AN ASSESSMENT OF THE IMPACT OF CLIMATE CHANGE ON THE RISKS, RETURNS AND OPPORTUNITIES OF SELECTED SOUTH AFRICAN COMPANIES

by

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SUMMARY

The risk of climate change has gained prominence globally and also in South Africa. Companies operating in developing countries such as South Africa are perceived to be particularly vulnerable to climate change. There have been mixed reactions to this risk by companies ranging from inaction to significant financial outlays expended on mitigating this risk. Whilst climate change is potentially a downside risk to financial performance, certain companies have identified opportunities to enhance their returns in the course of adapting to climate change. This study assessed whether there is a relationship between climate change and the financial performance, as manifested in the mitigation of risks and exploitation of opportunities of selected South African companies. The study sought to establish the extent to which climate change creates relevant and material risks, returns and opportunities for companies.

The study was conducted using a combination of a literature review and empirical research in the form of secondary analysis. Data on climate-change performance, risks and opportunities was compared to data on financial indicators. The population of companies selected for the empirical research consisted of the Johannesburg Stock Exchange-listed companies that had publicly disclosed information to the Carbon Disclosure Project (CDP) in 2012. Climate-change data was categorised to differentiate between varying levels of climate-change performance, and the identified categories were compared to a range of ratios that demonstrated financial return. The research concluded that climate-change risks and opportunities are expected to have a significant and highly likely impact on company operations, revenue and expenditure. Positive and statistically significant correlations were identified between climate-change performance and equity analyst recommendations, historical internal rates of return, market values to book values, forecasted earnings per share, beta coefficients, and return on equity. Climate-change performance was not found to have a significant effect on the cost of capital.

Key terms: Climate change; sustainability; performance; risk mitigation; returns; opportunities; greening; value creation; adaptation; triple bottom line

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Responding to climate change has become an increasingly significant issue to companies globally and in South Africa. In 2010, the Ernst & Young Business Risk Report on the top 10 risks for business rated radical greening as the eighth most severe risk facing businesses across the globe. The report suggests that this risk is also an opportunity and companies that succeed will be those that adapt (Ernst & Young, 2010a:24). Climate change is a risk that could severely damage economies and erode the interests of investors. This risk is exacerbated by scientific uncertainties over the pace of climate change, technological uncertainties arising from future adaptation to a low-carbon economy and policy uncertainty given the unclear direction as to how regulators will act (UN Global Compact, 2009:18).

Low (2006:272) states that Africa is susceptible to climate change as evidenced by the almost six-fold growth in reported disasters in the ten years ending 2002, as compared to the ten years ending 1973, using the Centre for Research on the Epidemiology of Disasters criteria. It is therefore important to explore this continent's sensitivity to climate change, with particular reference to economically valuable assets such as major companies, so as to build capacity to respond to this risk (Low, 2006:272). The Institute for Futures Research (IFR, 2006:120) projects that Africa's gross domestic product (GDP) could decline by as much as 10% due to climate change. Within Africa, companies are exposed to physical climate-change risks as firstly, South Africa is ranked as a medium vulnerability country and secondly, companies are exposed to reputational climate-change risks as South Africa contributes 40% of the continent's fossil fuel-related greenhouse gas emissions (IFR, 2006:120).

The IFR (2006:128) indicates that companies will consequently face physical, regulatory, competitive and technological risks. Conversely, those companies that capitalise on the changes in energy use and production techniques arising from

climate change will have significant investment opportunities. An Ernst & Young report on the business response to climate change concurs with this view and indicates that three hundred global executives surveyed felt that strategies for dealing with climate change not only reduce risk but can create financial returns (Ernst & Young, 2010b:2). However, South African businesses are lagging behind in capitalising on this as exemplified by the country being ranked 23 out of 27 countries on the Ernst & Young renewable energy country attractiveness indices (Ernst & Young, 2010c:9).

Given the risks indicated above and potentially overlooked opportunities, South African companies that fail to adapt to climate change could face threats to their long-term sustainability. According to Munashinghe and Swart (2005:101), sustainability should be viewed as a triangle that connects interdependent economic, environmental and social factors. In other words, ignoring the environmental sustainability element of this triangle imperils the other two elements. The King III Code of Governance takes this concept further by indicating that "governance, strategy and sustainability have become inseparable" (IOD, 2009:11).

There are several forces that are increasing the interest in climate change and sustainability (Ernst & Young, 2010d:1). These include better public access to information, increased expectations of corporate transparency, high profile incidents such as oil spills, shifting consumer expectations, competitor activities, new regulations, increased engagement by the investment community and employee expectations. Ernst & Young (2010d:1) indicate that the risks related to climate change will affect the strategic, compliance, financial, reputational and operational components of companies. Conversely, the UNEP (2010:71) reports on positive aspects to managing such risks such as new market opportunities, brand differentiation, new business ideas and new technologies.

As a result of the changing landscape, companies are making 'green' investments and introducing new initiatives. The push factors for such investments include guarding against downside risk such as environmental liabilities and negative consumer reactions. Conversely, there are pull factors associated with such investments, for example, the opportunity to develop new products that are more efficient and less expensive to produce than climate-unfriendly legacy products.

Engardio (2009:170) highlights that nobody can anticipate the environmental events that can knock value off a company's statement of financial position. Engardio further argues that, in future, eco-friendly and socially responsible practices will help the bottom line of companies and this will become the key way to conduct business in an innovative manner. Engardio (2009:170) concludes that such preparation for future trends would create an intangible asset for responsive companies. This sentiment is reinforced by a survey of South African investors where 86% of the participants indicated an interest in seeing the growth of environmentally responsible investment (Giamporcaro, 2010:25).

In summary, the impact of climate change is expected to be significant in a developing country such as South Africa and this could lead to heightened uncertainty, different exposures and opportunities to companies operating in this environment (Munashinghe & Swart, 2005:221). However, those impacts should be assessed in a reliable manner so that business leaders can understand the vulnerabilities their organisations face and, conversely, the opportunities that may arise in a potential transition to a low-carbon economy.

1.2 PROBLEM STATEMENT

Although extensive research has explored individual case studies of opportunities arising from implementation of climate-change initiatives, few studies globally and in South Africa have specifically questioned and monetised the aggregate effect of climate change on companies. This largely unanswered question has lead to companies facing challenges in obtaining reliable information on the extent to which they should allocate their capital, management time and other resources in responding to the risk of climate change.

The main problem to be addressed in this study is the knowledge gap over whether responding to climate change materially affects the risks, returns and opportunities for companies, as ultimately manifested in their financial performance.

