13. THE DECISION CHECKLIST

The aim of this decision checklist is to assist in the choice of the most sustainable RET project. For a mining company operating in today's world it is imperative that the company be seen to be a good global citizen. The best way to do that is for the company to ensure that all its projects are in symbiosis with the financial world, the social environment (both micro in the area of the project and macro on a global level) and the natural environment. The following checklist is proposed:

Is this project good for the bottom line? – Financial and manufactured capital

- Does the project make engineering sense?
    - Has a complete technical analysis of the project been done to determine its technical feasibility?
        - The aim of this step is to ensure that the project will work and that the underlying engineering principles are sound.
- What are the NPV and IRR of the project? (F_{BL})
    - Has a complete financial analysis been done to calculate the NPV and the IRR of the project?
        - This step needs to find the financial bottom line value of the project. This value (F_{BL}) will be used to add to the project's societal value (S_{BL}) as well as its environmental value (E_{BL}). Because of the ambiguity of the IRR calculation, the NPV value will be used in further calculation. The IRR value should be used if a tiebreaker is required to choose between projects.

Is this project good for society? – Social and human capital

- Have all stakeholders been engaged?
    - Has a recognised engagement standard, like the AA1000 Stakeholder Engagement Standard, been used to ensure that all stakeholders have been consulted properly and systematically?

- Has shared value been created?
    - Is shared value created through this project?
        - If there is no perceived shared value, i.e. the community does not find value in the project, the perceived value only applies to the company and no shared value is created. In this case, it might make economic sense to terminate the project at this point in time and invest in an alternative project that increases the social investment of the company.
    - To what extent is the value created truly shared in the community?
        - Out of the sample population, what percentage agrees to the shared value of the project? People in an area might be divided on the value of a project. Even if the majority finds that shared value is created and are happy with the project to go ahead there might be some that feel the project is not valuable. The percentage of value-finders must be noted in the comments column of the checklist.
    - If shared value is created, what is the capital expenditure of the company on the project? (S_{BL}).

Is this project good for the environment? – Environmental capital

- Has an EIA for the project been done?
    - What is the financial cost of the environmental impact study?
    - What are the associated impacts of the project?
    - What is the NPV of the EMP and all associated costs?
- Has a MACC been created for the project?
    - What is the full abatement cost of the project
- EMP + EIA + MAC = E_{BL}

What is the triple bottom line of the project?

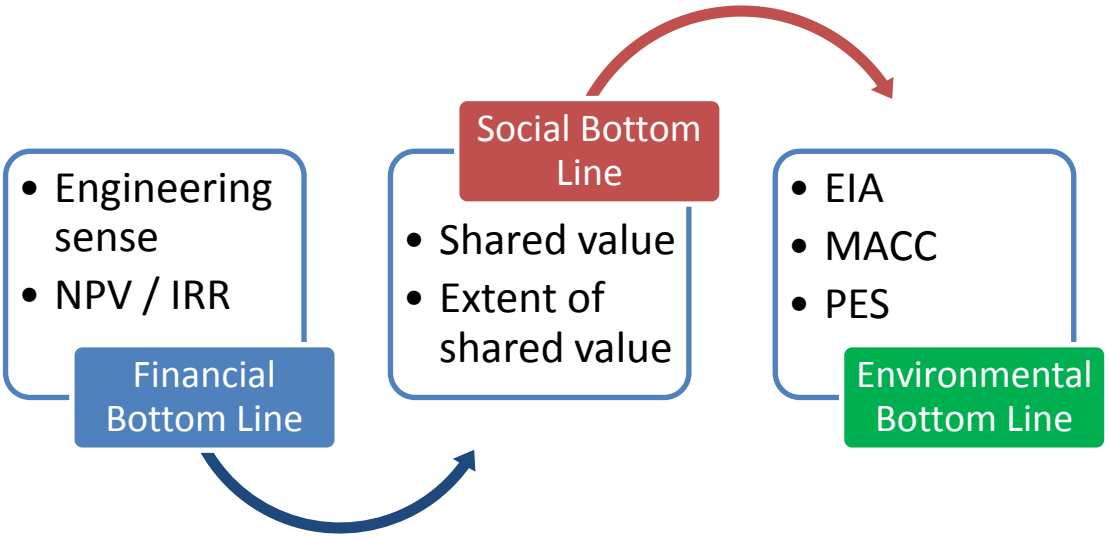


Fig. 10: TBL Workflow

13.1. Commentary on the findings

13.1.1. Keeping the triple bottom lines seperate

There is a temptation to simply add the F_{BL} and the S_{BL} together and then subtract the E_{BL} from that figure to get a value for a project that can then be compared to a value for another project that was calculated in the same way. In other words:

Total Bottom Line = Financial Bottom Line + Social Bottom Line – Environmental Bottom Line

Or

$T_{BL} = F_{BL} + S_{BL} - E_{BL}$

Although this function would result in a single monetary bottom line value for the sustainability of the project across all three bottom lines it has the risk of being skewed by any one of the factors if it is much larger than the others. If, for example, the revenue for the project (F_{BL}) is ten times as large as the environmental impact (E_{BL}) the E_{BL} figure would have a very small impact on the T_{BL}. In this way a project that has a very high environmental impact but an even larger projected revenue will

automatically beat a project that has a smaller revenue stream but also has a smaller impact on the environment.

It is necessary to report three separate bottom lines in the decision checklist and not combine the values.

13.1.2. Substance over form

Another risk to the process is the lack of disclosure of information. If the project is simply presented as a list of figures to be compared with one another the board, the ultimate decision makers, will not have enough qualitative information to work with. It is necessary that each of the final answers to the three questions have a comments column. These comments will assist with decision making by ensuring full disclosure but are also essential for the concept of "substance over form". Principle 6.2 of the King III report states that "Sustainability reporting should be focused on substance over form and should transparently disclose information that is material, relevant, accessible, understandable and comparable with past performance of the company" (IoDSA, 2009).

Substance over form is described by the International Accounting Standards Board (IASB, 2010, p.60) as "Faithful representation means that financial information represents the substance of an economic phenomenon rather than merely representing its legal form. Representing a legal form that differs from the economic substance of the underlying economic phenomenon could not result in a faithful representation".

13.1.3. Qualitative assessment on the EIA

The use of an EIA as described in the checklist is as a decision aiding tool and not as a decision making tool. An EIA is usually used as a tool to decide whether or not to continue with a project, but in the context of this work it is also used to choose between possible projects based on the impacts those projects might have on the environment. The decision makers need to assess all three the bottom lines before a

choice between RET projects is made. In the spirit of substance over form it is again important to note qualitative data because the E_{BL} figure as described in Section 12.5 does not paint the whole picture. The E_{BL} does give an indication of the monetary cost to the environment as a function of the mitigation costs of those impacts. The assessed impacts, as described in Section 12.1.6, need to be disclosed in the final report. To ensure fairness and comparability between RET projects the same ranking system for environmental impacts should be used for all projects under review.

13.2. Concluding the commentary

This means that the final answers on the checklist should contain not only the data on the three bottom lines but all substantive information that is necessary for the final decision makers to come to an informed conclusion as to which project to fund. A comments column must be added to all three the bottom line figures to describe how they were calculated. This approach will ensure a quantitative as well as qualitative approach thereby satisfying the substance over form principle.

13.3. Application of the checklist

13.3.1. Timing

It is envisioned that this checklist be integrated into the various phases of feasibility studies that are done in preparation for a RET project. It is common practice for a "mini EIA" to be done before a full scoping study is commenced. Similarly the pre-feasibility study is usually not as detailed as the full scoping study. The stakeholder engagement process can also be scaled down to get a preliminary take on stakeholder sentiment. All of this work must be integrated into the checklist early on. The reasons for these scaled down, early studies are for cost and time saving purposes. The same reasons count for a scaled down sustainability study utilising the checklist.

13.3.2. Fairness, validity and reproducibility

Some aspects of the checklist have a notable qualitative approach. In order for the process to be fair, valid and reproducible it is essential that the same team is used to complete the checklist for all projects under review. This will not remove the qualitative aspect from the work but it will ensure that projects are compared fairly – "apples with apples" as it were. If the team needs to be changed or altered due to operational necessity it is necessary that new team members with the same academic qualifications as the original team members are chosen. As with all scientific research it is important to ensure that team members are as neutral and objective to the outcome as possible.

A team consisting of experts from all the bottom line fields is necessary. This means that the team should at least have a qualified person for each of the three questions. It is suggested that there is at least one team member each from the financial sciences, engineering sciences, social sciences and environmental sciences. In this way all the bottom lines can be represented by its own agent.