1.3 RESEARCH OBJECTIVES

The main objective of the research was to analyse risks to companies arising due to climate change, and opportunities or returns that may arise as a result of companies' response to climate change. A UNEP (2009:5) report on public finance mechanisms to scale up private sector investment in climate solutions indicates that, for interest to be stimulated, the anticipated returns on climate-change mitigation initiatives should be in line with perceptions of the level of risk. The current study therefore sought to evaluate climate-change risk-return relationships in a manner that assesses the resultant effect on the performance of South African companies. This will enhance awareness regarding the risks and opportunities of climate change that are pertinent to South African companies. Ultimately, the study sought to establish whether there is a correlation between climate-change performance and the financial performance or sustainability of South African companies. This was done by:

- establishing whether climate change is a relevant risk to companies as a result of the materiality of climate change, stakeholder and ethical pressures, and business drivers for companies to 'go green';
- assessing and categorising the potential downside risks that companies face as a result of climate change;
- assessing and categorising the upside opportunities that companies face as a result of climate change so as to establish the potential returns that business leaders should consider;
- identifying and measuring the specific risks and opportunities that South African companies face as a result of climate change;
- comparison of the level of climate-change activity and performance of selected South African companies;
- establishing commonly accepted indicators of financial return and performance that are used to measure South African companies; and
- evaluating the impact of climate-change performance, risks and opportunities on the financial indicators of selected South African companies.

1.4 REASONS FOR THE RESEARCH

In an analysis of the investment community's role on climate change, the UN Global Compact (2009) highlights that climate change is a significant source of opportunity and risk. The UN Global Compact (2009:18) quotes the International Energy Agency that it is estimated that approximately $10 trillion would be required by 2030 to invest in low-carbon technologies to deal with the risk of climate change. Companies and their investors need to have reliable information in order to decide how to allocate their capital, management time and other resources in responding to the potential risk of climate change. With the risk of climate change being complicated and subject to uncertainty regarding its impact and likelihood, failure to respond appropriately could lead to capital being misallocated or the sustainability of companies being threatened (UN Global Compact, 2009:18). For this reason, this study sought to analyse the impact of climate change to help increase the reliability around decision-making in respect of this risk.

Research is required on the impact of climate change so as to enhance information for decision-making, establish monetary impacts of climate change, improve risk assessments based on climate-change vulnerabilities and to assess opportunities arising from adaptation (IPCC, 2001:17). Burns and Weaver (2008:256) further caution that there tends to be an underestimation of the impact of problems where environmental damages are concerned due to decision-making that does not sufficiently focus on all the criteria that should be examined. In their book on sustainable options, Blignaut and De Wit (2004:429–444) express a similar view when they indicated that sustainable options are not seen to be widely applied in decision-making in South Africa. They further indicate that accounting for the environment at a business level is a topic that will gain prominence in the future as the triple-bottom line concept is developed into more comprehensive measures of performance (Blignaut & De Wit, 2004:438).

As far back as 1990, concerns were expressed at the second world climate conference that risk management had not developed sufficiently to respond to climate change (Turner, O'Riordan & Kemp, 1990:397-408). With economic and ecological systems being interrelated, risk analysis does not cope well with a multi-faceted risk that combines scientific uncertainty with unknown responses by

stakeholders to such a risk (Turner *et al*. 1990:397-408). The global credit crisis experienced by financial institutions in 2008/9 suggests that almost 20 years later, there may still be shortcomings with the evolution of risk management in leading companies. That is a further reason to examine the impact of the climate change from a risk point of view.

Strong emotions from diverse stakeholders are invoked as a result of climate-change debates and companies may be pushed into a 'green wave' without properly evaluating the impact of action or non-action (Esty & Winston, 2006:2-5). The environment could be the next source of competitive advantage or corporate failure for many companies and it is therefore critical to assess how climate change affects sustainability for South African companies.

1.5 RESEARCH METHODOLOGY

The research comprised of two phases – a literature study and an empirical study. The research commenced with a review of literature regarding risks, opportunities and returns related to climate change for companies. Various sources were examined for the purpose of:

- extracting results and conclusions of other studies, the relevant data and trends from previous research;
- clearly conceptualising the variables and examining various aspects thereof;
- determining ways of measurement and selecting appropriate measurement techniques for the purposes of this research; and
- developing a research instrument, in the form of a checklist, that was used for the empirical study.

This was followed by an empirical study within the context of selected South African companies. Quantitative techniques were used based on the findings of the literature review. The selected South African companies were –

- those that were listed on the Johannesburg Stock Exchange (JSE) and thus had publicly available financial information; and

- those that had disclosed information on their carbon performance.

The sample selected was judgemental in order to achieve coverage of a significant portion of the JSE as well as a diverse range of industries. From the literature survey, a list of questions and analysis techniques was developed. This list was compared with existing checklists. The questions developed were applied, in the form of secondary and document analysis, against global carbon disclosure information and financial analyst reports. Empirical hypotheses were formulated from the central hypothesis to test whether a relationship existed between climate change and the financial variables.

Information and data were analysed and conclusions were drawn from the analysis through a process of inductive reasoning. The results of the study are reported in tables and figures and the results are interpreted in order to clarify the results.

The research findings were concluded at the end of the research project. This involved a review of the aims set for the research project. Conclusions were drawn from the empirical study. The recommendations section of this research report therefore involves answering the research questions and solving the research problem.

1.5.1 Hypothesis

The goal of the formal research design was to test the hypothesis and answer the research questions posed. The central hypothesis was as follows:

> *Climate change will have an increasingly material impact on the financial risks, returns and opportunities of leading companies in South Africa*.

The study attempted to provide an accurate description or picture of this particular phenomenon. It identified variables that existed in this situation and described the relationship that existed between those variables.

This research used the ex post facto design as the researcher had no control over variables and can therefore only report on what happened.

1.6 SCOPE, ASSUMPTIONS AND LIMITATIONS

Whilst literature from global sources was reviewed, the empirical study was limited to a representative sample of JSE-listed companies that disclosed sustainability information. This was because of the particular vulnerability Africa faces to climate change and the continent's low capacity to adapt as a result of economic constraints (Munashinghe & Swart, 2005:232). South Africa is a focus area as the leading emitter of greenhouse gases as indicated in section 1.1 of this report. Information is more readily available for JSE-listed companies than unlisted companies and these JSE-listed companies represent a statistically significant portion of the South African corporate landscape.

The mechanisms and efficacy of financial instruments developed to deal with climate change such as emissions trading, cap-and-trade schemes and carbon taxes did not form part of the specific scope of this study as it is a study on its own. The study also did not attempt to conclude on the accuracy or otherwise of scientific observations regarding climate change or debate on the causes of climate change.

Whilst the study sought to establish whether there was a correlation between climate-change performance and financial performance variables, its scope did not extend to an analysis of causality between the variables.

1.7 DEFINITION OF CONCEPTS

The key definitions as contained within this study are briefly explained below.

Climate change: Climate change is defined as long-term and persistent changes to the average climate (Llewellyn & Chaix, 2007:86). This is also referred to as 'global warming'.