14. CONCLUSION

The main aim of this paper was to propose a methodology to aid in decision making within mining companies when choosing between possible RET projects. The method proposed herein ensures that all three the bottom lines are accounted for by asking the three main questions at the heart of this paper:

- Is the RET project financially viable? – Profit
- Is it good for the community? – People
- How will it impact the environment? – Planet

These three questions were indeed incorporated into a questionnaire that also expanded on the three questions. A case study of the Beatrix Methane Burn-off project was done to examine how the mining industry treats decisions regarding RET projects and applicable literature was studied to find ways of accounting for all three the bottom lines. An attempt is made to define sustainability as a value that can be used to compare projects with one another.

The initial vision was to create a checklist that could lead to quantitative values for the three bottom lines but the research has shown that quantitative answers alone would not suffice. It is has become apparent that, to fully account for all three bottom lines and to hold true to the concept of function over form, a qualitative aspect to the questionnaire was necessary. The questionnaire that was developed is not considered as the final solution in gauging the feasibility of RET projects but should rather be recognised as an attempt to incorporate the TBL approach and sustainable thinking into decision making for RET projects.

The derived decision tool was not applied for the purposes of this paper because the report would have been too big for the prescribed requirement of an MSc with 50% research.

The question that arises with regard to sustainable development is why big business would bother with something that is not core business. Considering the concept of

moral responsibility it is clear that this idea is built on the expectation of a reaction to an action. The mining industry wants to do something that is perceived as good in the expectation of a positive reaction. It wants society to look at it in a favourable light.

Sustainable development has become an integral part of today's business world. Many sustainable projects take the form of renewable energy projects since in a power-hungry industry such projects can add the most value. For most industries, however, renewable energy projects are not core business and there is the risk that such projects will be sacrificed first when the economy takes a downturn. In this research I have not only endeavoured to find acceptable reasons for the mining industry to continue investing in sustainable development, even in economically difficult times, but also to find a method for selecting the most sustainable project from a range of renewable energy projects.

A major challenge lies in valuing sustainable projects. According to value theory it is necessary, albeit not always easy, to identify some value with which to compare projects to one another. This value was called sustainability for the purposes of this work and is described in detail. Various renewable energy projects are currently in operation in the mining industry world-wide. Choosing between renewable energy projects would be difficult without identifying one core value with which to compare the projects. The field of sustainable development is such a wide concept that it makes sense to use sustainability as the determining metric for renewable energy projects.

In order to design a thorough decision-tool it is necessary to review the history of valuing sustainability within a company. The TBL accounting method was investigated since this was the first attempt at finding a common denominator for evaluating sustainability. Critique of the TBL method made it clear, however, that this method was not adequate to evaluate sustainability on its own. The TBL was then

expanded by the work done by Jonathon Porritt (2007) and the Forum for the Future (2012).

Porritt has proven himself to be a visionary in the field of sustainable development. In his opinion capitalism is, at least for now and the foreseeable future, our main economic driving force. Instead of countering capitalism, Porritt and the Forum for the Future built on the TBL method and identified five capitals – financial, human, social, manufactured and environmental − on which a sustainable society is built. From the so-called five capitals model the idea is derived that a sustainable project should make financial, engineering, social and environmental sense.

The five capitals model, as well as the 12 features of a sustainable society, have been described in detail. The main difficulty with the 12 features as highlighted by the Forum for the Future is that they are highly subjective. It would be difficult to find one common value among these features with which to compare projects.

Gold Fields is an international gold mining company. At the time of writing of this work the company had unbundled its South African operations into a company called Sibanye Gold. All the literature on the work that Gold Fields has done with regards to sustainability was taken from the company's 2012 integrated annual report. As such, all of Gold Fields' sustainable projects were still operating at the time. Because of the company's international nature it is keen to highlight its sustainable projects in all the regions in which it does business, i.e. West Africa, South America, Australia and South Africa.

Gold Fields was used as an example of the sustainability projects of a mining company as the student was an employee of the company at the time of writing and Gold Fields has achieved much in the field of sustainability. This made it a clear choice as a case study.

Integrated reporting is the corporate world's way of certifying work in the field of sustainable development. By publicly reporting on its sustainable activities, a

company declares its commitment to sustainability. In this regard also, Gold Fields is a good case study.

Three questions were used to identify the sustainability of a renewable energy project. The first question speaks to the advantages of the financial bottom line. The concepts of financial capital and financial evaluation in terms of NPV and IRR were discussed. An in depth look was taken at Beatrix gold mine's methane burn-off project. By studying this prime example of a RET project a good understanding was gained of how industry evaluates an RET project financially and technically. The financial evaluation speaks to financial capital and the technical aspects speak to manufactured capital as described by the Forum for the Future (2012).

The next question investigated whether a RET project was good for the community or not. The concept of CSR was found to be a slightly dated method of determining a company's interaction with the community. Creating shared value is the new norm for trying to evaluate the social good of a company. CSV is a term coined by Michael Porter (2012). Measuring shared value when reviewing a project is a challenging task and a method to forecast the creation of shared value was derived.

The first step in ensuring shared value is to follow a robust stakeholder engagement process. For this the AA1000 Stakeholder Engagement Standard is used. If all the stakeholders find value in a RET project the capital expenditure on the project should be deemed the monetary or economic value of social value. Shared value is quantified before commencing with a project.

The third question concerned itself with the issue of whether or not a RET project is good for the environment. As per the value theory, the concept of good or bad automatically involves valuing. The EIA was discussed as a longstanding method of auditing a project in terms of its environmental impact. The format and content of the EIA is legislated in NEMA. Unfortunately, however, an EIA is a highly subjective tool and one that does not necessarily lead to a specific economic value for

environmental impact. Because the use of an EIA is dictated by law it is necessary to find additional methods of evaluation to obtain a more objective answer. PES and marginal abatement costs are two methods identified for use in conjunction with an EIA.

PES is the process of finding an economic value for a service the environment is already supplying free of charge. A PES study attempts to find the cost of a project when technology is substituted in the place of the services of the environment. PES is not particularly applicable to renewable energy projects. However, MACCs calculate the economic cost for the abatement of 1 t of CO_2 from the atmosphere for a particular RET project. MACCs are applicable to RET projects, especially when used in conjunction with EIAs.

The use of hurdle rates was advocated for all three questions. The financial hurdle rate is used to gauge the financial risk of the project. If the NPV and IRR figures were below the company's internal hurdle rates for those metrics the feasibility for the project could still continue because the social and environmental value might redeem the project but caution is warned. An NPV and IRR of more than the company's hurdle rates means automatic license to continue to the other two questions. The Social Value, or MSV, is also suggested to have an internal company hurdle rate and gauges the company's appetite for creating shared value with the community through the project. Even if no MSV is created through project, however, it might still be meaningful to go ahead with the project as the other two capitals might create enough value. The environmental hurdle rate gauges the company's appetite for environmental risk. If the project has a higher E_{BL} than the company's hurdle rate the risk to the environment is too high to continue and the project should not be considered.

It is possible to calculate a monetary value for all three the bottom lines. These values do not necessarily reflect the full cost on that specific capital but as a metric

to compare one project with one another these values are particularly useful. The three bottom lines should be kept separate but juxtaposed with that of other projects to compare and find the most sustainable RET project. A comments column should be added to each bottom line value for the sake of full disclosure and good governance. The checklist and the processes needed to arrive at the bottom lines in question are completely scalable to the stage of scoping study that the project is in. It is recommended that the checklist be used during all stages to assist in project planning.

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Addendum A: Countries where there are triple bottom line reporting laws

Country	France	Portugal	Australia	Denmark	Sweden
Law	Nouvelles Régulations Economiques	Social Balance Report	Corporations Act, 2001, §§ 299(1)(f) and 1013(D)(1)(l)	The Green Accounts Act and The Danish Financial Statements Act	The Annual Accounts Act, Arsredovisningslagen
Synopsis	Businesses publicly traded on the French market must issue annual reports about the social and environmental performance report In addition, employees must be consulted before mergers and acquisitions under 2001-420 Art. 113	Businesses must issue a social performance report about their labour force under two laws: 1. Leido Balanco Social no. 141/85 14 do Nov. 2. Decreto Regulamenar no. 9/92 ambos de 28 de Abril	Australian businesses that operate under environmental protection laws must include reportage about their environmental performance with their annual financial reports (§ 299). Australian businesses must also issue a triple bottom line report for any product that is funded through the Australian capital market (§ 1013).	Businesses in industries that are highly polluting must submit annual environmental performance reports to the Danish Commerce and Companies Agency. A Green Report has 3 parts: 1. General company information 2. A directors' report written for non-expert readers 3. Data on resource consumption based on flow of inputs and emission/releases of polluting substances Financial statements must include the true and fair value of intellectual capital and environmental performance must be reported for businesses above a certain size	The amended Annual Accounts Act In Sweden, companies over a certain size must include reporting on environmental performance and social issues in the board of directors' report section of their financial reports