Risk: Valsamakis, Vivian and Du Toit (2005:27) indicate that risk concerns the variation of an actual outcome from the expected outcome. It implies uncertainty around the outcome of an event.

Return: According to Friend (2009:23) return comprises profit gained on an investment in relation to the amount of money

invested. Companies generate profits to pay for the capital invested in them and for the purposes of further growth (Friend, 2009:23)

Sustainability: Sustainability is the capacity to endure. Blignaut and De Wit (2004:465) indicate that sustainability refers to "balancing the satisfaction of near-term interests with the protection of interests of future generations". Applied to companies, sustainability refers to successfully integrating economic, environmental and social outcomes and is also referred to as 'the triple bottom line'.

Opportunities: In the context of this study, opportunities are a precursor to companies creating returns. Opportunities are factors that can create growth and are used by sustainable companies to increase revenues and brand values whilst reducing expenses and risks (Lowitt, 2011:5).

1.8 FRAMEWORK OF THE STUDY

The remainder of this dissertation is organised into chapters as outlined below.

Chapter 2: Theoretical framework

This chapter provides a theoretical foundation to the study by establishing the extent to which climate change is a material and relevant risk to companies and their stakeholders.

Chapter 3: Risks to companies as a result of climate change

This chapter contains the first part of the literature review related to the study regarding the risks to organisations arising from climate change. This chapter comprises of a review of books, published articles, journals or professional literature, research studies, newspaper articles and web-published materials that relate to the research problem. A list of all the material consulted in the study is contained in the reference section at the end of the dissertation.

Chapter 4: Opportunities to enhance returns and sustainability as a result of adapting to climate change

This chapter contains the second part of the literature review related to the study and reports on the opportunities arising from adapting to climate change and the consequent effect on the returns and sustainability of companies. The chapter therefore also comprises of a review of books, published articles, journals or professional literature, research studies, newspaper articles and web-published materials that relate to the research problem.

Chapter 5: Empirical research and methodology

This chapter outlines the methodology adopted in the research. It deals with the research design, and covers issues such as sampling frame, research checklists, data collection methods and data analysis techniques and procedures. This chapter also outlines the limitations of the study, which have bearing on the overall results.

Chapter 6: Analysis of empirical research findings

This is the chapter that carries the results of the research. Chapter 6 therefore reports, in detail, on the results of the analysis of company information contained in financial analyst reports and carbon disclosures. The results of the research are discussed and linked with the literature review section of the dissertation.

Chapter 7: Summary, conclusions and recommendations

This chapter is a summary of all the previous chapters. It concludes on the research problem, provides recommendations and indicates areas for further research.

CHAPTER 2

THEORETICAL FRAMEWORK

2.1 INTRODUCTION

In relation to the problem statement, this chapter seeks to establish whether climate change is a material and relevant risk for companies and their stakeholders. The chapter also aims to examine the manner in which stakeholders who believe climate change to be a material risk are likely to influence companies to adapt their actions, to understand the ethical dilemmas that arise for companies, and to ascertain the attitudes of businesses towards climate change.

The chapter is structured as follows:

- **Climate change as a material risk**

This section will establish if climate change is a potential risk that is significant and deserves attention from companies and their stakeholders. Chapter 3 will delve deeper into the specific risks arising from climate change.

- **Stakeholder influences in relation to climate change**

In the context of climate change, this section explores how principals and other stakeholders are affected by this risk and therefore how they are likely to influence the response to this risk by their agents. By exploring international and South African principles, the interests of stakeholders regarding climate change will be explored based on what they are likely to perceive as important to their agenda.

- **Climate change as an ethical dilemma**

Besides looking at the financial consequences, stakeholders typically view environmental risks as ethical risks and this section will discuss the ethical dilemmas that can emerge. Whether material or not, ethical risks can become relevant for companies due to qualitative considerations.

- **Attitudes by business**

In this section, different attitudes that business may have regarding the environmental concerns of stakeholders are explored. This section will answer the question whether businesses see environmental risks as relevant and worthy of significant risk management attention.

2.2 CLIMATE CHANGE AS A MATERIAL RISK

Africa is highly vulnerable to climate change and this is compounded by stresses such as resource inequity, limited access to capital, infrastructure limitations and challenges with governance (Houghton, 2009:216). The IIED (2006:1–2) warned that Africa would be exposed to the greatest impacts of climate change because:

- at least 70% of sub-Saharan Africa people rely on agriculture and natural resources, which make up 30% of their GDP and 40% of export revenue; and
- African countries are already behind in achieving the United Nations Millennium Development Goals.

Why should companies even be worrying about ecosystem risks such as climate change? Ecosystems are rapidly being degraded and businesses are being impacted through:

- reduced availability of inputs that need to be sourced from the ecosystem and increased outbreaks of disease (WRI, 2005:14), which leads to corruption and conflict;
- according to the WRI (2005:4–14), negative repercussions from regulators, activist shareholders, civil society and customers could follow as these actors increasingly draw the link between business degradation of ecosystem services and the impact on societal well-being (security, material for good life, health and social relations);
- impairment of assets that are vulnerable to natural disasters (WRI, 2005:9);

- unexpected and abrupt physical changes once tipping points are reached (WRI, 2005:18); and

- higher insurance costs as vulnerabilities and environmental uncertainties are factored into insurance pricing and coverage exclusions (WRI, 2005:17–18).

Esty and Simmons (2011:3–16) agree and state that all businesses face ‘eco-risks’ and these risks can bring down companies if not properly managed. Esty and Simmons (2011) further explain that these eco-risks can crystallise at any part of the company’s upstream or downstream value chain and thus require a continual analysis of scenarios, probabilities and potential effects. Managing environmental risks should assist in cutting costs, increasing revenue, building intangible value and engaging with employees. There are various levels of achievement in this, ranging from eco-resistance and eco-compliance to eco-efficiency and eco-advantage (Esty & Simmons, 2011:3–16).

Most business leaders, incorrectly, tend to see the ecosystem as separate from the economic environment (Gilding, 2011:35–42). However, most services offered by the ecosystem that companies use are being used unsustainably. At some stage, these ecosystem services will become largely unavailable for the economies that rely on them. There are certain limits to our use of natural system and we have already crossed the barriers on climate change, biodiversity loss and nitrogen levels, which will put economic prosperity and stability at risk (Gilding, 2011:35–42). Practically, this means we are using 40% more capacity than the earth can naturally replenish and the planetary balance sheet is trading insolvently. This could trigger significant disruptions due to economic costs of extreme weather and climate disasters as well as adaptation costs such as building costly desalination plants – all this leading to potential GDP declines of up to 20% (Gilding, 2011:35–46).

The potential severity of climate-change risks is demonstrated by the following:

- climate-change will impact on issues such as water availability, ecosystem diversity, food production, coastal preservation, health burden of disease and an increase in “singular events” (Houghton, 2009:175);

- the possibility of negative climate change-related events for the above examples ranges from likely to virtually certain (Houghton, 2009:230); and

- the overall impact of climate change is projected to be a reduction of up to 20% in per capita production with a greater impact in developing countries (Houghton, 2009:233).

According to Armatte (2009:89–90), risk assessments should consider the future states of the world, the impacts of climate change, the cost of such impacts and ascribe a degree of likelihood to varying extents of climate change. In assessing the magnitude of damage to the environment, one should consider the expected responses by affected parties towards averting or mitigating some portion of the damage as well as placing a monetary value on the physical damage (Tietenberg, 2006:35). There are questions over the evaluation of the costs of such impacts and how to assign a scale of likelihood in terms of the uncertainty of climate change (Touffut, 2009).

Taleb (2007:xvii) warns that there are catastrophic events termed ‘black swan events’ whose impacts and likelihood are difficult to predict. These black swan events are outliers in comparison to past history, carry extreme impacts and seem easily explainable after the event even though they could not be accurately predicted prospectively (Taleb, 2007:xvii). Climate-change risk could fit the definition of a black swan event. Taleb (2007:77–79) is concerned about natural bias where human nature tends to be short-termist and highlights an experiment where test subjects under-estimated the effect of a rare event thirty-three fold! Whilst one cannot compute the likelihood of rare events, the effect is easier to establish, and Taleb (2007:211) defines good decision-making as events where the consequences or potential impacts are considered rather than endlessly speculating on the probabilities of such events occurring. He surmises that it is a waste of time to complain about unpredictability or to fight endlessly with forecasters (Taleb, 2007:210). Company executives should consider addressing climate change as such a black swan event that would be dangerous to ignore.

Industrial development has come at a price as it has resulted in high environmental and social costs. This is a corporate dilemma in that industries are now caught

between the imperative to increase profit and increasing environmental and social demands from society as well (Hardisty, 2010:9–12). Gilding (2011:51–52) agrees and cautions that whilst we assume the global economy can double in size within 22 years to accommodate lifestyles and two billion new citizens, such growth at current resource consumption levels will defy the laws of physics and mathematics. Even though Gilding (2011:51) forecasts that there may be a 38% improvement in technological efficiency regarding the use of resources by 2050, this will be offset by increased population growth and the economic upliftment of poorer individuals who are currently consuming a fraction of the resources used by their wealthier counterparts.

Therefore, by the year 2031, the global economy could be requiring 280 per cent of the environment's available capacity at current trends (Gilding, 2011:52. Gilding (2011:52) further says this is not possible, and the greatest limiting factor on the economy will be the climate. In explaining his conclusions, Gilding (2011:52–53) cites an equation by Paul Ehrlich, which concludes that environmental impact is a product of population size, multiplied by the affluence level of each person, multiplied by the technological intensity of economic output. Given that it is not feasible to reduce population size and affluence/economic growth, one has to question whether markets and technology are the levers that will reduce our environmental impact (Gilding, 2011:56). This dilemma poses both a significant economic risk and a financial opportunity for companies. Sustainability requires that companies must be able to operate for the long term whilst maintaining the environment and communities on which sustainability depends, for current and future generations (Hardisty, 2010:9–12). However, the costs of mitigating harm and protecting the environment can be significant and daunting. Compounding this is the fact that, in respect of common goods such as air, the atmosphere may be viewed as a mechanism of absorbing the waste products for our activities that has no value (Hardisty, 2010:9–12).

In responding to risks, it is important to seek the truth in navigating the extreme views on both sides of the climate-change debate (Phyper & MacLean, 2009:10–27). One side of the climate change says global warming is the greatest hoax and is being used as a clandestine political and economic movement. The other side claims doomsday scenarios where twenty per cent of the economy will disappear within a

few decades. Nevertheless, companies should not forget basic business principles in managing climate-change risks such as translating issues into financial metrics and leveraging current business systems (Phyper & MacLean, 2009:10–27). Fundamental risks that companies need to control in respect of climate-change are regarding their social license to operate, reputation, compliance, business viability and competitive advantage (Phyper & MacLean, 2009:31–73). Internally, this ultimately comes down to conserving, enhancing and creating value whilst externally, risk management entails informing, consulting and engaging stakeholders (Phyper & MacLean, 2009:31–73).

As investors and regulators become increasingly aware of reputational and financial risks arising from social/environmental issues, 50% of shareholder resolutions are expected to focus on these risks (Ernst & Young 2011a:1). Eighty-three per cent of shareholders see the long-term material impact on shareholder value that climate-change and other sustainability risks pose. As a result, companies are increasingly asked to disclose their risk mitigation activities, use different performance metrics to align compensation with risk and address shareholder questions on these risks (Ernst & Young, 2011a:2–5).

If one assumes that the risk of climate change should indeed be managed, it must be borne in mind that agents are very diverse in their decision-making and they face different situations in their sectors. It is therefore important to ask whether agent responses to climate change may be sub-optimal in relation to the long-term sustainability of the companies they are managing on behalf of stakeholders. In this regard, Touffut (2009) reminds us of the 2009 credit crisis in the financial market that served as a warning of how agents tend to focus on short-term profitability to the detriment of long-term market equilibrium.

In summary, robust risk assessment and risk management for any company require that emerging risks such as climate change be predicted early so as to enable mitigating actions that will reduce the residual level of risk to an acceptable level to be implemented. Stakeholders typically influence responses to risks, and the next section of this chapter discusses these influences in detail.

2.3 STAKEHOLDER INFLUENCES IN RELATION TO CLIMATE CHANGE

According to Willard (2005:17), ‘sustainability’ refers to protecting different groups of capital, which are economic, environmental and social (also referred to as ‘profit’, ‘planet’ and ‘people’ respectively). The economic group of capital refers to financial, structural and manufactured capitals whilst the social group sustains human, relationship, intellectual, knowledge and societal capitals (Willard, 2005:16). These groups live out of the natural capital that is within the environmental group (Willard, 2005:16). Boards are caught in a “commercial-societal vice” where they have to assess the business case for sustainability (Willard, 2005:11). They face commercial pressures from groups such as shareholders and innovative competitors. On the other hand, they also face societal pressures from groups with high expectations for socially and environmentally acceptable behaviour such as consumers, non-governmental organisations and governments (Willard, 2005:11).

Given that business leaders do not operate in a vacuum, as indicated above, and that they are influenced by the perspectives that their principals and other stakeholders define it is useful to examine theories on principal agents and stakeholder interaction. According to the principal-agent theory, there are relationships in the governance chain that cascade from the ultimate beneficiaries of an enterprise through to investment managers, boards, executives and managers (Johnson, Scholes & Whittington, 2005:164–211). Johnson *et al.* (2005:164-211) demonstrate that each of the agents in this governance chain is incentivised to work for the best interests of their respective principals due to the manner "in which targets, budgets and rewards are structured". However, Johnson *et al.* (2005:164-211) indicate that this governance chain may not operate perfectly due to agents working for short-term rewards in a manner that can conflict with the expectations of stakeholders. Company strategy therefore reflects the relative power of the different stakeholder groups that an organisation has. Such stakeholder interests, as well as the ethical stance of stakeholders, help shape the purpose of an organisation (Johnson *et al.* 2005:164–211). The principal-agent theory therefore provides a basis to understand the actions or non-actions of company management in response to the risk of climate change.