Who	Group companies (parent and subsidiary, two subsidiaries held by an entity, etc.) and international companies that are quoted (listed) on the capital market	Businesses that employ over 100 people	Any business for which environmental protection laws apply and any business that finances a product or service on the Australian capital market.	• Environmental Reports: polluting businesses listed in the act (e.g. production, processing, extraction) • Financial impacts of social and environmental performance businesses with over 250 employees and a turnover of DKK 238 M	Companies of a certain size. Over 2 000 companies report in Sweden

Country	**Germany**	**Japan**	**South Africa**	**Norway**	**Belgium**
Law	Bilanzrechtreformgesetz (BilReG)	Law of Promotion of Environmentally Conscious Business Activity	National Black Economic Empowerment Act No. 53 of 2003, and theEmployment Equity Act No. 55 of 1998	Norwegian Accounting Act: Regnskapsloven	VLAREM II, art. 4.1.8 and Bilian Social
Synopsis	Companies must report performance for environmental and social indicators	Companies must issue annual environmental reports	Act No. 53: Companies must submit progress reports to the government for promoting black empowerment Act No. 55: Annual status reports to government on affirmative action for black people, women and the disabled	Environmental, health and safety performance must be included in directors' report	VLAREM II: Companies must issue annual environmental reports Bilian: Companies must issue social reports covering employment issues

Who	German companies	Companies specified under the act	National Black Economic Empowerment Act: Any companies that intend to do business with the government Employment Equity Act: Public and private companies that employ people	All companies must report environmental impacts	VLAMREM: only companies in Flanders

Country	**Brazil**	**India**	**Spain**	**Canada**	**USA**
Law	Decreto Lei no 76.900 – the Annual Report of Social Information (Rais in Portuguese)	Companies Act, §217(1)	Resolution de 25 de Marzo de 2002, and National Accounting Plan	Securities Commission	EEO-1 and Securities Exchange Commission, reg. S-K and Sarbanes-Oxley Act and Toxic Release Inventory
Synopsis	Companies must issue reports covering employee data The Instituto Brasileiro de Análises Sociais e Econômicas (IBASE) is a voluntary framework with quantitative indicators. It was created by non-governmental organisations. The Ethos Institute of Social Responsibility competes with the IBASE with its Guide for Social Responsibility Annual Report Statement. It includes stakeholder engagement where IBASE does not.	At all company general meetings at which a balance sheet is laid out, there must be an accompanying report on environmental conservation issues and foreign exchange earnings.	Must include environmental assets and liabilities in financial statements, with details under the National Accounting Plan	Annual report must include impact of environmental protection laws on current and future financial status	Companies must file employment data with the government, including race and gender proportions Annual financial reports must include information about reasonably certain material impacts from environmental performance Also, under various environmental laws, a company must report data to show compliance with the law

Who	All companies must issue employee data	All companies		Public companies	EEo-1: Any company with over 100 employees SEC and SOX: Public companies Environmental laws: Depends on the company's activities. TRI aims at industrial faculties.

Countries where CSR and TBL laws are under consideration

Country	**USA**	**Great Britain**	**The Netherlands**
Effort	Corporate Code of Conduct Act, H.R. 5377	Corporate Responsibility Bill	Environmental Protection Act
Synopsis	• Code of conduct for environmental and social practices • Extends to suppliers and partnership outside of US borders • Annual CSR reports to be issued to Congress and the public • Creation of agency to enforce code. Introduced in the House of Representatives	• Environmental, social and environmental responsibility extend to subsidies outside of Great Britain • Annual CSR reports issued to Parliament. • Secretary of State as enforcement agency. Stakeholders can take complaints to the Secretary • Directors liable for breach as a result of negligence or wilful misconduct.	Largest polluting companies were required to publish two environmental reports to the public and to the government. Deregulation acted to repeal this law.
Who	Any company that employs more than 20 people outside the US	Vaguely described in the bill as 'certain companies'.	No longer law