The impact of stakeholders on the way sustainability risks in businesses are addressed is explored further below to understand whether shifting ethical views of stakeholders (including principals) are likely to be powerful early drivers for change. This understanding will lead to decisions such as whether companies should proactively collaborate with stakeholders in managing risks that affect the company or alternatively to merely inform stakeholders on an ongoing basis. Esty and Simmons (2011:63–80) understand companies to have five groups of stakeholders, namely –

- business partners and competitors;
- consumers and the community;
- investors and risk assessors;
- rule makers and watchdogs; and
- idea generators and opinion leaders.

Ferrell, Fraedrich and Ferrell (2008:30–44) explain that businesses exist on account of relationships with stakeholders. Stakeholders define ethical issues for businesses, and environmental issues are an example of such ethical dilemmas. A balanced stakeholder interaction model is increasingly seen as key in the successful sustainability of relationships. Ferrell *et al.* (2008:30–44) suggest that businesses have increasingly moved to a broader stakeholder model of corporate governance and away from the more narrowly defined shareholder model of corporate governance. A stakeholder model recognises that there are interests other than just shareholder interests that are fundamental to staying in business. It recognises that those interests are material and that they influence corporate decision-making (Ferrell *et al.* 2008:30–44).

The King III Code of Governance for South Africa (IOD, 2009:11–13) supports this view and indicates that sustainability cannot be achieved without inclusivity of stakeholders, and differentiates between an “enlightened shareholder model” and a “stakeholder inclusive model” of corporate governance. In the stakeholder inclusive model, the legitimate interests and expectations of stakeholders are viewed as fundamentally linked to the interests of the company rather than being just an additional consideration (IOD, 2009: 11–13).

Stakeholders can be powerful drivers for changing corporate strategy and they can drive this in either a passive or an activist manner (Brooks & Dunn, 2010:5–11). Passive stakeholders are likely to be reactive and will only act once their interests are directly threatened – often where a predicted risk has already crystallised. Activist stakeholders will, however, seek to direct corporate strategy pro-actively (Brooks & Dunn, 2010:5–11). Two key groups of activist stakeholders are emerging and these are ethical consumers and ethical investors (Brooks & Dunn, 2010:5–11).

In explaining the power of activist stakeholders, Brooks and Dunn (2010:5–11) refer to studies, which indicate a positive linkage between above average social performance and profitability. An example they quote is a weighted index of 400 ethically screened US stocks, which have been shown to outperform the Standards & Poor (S&P) 500 index repeatedly.

Brooks and Dunn (2010:5–11) further argue that since the 1980s, the costs of externalities, which were previously ignored, have increased exponentially. Stakeholders are increasingly becoming aware of such externalities. Externalities are defined as “the impacts of corporate decisions and activities that are not included in the determination of the profit of the company that caused the impact” (Brooks & Dunn, 2010:191).

Brooks and Dunn (2010:14–17) propose an approach to understanding stakeholders that considers values, reputation and risks. This approach merits consideration as the response by company directors or management to climate-change risk will be influenced by the need to incorporate the interests of stakeholders into their decision-making model. Brooks and Dunn (2010:14–17) identify and define three elements of this approach, namely values, reputation and risk. These are explored in detail below.

Values: Six universal values commonly respected by stakeholder groups are honesty, fairness, compassion, integrity, predictability and responsibility (Brooks & Dunn, 2010:14–17). Brooks and Dunn (2010:14–17) contend that these values are key for companies to receive support from stakeholders such as customers, suppliers, employees, government, lenders and shareholders.

Reputation: Reputation often defines the license for a company to continue operating, and Brooks and Dunn (2010:16) refer to the work of Charles Fombrun

when they indicate four determinants of reputation, namely credibility, reliability, responsibility and trustworthiness. Ernst & Young (2010a:26) agree and say that addressing reputation encompasses matters such as transparency, accountability and social license to operate. Furthermore, in a report on the top 10 strategic risks for business, Ernst & Young ranks social acceptance risk as the 9th top risk – a new risk that emerged after the financial crisis (Ernst & Young, 2010a:26). Public pressure creates an ethical standard, and environmental impact is an area where companies should create trust with the public (Ernst & Young 2010a:26). It can be surmised that failure to embrace environmental responsibility towards climate-change risks will have an adverse effect on reputation.

Risk: Brooks and Dunn (2010:17) define ethics risks as the "risks of failing to meet the expectations of stakeholders". Major impacts to the sustainability of companies such as Enron, Arthur Andersen and WorldCom arose due to failure to manage such ethics risks (Brooks & Dunn, 2010:17). Environmental risks are ethics risks, and ignoring ethics risks could lead to a fate similar to companies that are typically the subject of historical corporate failures.

Consequently, dealing with climate change is an ethical dilemma and the section below explores why this is the case.

2.4 CLIMATE CHANGE AS AN ETHICAL DILEMMA

Ferrell *et al.* (2008:63–64) define an ethical dilemma as a problem or opportunity that requires a choice among several actions for which there is no single correct answer in the eyes of stakeholders. Environmental issues, including climate change, are an example of such an ethical dilemma. An example of the effect of such stakeholder concerns is that environmental protection laws have led to the elimination or modification of goods and services (Ferrell *et al.,* 2008:100).

Choices that involve the environment can be driven by ethical (fair treatment) and efficiency (waste reduction in use of resources) considerations (Tietenberg, 2006:99). Such inter-linked ethical and efficiency concerns are likely to be communicated to companies by environmentally conscious stakeholders.

There used to be a widely held assumption that businesses do not have social responsibilities beyond maximising profits, but Shaw (2011:175–178) is critical of this view. This view held that unlike people, companies cannot have responsibilities and when a company executive spends on social responsibility such as reducing pollution he is going against the profit-seeking desires of his principals, which is akin to levying a tax on their profits or unfairly increasing consumer prices (Friedman, 1970:1–6). Friedman (1970:1–6) regards social responsibility as a "fundamentally subversive doctrine" and saw it as a deceptive way of generating goodwill entirely in the interest of companies. Friedman (1970:1–6) holds that the only responsibility of business is to engage in activities for maximising profits as long as it stays within the rules of the game – rules that are defined by law and ethical custom. Contrary to this view, Shaw (2011:26–28) surmises that the public and political response to climate change will define new rules for the game. Lack of compliance would diminish profitability if a business loses its social license to operate and businesses will have to adjust to those rules to maintain their sustainability. However, the change to new rules is not as straight forward as organisational norms or conformity groupthink, and diffusion of responsibility may constrain ethical decision-making in this instance (Shaw, 2011:26–28).

Adapting to climate change includes considering externalities and this poses an ethical dilemma for corporations (Shaw, 2011:191). It is often assumed that there is a direct relationship between profitability and ethical corporate behaviour. However, Shaw (2011:191) indicates that it has been demonstrated that the most morally responsible companies are consistently among the most profitable companies. In considering moral responsibility, the question of separating individual responsibility from corporate responsibility arises. Shaw (2011:175–178) indicates that the controversy over the concept of corporate moral agency is complicated by diffusion of responsibility in companies. This diffusion of responsibility results in difficulties in assigning accountability for consequences of corporate activities.

Business leaders have ethical responsibilities to minimise harm through their company's activities and to recognise the benefits of considering the environmental and social sustainability spheres (Hopwood, Unerman & Fries, 2010:5–9). Climate change affects all three elements of sustainability (economic, environment and

social) and the ethical challenges faced are that not all activities have ‘win-win-win’ results across the economic, environmental and social elements (Hopwood *et al.,* 2010:5–9). Business practices that are not environmentally sustainable can impair financial sustainability as well as create undesirable climate-change social impacts, which could create poorly functioning societies that in turn impose additional costs on business such as by way of security costs and tax (Hopwood *et al*., 2010:5–9).

Companies often do not view the environment as an asset that requires preservation. Tietenberg (2006:14–15) indicates that the environment is an asset that provides services to sustain the economy with inputs into the production process, as well as absorbing the resultant waste products. According to Tietenberg (2006:14–15), if we consider the environment as an asset, we would wish to avoid excessive depreciation of this asset as this reduces the level of services that it can provide. Companies traditionally viewed environmental resources as virtually limitless (Shaw, 2011:266–268). However, pollution, such as in the form of carbon emissions, creates a decline of resources within the common public domain. Businesses traditionally only consider the private costs of their activities and not the social or ecological costs (Shaw, 2011:266–268). Shaw (2011:265) explains that the elements within ecosystems are interdependent and a change in any one of them can affect the entire system. Therefore, companies cannot assume that they will be immune to the effects of climate change.

In considering ethical issues, it is necessary to consider the principles behind these ethics. If stakeholders take a stand regarding climate change, what are the principles that define the action they desire from companies? Houghton (2009:278) singles out four relevant principles for international action from the 1992 Rio Declaration on Environment and Development that was signed by more than 160 countries at a United Nations Conference on Environment and Development. This declaration set the agenda for international climate action and therefore the principles identified by Houghton apply to companies because they cascade down from global imperatives. These principles are indicated below:

- Precautionary principle (principle 15). This principle indicates that uncertainty about serious environmental threats should not be an excuse for deferring

environmental protection (United Nations Conference on Environment and Development, 1992:3).

- Principle of sustainable development (principles 1 and 7). Principle 1 indicates, “Human beings are entitled to a healthy and productive life in harmony with nature”, while principle 7 refers to international co-operation in sustainable development and restoring the earth’s ecosystem in acknowledgement of the environmental pressures arising from development (United Nations Conference on Environment and Development, 1992:1–2). Houghton (2009:272) refers to a 1990 definition by the United Kingdom Department of the Environment, which said, “Sustainable development means living on the Earth's income rather than eroding its capital.”

- Polluter-pays principle (principle 16). This principle refers to the ideal of promoting “the internalisation of environmental costs and the use of economic instruments, taking into account that the polluter should bear the cost of pollution” (United Nations Conference on Environment and Development, 1992:4). Society faces costs (Houghton, 2009:285–286) from climate change such as adaptation costs, damage costs and mitigation costs. In addition, there are non-monetary impacts such as the effect on human beings of a decline in natural capital. As opposed to being a cost, climate change should also be seen as an opportunity for companies to harness their “imagination, innovation, commitment and activity” to address the problem (Houghton, 2009:285–286).

- Principle of equity – international and intergenerational (principles 3 and 5). Principle 3 indicates that development must “equitably meet developmental and environmental needs of present and future generations” and principle 5 reinforces this by emphasising the elimination of poverty as fundamental to sustainable development (United Nations Conference on Environment and Development, 1992:2).

According to Agenda 21 of the United Nations Programme of Action from Rio (2002), companies should prioritise reducing their impact on the environment. Companies should strive for cleaner production through greater efficiencies and reduction of waste. In addition, they should promote responsible entrepreneurship, which will

enhance efficiencies, reduce environmental risks, reduce waste and protect the environment (United Nations Programme of Action from Rio 2002). In conjunction with governments, companies should advocate for more sustainable consumption through activities such as reducing energy use, informing consumers of environmental impacts and promoting values on sustainable consumption (United Nations Programme of Action from Rio, 2002).

The precautionary, sustainable development, polluter-pays and equity principles outlined above are likely to be communicated by stakeholders to companies in varying forms and companies would do well to design an appropriate response strategy. To understand how the principles above have been translated in the South African context, it is important to refer to legislation and governance codes.

Section 24 of the Constitution of the Republic of South Africa (RSA, 1996) indicates –

> *Everyone has the right to an environment that is not harmful to their health or well-being; and to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that*
>
> - *prevent pollution and ecological degradation;*
> - *promote conservation; and*
> - *secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.*

The term 'environment' is further defined in Section 1(xi) of the National Environment Management Act (RSA, 1998) as follows:

> *environment means the surroundings within which humans exist … interrelationships among and between them … and physical, chemical, aesthetic and cultural properties and conditions that influence human health and well-being …*

Chapter 1 of the National Environment Act (RSA, 1998) proceeds to set out principles, which are similar to the international principles referred to by the United Nations. The onus for enforcing such principles is on organs of state. In summary, the principles from the National Environment Act (RSA, 1998) that are relevant for companies to consider refer to:

- sustainable development that avoids or minimises disturbance of ecosystems, pollution of the environment and negative impacts on the environment;
- integration of environment, social and economic matters into transparent decision-making, including consideration of the interests of all parties such as the community and workers who could be affected or interested;
- “a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”;
- pursuance of environmental justice to avoid unfair distribution of environmental impacts;
- “equitable access to environmental resources, benefits and services”; and
- “responsibility for the environmental consequences of a product, process, service or activity exists throughout its life cycle” as well as assessment and evaluation of disadvantages and benefits of activity.

The above principles are not dissimilar to the precautionary, sustainable development, polluter-pays and equity principles referred to by Houghton (2009) as explained previously. This serves to illustrate that South African companies are subject to similar ethical and legal principles as their international counterparts regarding climate change and sustainability.