Addendum B

Inputs - Indexation, forex and CERs

Input Cells

1. Timing

Flares commissioned on	1-Feb-2011
Engines commissioned on	1-Jan-2012

2. Emission reduction

Year	Methane from Shaft	Borehole methane	Total CER's
2008			
2009			
2010	-	-	-
2011	183,360	75,125	258,485
2012	183,360	75,125	258,485
2013	183,360	75,125	258,485
2014	183,360	75,125	258,485
2015	183,360	75,125	258,485
2016	183,360	75,125	258,485
2017	183,360	75,125	258,485
2018	183,360	75,125	258,485
2019	183,360	75,125	258,485
2020	183,360	75,125	258,485

3. Indices

Date	Rand$/Euro	South African Inflation - CPI	South African Inflation - PPI	Euro Inflation	€/CER	Grid Emissions Factor - ton CO2e/MWhr	Engine oil costs - R/litre	Eskom price escalation	Eskom reference price - Rc/kWh
2008	11.8	8.0%	9.0%	2.5%	10.00	1.02	20.9		25.0
2009	11.5	8.0%	9.0%	2.5%	10.00	1.02	20.9	25.0%	33.0
2010	9.5	4.5%	7.0%	2.5%	10.19	1.02	20.9	25%	41.3
2011	9.9	4.5%	5.0%	2.5%	13.65	1.02	22.2	25%	51.6
2012	10.4	4.5%	5.0%	2.5%	17.02	1.02	23.7	25%	64.5
2013	10.8	4.5%	5.0%	2.5%	20.30	1.02	25.2	25%	80.6
2014	11.3	4.5%	5.0%	2.5%	23.52	1.02	26.9	4.5%	84.2
2015	11.8	4.5%	5.0%	2.5%	26.68	1.02	28.6	4.5%	88.0
2016	12.4	4.5%	5.0%	2.5%	29.80	1.02	30.5	4.5%	91.9
2017	12.9	4.5%	5.0%	2.5%	32.88	1.02	32.4	4.5%	96.1
2018	13.5	4.5%	5.0%	2.5%	35.93	1.02	34.6	4.5%	100.4
2019	14.1	4.5%	5.0%	2.5%	38.95	1.02	36.8	4.5%	104.9
2020	14.8	4.5%	5.0%	2.5%	41.93	1.02	39.2	4.5%	109.6
2021	15.4	4.5%	5.0%	2.5%		1.02	41.7	4.5%	114.6
2022	16.1	4.5%	5.0%	2.5%		1.02	44.5	4.5%	119.7
2023	16.8	4.5%	5.0%	2.5%		1.02	47.3	4.5%	125.1
2024	17.6	4.5%	5.0%	2.5%		1.02	50.4	4.5%	130.7
2025	18.4	4.5%	5.0%	2.5%		1.02	53.7	4.5%	136.6
2026	19.2	4.5%	5.0%	2.5%		1.02	57.2	4.5%	142.8
2027	20.1	4.5%	5.0%	2.5%		1.02	60.9	4.5%	149.2
Index Sensitivity	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	

Inputs - Facility Operations

4. Technical

Plant Size		
Unit size	MW	1.345
Number of units	#	4.0
Parasitic load	MW per unit	0.110
	total	0.44
Net installed capacity	**MW**	**4.94**
Oil consupmtion	ltr/MWh	0.52

5. Revenues

Revenues from host			
Price of electricity	R/MWhr	*Eskom Prices*	
Availability factor	%	90.0%	

Inputs - Operating Costs

6. Frontline maintenance

Spares contract			
Spare flat-line contract rate per unit / ophour	E/unit/ophour	9.8	*Inflated at Euro CPI*

2. Operating costs

Headoffice Contract Services Agreement			
Head Office Operating Indirects	Rand	100,000	*Per annum / Inflated at SA CPI*
Site Operating Indirect Costs	Rand	1,857,000	*Per annum / Inflated at SA CPI*
Total	***Rand***	***1,957,000***	
Fixed Site Ops and Maintenance			
Direct Operating Consumables	Rand	55,000	*Per annum / Inflated at SA CPI*
Maintenance Costs	Rand	25,000	*Per annum / Inflated at SA CPI*
Inspections and Testing	Rand	310,000	*Per annum / Inflated at SA CPI*
Total	***Rand***	***390,000***	
Opex sens	%	-	

Inputs - Capex, Tax, Working Capital

6. Capex

Containerised Jenbachers	Euro	2,563,000	
Containerised Jenbachers	Rand	25,444,183	
Balance of plant	Rand	48,452,000	
Total Project Costs	Rand	73,896,183	
Rebuild Capex	Rand	13,838,000	

Tax rate	%	-
Secondary Tax on Companies	%	10.0%

7. Capital allowances

8. Working capital

	Months	Days equivalent
Payables	1.5	45.6
Receivables	1.0	30.4
Stock	1.0	30.4

Calculations

8. Financial Variables

Euro Exchange rate in 2009 R 11.50 per €

From	CPI	CPI Index	PPI	PPI Index
2009	8.00%	1.00	9.00%	1.00
2010	8.00%	1.08	9.00%	1.09
2011	4.50%	1.17	7.00%	1.19
2012	4.50%	1.22	5.00%	1.27
2013	4.50%	1.27	5.00%	1.33
2014	4.50%	1.33	5.00%	1.40
2015	4.50%	1.39	5.00%	1.47
2016	4.50%	1.45	5.00%	1.55
2017	4.50%	1.52	5.00%	1.62
2018	4.50%	1.59	5.00%	1.70
2019	4.50%	1.66	5.00%	1.79
2020	4.50%	1.73	5.00%	1.88
2021	4.50%	1.81	5.00%	1.97
2022	4.50%	1.89	5.00%	2.07
2023	4.50%	1.98	5.00%	2.17
2024	4.50%	2.07	5.00%	2.28
2025	4.50%	2.16	5.00%	2.40
2026	4.50%	2.26	5.00%	2.52
2027	4.50%	2.36	5.00%	2.64
2028	4.50%	2.47	5.00%	2.78
2029	0.00%	2.58	0.00%	2.91
2030	0.00%	2.58	0.00%	2.91
2031	0.00%	2.58	0.00%	2.91
2032	0.00%	2.58	0.00%	2.91

Addendum C

Calculations - Indices, Prices		
Indexation, fore and CERs Timeline		
Year	Date	
Year	Date	
Construction	Index	100%
Rebuild Capital cost	Index	0%
Flare running	Index	100%
Power generation	Index	0%
Index Values		
Rand/Euro Exchange rate	Rate	
EU CPI Index	Index	
CPI Index	Index	
PPI Index	Index	
CER Price	€ per ton CO2e	
CER discount to market price		
CER Price	R per ton CO2e	
Electricity price in this model	R/MWhr	
Calculations - Operations		
1. Technical and timing		
Capacity factor	%	
MWhr produced	MWhr	
2. Revenues		
Revenues		
Electricity price	R/MWhr	
Electricity revenue	***Rand***	
Emission reduction achieved - U/G flare	ton CO2e	24
Emission reduction achieved - U/G power generated	ton CO2e	24
Emission reduction achieved - Surface flares	ton CO2e	24
CERs issued	ton CO2e	
CERs sold	ton CO2e	income delayed
CER Price	R/ton CO2e	
CER revenues	***Rand***	
Electricity revenues	**Rand**	-
Total Revenues	**Rand**	**594,042,888**
3. Costs		
Operating hours	hours per year	
Spares contract	R/unit/ophour	
Cost of spares contract	***Rand***	
Cost per kWhr	***c/kWhr***	
O&M costs		
Head office Contract Services Agreement	Rand	
Fixed Site Ops and Maintenance	Rand	
O&M Costs	***Rand***	
Cost per kWhr	***c/kWhr***	
Rebuild costs		
Rebuild cost	Rand	
Total costs	**Rand**	
Cost per kWhr	***c/kWhr***	***#VALUE!***

Calculations - Tax, working capital			
			Jenbachers Rebuild
1. Capital Allowances	%		Flares
Initial Construction allowance in period	%		Jenbachers
Capital allowance	***Rand***		***54,145,376***
2. Tax Paid			
Electricity revenues	Rand		-
Total costs	Rand		-
EBTDA	***Rand***		-
Capital allowance	Rand		54,145,376
EBT	***Rand***	-	***54,145,376***
Tax Calculation			
Taxable profit before loss utilisation	Rand		
Losses arising	Rand		
Losses utilised	Rand		
Taxable profit after loss utilisation	Rand		
Tax paid	***Rand***		
Tax losses			
Opening Balance	Rand		
Losses arising in period	Rand		
Losses utilised to relieve current period profits	Rand		
Closing Balance	Rand		
3. Working Capital			
Accounts Receivables	Rand		
Accounts Payables	Rand		
Net Working Capital (NWC)	Rand		
Change in NWC	***Rand***		
Calculations - Cash			
Capex	Rand	-	***54,145,376***
Change in NWC	Rand		-
Total Revenues	Rand		***282,974,825***
Tax paid	Rand		-
Net cash generation	Rand		***228,829,449***
			10 years
Phase 1- Flares only: Nominal cash flows	***Rand***		***10 years***
Phase 1- Flares only: Real cash flows	***Rand***		***10 years***