The King III Code of Governance for South Africa (King III) confirms that sustainability is grounded in the South African Constitution in relation to the interdependency of people, planet and profit, and predicts that sustainability will become the most significant source of risk and opportunity for companies (IOD 2009:9–10). King III further indicates that, “Strategy, risk, performance and sustainability have become inseparable” for companies (IOD 2009:11).

In summary, addressing the relevance of climate change and sustainability issues requires an approach that is based on ethical principles. Ethical principles may influence the response by companies to stakeholder influences, and the section below explores the different attitudes companies may have.

2.5 ATTITUDES OF BUSINESSES

Doyle and McEachern (1999:135–146) indicate that there are three attitudes of business towards environmental concern. These attitudes are categorised as rejectionists (who reject the case for concern), accommodationists (who are sceptical but make limited changes) and thirdly, those that believe in environmental business (who redesign processes to minimise environmental damage). Most businesses are perceived to be in the accommodationist category and this is encouraged by the fact that responding to environmental concerns by enhancing efficiency of production and adopting new technologies inherently increases profitability whilst reducing environmental impact (Doyle & McEachern, 1999:135–146). This is an outcome that principals or stakeholders and their agents could view as a win-win compromise. Doyle and McEachern (1999:135–146) conclude that despite scepticism, the push for commercial advantage can push companies toward greener options. This results from companies harmonising profit motives and environmental matters.

Willard (2005:27) describes a sustainability continuum where companies go through five different stages of green:

- Stage 1 is the ‘pre-compliance’ stage, where companies are not interested in sustainability issues and may resist or evade regulations (Willard, 2005: 27–28).

- Stage 2 is the ‘compliance’ stage, which indicates a company that reactively complies with environmental regulations and responsibilities (Willard, 2005:27–28). Willard (2005:31) further labels companies in stages 1 and 2 as ‘locusts’ in that they focus on the short-term interests of their stakeholders, which results in environmentally damaging actions.

- ‘Beyond compliance’ refers to stage 3, according to Willard (2005:27), and indicates a company that starts to capitalise on sustainability benefits resulting from eco-efficiency, reduced waste, reputation management and the like. Willard

(2005:31) compares these companies to ‘caterpillars’ because of their as yet unrealised potential to transform into sustainable enterprises.

- A stage 4 company is transformational and has an ‘integrated strategy’ where sustainability is ingrained into every aspect of the company’s operations and culture (Willard, 2005:29).

- Stage 5 companies have a ‘purpose and passion’ for sustainability and are committed to improving the well-being of stakeholders and the environment (Willard, 2005:27–29). Whilst companies in stage 4 are comparable to ‘honeybees’ because of the way they network with ecosystems, cross-pollinate and incubate new offerings, the highest stage is ‘butterflies’ as the way they live their sustainability values is beautiful to watch (Willard, 2005:31).

As company attitudes adapt, this may require a significant turnaround in strategy and Johnson *et al.* (2005:357) indicate that there are three success criteria to be considered in such instances. These are **suitability** of the strategy to the circumstances within which the organisation finds itself operating; **acceptability** of intended outcomes to what stakeholders expect; and **feasibility** of that strategy in the context of what the organisation is capable of.

Focusing on acceptability of climate-change strategy to stakeholders, the framework set out by Johnson *et al.* (2005:361) may be useful. This framework for considering acceptability has three elements, being returns (benefits of a strategy to stakeholders), risk (likelihood and impact of strategy failure) and stakeholder reactions to new strategies.

Johnson *et al.* (2005:577) indicate that, should managers fail to adapt to an issue that the majority of stakeholders view as important, businesses could face externally imposed strategy where a powerful stakeholder such as government dictates the course of action.

This section therefore illustrated how business attitudes to climate change may be affected by the harmonisation between profit motives and environmental matters.

2.6 SUMMARY AND CONCLUSION

This chapter dealt with the factors that indicate climate change as a significant issue for stakeholders that will affect the actions they require from their agents (company executives). It was established that, even though the future cannot be predicted with certainty, it would be remiss of company executives to ignore the compelling evidence that climate change is a major threat to sustainability. The principal agent theory indicates how the flow of requirements, within the governance chain, from shareholders is likely to increase pressure on companies. Conversely, stakeholder models adopt a broader view than shareholder models of the parties that are demanding a suitable, acceptable and feasible strategy for addressing climate-change risks.

Following that, the chapter differentiated between different types of stakeholders that range from passive to activist stakeholders. Activist stakeholders are largely ethical consumers and ethical investors who increasingly require companies to consider externalities, i.e. the impacts of their activities that are not considered in determining profit. In the information age, activist stakeholders are increasingly expected to make their voices heard. Besides externalities, stakeholders were shown to be interested in values, reputation and risks and it was demonstrated that an inadequate response to climate change would result in a company falling short of all these expectations. Given that ethics is at the core of activist stakeholders, the chapter also explored the ethical dilemmas regarding dealing or not dealing with climate change. The chapter discussed how the historical drive of pursuing profit at any cost may increasingly become less relevant. This is due to stakeholders defining the rules of the game in a manner that will reduce the sustainability of companies that fail to achieve a social license to operate. The chapter further identified ethical principles that may be used by stakeholders in driving the climate-change agenda. The principles identified refer to a precautionary stance, sustainable development, polluter-pays and equity. These principles implicitly contain the views on values, reputation, risk, ethics and externalities referred to in the chapter. Such principles have been documented within international declarations. From a South African perspective, section 24 of the Constitution, the National Environment Management Act and the King III Code of

Governance for South Africa embody and clarify the principles upon which actions by agents should be based.

The chapter then concluded by evaluating different types of business attitudes towards stakeholder concerns on climate change. It was surmised that accommodationism is a current middle road where there could possibly be consensus between stakeholders and agents before environmental business becomes mainstream.

From a theoretical perspective, Chapter 2 has established climate change as a relevant and material issue for companies, and this sets the scene for Chapters 3 and 4, which will deal with the risks and opportunities arising from facing and mitigating this sustainability issue.

CHAPTER 3

RISKS TO COMPANIES AS A RESULT OF CLIMATE CHANGE

3.1 INTRODUCTION

Chapter 2 broadly established that climate change is a material and relevant sustainability risk. Chapter 3 will now proceed to establish and evaluate the specific risks to companies, which are caused by or associated with climate change. Chapter 3 commences with a background that recaps on the risk of climate change and provides an overview of the vulnerabilities occasioned by climate change. The chapter then proceeds to establish the categories of risk that require further study. Each risk category is subsequently analysed in the remainder of the chapter.

Risk assessment is a well-established discipline in many companies. Typically, risks that can have a catastrophic effect, even if they have a very low likelihood, are mitigated by companies (Hardisty, 2010:43–44). Based on that principle, even if the likelihood of climate change is, for argument's sake, only 25% (some say it could be as high as 95%), any reasonable risk assessment would deduce that this is unacceptable and seek to mitigate against it (Hardisty, 2010:43–44).