Model - outputs		**Model - current**
Project IRR Nominal values	**%**	**45.66%**
Project IRR real values	**%**	**45.66%**
Project NPV Nominal values	***Rand***	**R 228,829,449**
Project NPV real values (	***Rand***	**R 228,829,449**

Net cash generation - Phase 1 Flares only		**Total**
		2009
		2010
R 239,862,500	**NPV Base**	**2011**
R 228,829,449	**NPV 6 month delay**	**2012**
R 11,033,051	**6 month delay on flare**	**2013**
R 61,295	**1 day delay**	**2014**

Addendum D

Calculations - Indices, Prices		
Indexation, fore and CERs Timeline		
Year	Date	
Year	Date	
Construction	Index	200%
Rebuild Capital cost	Index	200%
Flare running	Index	100%
Power generation	Index	100%
Index Values		
Rand/Euro Exchange rate	Rate	
EU CPI Index	Index	
CPI Index	Index	
PPI Index	Index	
CER Price	€ per ton CO2e	
CER discount to market price		
CER Price	R per ton CO2e	
Electricity price in this model	R/MWhr	
Calculations - Operations		
1. Technical and timing		
Capacity factor	%	
MWhr produced	MWhr	
2. Revenues		
Revenues		
Electricity price	R/MWhr	
Electricity revenue	***Rand***	
Emission reduction achieved - U/G flare	ton CO2e	24
Emission reduction achieved - U/G power generated	ton CO2e	24
Emission reduction achieved - Surface flares	ton CO2e	24
CERs issued	ton CO2e	
CERs sold	ton CO2e	income delayed
CER Price	R/ton CO2e	
CER revenues	***Rand***	
Electricity revenues	**Rand**	
Total Revenues	**Rand**	**875,627,265**
3. Costs		
Operating hours	hours per year	
Spares contract	R/unit/ophour	
Cost of spares contract	***Rand***	
Cost per kWhr	***c/kWhr***	
O&M costs		
Head office Contract Services Agreement	Rand	
Fixed Site Ops and Maintenance	Rand	
O&M Costs	***Rand***	
Cost per kWhr	***c/kWhr***	
Rebuild costs		
Rebuild cost	Rand	
Total costs	**Rand**	
Cost per kWhr	***c/kWhr***	***15***

1. Capital Allowances	%	Flares
Initial Construction allowance in period	%	Jenbachers
Capital allowance	***Rand***	***38,332,591***
2. Tax Paid		
Electricity revenues	Rand	228,834,175
Total costs	Rand	40,068,236
EBTDA	***Rand***	***188,765,939***
Capital allowance	Rand	38,332,591
EBT	***Rand***	***150,433,348***
Tax Calculation		
Taxable profit before loss utilisation	Rand	
Losses arising	Rand	
Losses utilised	Rand	
Taxable profit after loss utilisation	Rand	
Tax paid	***Rand***	
Tax losses		
Opening Balance	Rand	
Losses arising in period	Rand	
Losses utilised to relieve current period profits	Rand	
Closing Balance	Rand	
3. Working Capital		
Accounts Receivables	Rand	
Accounts Payables	Rand	
Net Working Capital (NWC)	Rand	
Change in NWC	***Rand***	
Calculations - Cash		
Capex	Rand	- ***38,332,591***
Change in NWC	Rand	- ***408,133***
Total Revenues	Rand	***135,053,238***
Tax paid	Rand	-
Net cash generation	Rand	***96,312,514***
		10 years
Total Nominal cash flows	***Rand***	***10 years***
Total real cash flows	***Rand***	***10 years***

Model - outputs		**Model - current**
Project IRR Nominal values	***%***	**149.60%**
Project IRR real values	***%***	**149.60%**
Project NPV Nominal values	***Rand***	**R 96,312,514**
Project NPV real values	***Rand***	**R 96,312,514**

Net cash generation - Phase 2 Jenbacher generators only	**Total**