Should a potential risk crystallise, it will logically create vulnerability for the company. Vulnerability to climate change is affected by exposure, sensitivity and adaptive capacity (IPCC, 2007:64). The IPCC (2007:64) states, "Responding to climate change involves an iterative risk management process that includes both mitigation and adaptation, taking into account actual and avoided climate-change damages, co-benefits, sustainability, equity and attitudes to risk."

If it is accepted that there are reasons for concern due to climate change, how does one identify the risks that a company faces as a result of climate change? Identifying the broad risk areas entails asking which impacts the company creates for which it can be held accountable and whether these impacts can affect the way the company does business (Esty & Simmons, 2011:23–35).

3.2 RISK CATEGORIES

In order to evaluate the risks arising from or associated with climate change, this section will seek to establish the relevant risk categories, so as to facilitate further analysis. A framework is required to decide which sustainability risks should be addressed. According to Esty and Simmons (2011:63–80), companies should consider the materiality of the risks that they need to address. Material risks are those that can shift the business landscape by affecting operating costs, access and price of inputs, brand value and reputation, product differentiation and perceived value (Esty & Simmons, 2011:63–80). Furthermore, material risks affect the industry growth rate, innovation opportunities and the priorities of stakeholders such as government (Esty & Simmons, 2011:63–80).

The section below outlines three methods that are useful in identifying risk categories. These are market trends, threats to long-term value and industry-specific sources of risks.

The first method of identifying risks is to explore signals of risk that companies experience in the market. Phyper and MacLean (2009:31–73) cite government initiatives, consumer habits, investment community actions, energy price shifts, depletion of resources, new green technologies, significant environmental incidents and impairment of assets arising from climate events. Esty and Simmons (2011:63–80) agree and consider the typical risk categories, based on trends shaping the future landscape, to be as follows:

- natural pressures, such as climate events and shifting weather;
- shifts in social norms, political interest and views from upcoming generations;
- regulations and political debate leading up to changes;
- new science and potential technology breakthroughs; and
- demographic and economic changes.

The second method is to identify the climate-change risks that can affect the long-term value of a company. Stoffberg and Prinsloo (2009:92–96) outline the categories of risk as indicated below:

- Strategic risks – the absence of a climate-change risk strategy, incomplete disclosure of information relating to climate change, and lack of consideration of commercial and litigation exposures to the company.
- Competitive risks – lack of responsiveness to changing regulations and markets.
- Regulatory risks – risks that arise from current and future government actions to address climate change.
- Fixed assets, capital investments and operations risks – companies may face vulnerabilities and exposure to physical risks due to environmental conditions that are influenced by changing climates.
- Product risks – consumer demand changes as a result of climate change.
- Physical risks – risks can arise from the environment itself such as higher sea levels, extreme weather events, water shortages, floods and resource shortages.
- Adaptation risks – the costs and physical/regulatory consequences of adapting or not adapting the company's operations and products to climate change.
- Reputation and brand risks – the brand value of a company may be threatened by the attitudes of customers and suppliers.

Thirdly, whilst the above risks could apply to most companies, it is important to recognise that different industries have particular types of sustainability risks to which they are exposed, as illustrated in Table 3.1 below:

Table 3.1: Sustainability risks of different company types

Type of company	Sustainability risk
Brand-reliant	Tarnishing of brand
High environmental impact	Reputation and financial risks
Natural resource-dependent	Lack of resources for core product
Supply chain natural resource-dependent	Lack of inputs that are key for the supply chain
Major social and community impact	Reputation risks and effect on social license to operate
Regulated environment	Increase in regulations
Labour-intensive	Availability and health of employees negatively impacted by factors such as climate-induced diseases
Highly skilled labour	Lack of competitiveness in attracting the best talent

Source: Adapted from Kiernan (2009:97–122)

In view of the types of risks identified in this section, this chapter will therefore proceed to examine the following risk categories in further detail:

External risks

1. Physical
2. Market
3. Political
4. Legal
5. Energy

Risks related to the response to climate change

6. Strategic
7. Reputation
8. Products
9. Supply chain

10. Compliance
11. Human capital

Financial and accounting risks

12. Capital
13. Information for decision-making
14. Assets and liabilities
15. Income statement

In the remainder of this chapter, the risks of climate change are analysed according to these 15 identified risk categories. As risks can be interconnected in their source or in how they are addressed, it should be noted that the chapter explores the risks, as relevant, from the perspectives of:

- risks of not mitigating climate change (e.g. resulting in pressure from consumers and regulators);
- risks of not adapting to climate change (e.g. resulting in unplanned physical impacts on a company);
- risks created in the process of adaptation to climate change (e.g. incorrect responses to climate change that create unintended consequences); and
- risks associated with or related to climate change (e.g. diminishing sources of energy).

3.3 EXTERNAL RISKS

External risks comprise of physical, market, political, legal and energy risks that are explored in the sub-sections below.

3.3.1 Physical risks: impact on assets, socio-economic conditions, access to human and natural resources and health

Sub-Saharan Africa is more exposed to the negative effects of climate change than any other region due to a combination of environmental and socio-economic factors (Chevalier, 2010:191–192). This is despite the region contributing only 3.5% of global

emissions even though it has 11% of the global population. Over time, the region is expected to experience increasingly frequent and intense extreme weather events, droughts, floods, agricultural insecurity, vector-borne diseases and depletion of species (Chevalier, 2010:191–192). Schulze (2005:435) warns that Southern Africa is a high-risk hydro-climatic environment and climate-change impacts in South Africa will be experienced sooner than is expected. In responding to climate change, institutions face physical limits (finite water resources), feasibility limits due to socio-political pressures; financial constraints, and capacity limits in respect of skills/effort required to adapt (Schulze, 2005:446).

Climate change is not often a direct stress on business, but rather triggers other stresses due to the impacts between climate and human systems (IPCC, 2007:361–365). Such stresses inevitably affect the financial position of companies. Climate impacts currently cost between one and twelve per cent of the GDP annually for different locations (World Resources Institute, United Nations Environment Programme and Oxfam, 2011:12–14). Four groups of physical risks that can impair business operations are discussed below.

3.3.1.1 Extreme events – effect on assets and production

Other than gradual changes, climate extremes can threaten transportation and transmission linkage systems that are crucial for industry and services and physical infrastructure (IPCC, 2007:361–365). As impacts vary between regions, climate changes can also shift an area's economic patterns and comparative advantage, thus affecting prospects for industry (IPCC, 2007:362–368). Tellingly, from 1970 to 2005, global annual insurance losses from natural catastrophes rose from US$4 billion a year to US$100 billion a year (KPMG, 2008:27). KPMG (2008:26) feels that, whilst companies may be protected from some physical risks through insurance products, there are newer forms of risk where they face actuarial exposures. In addition, certain indirect consequences of climate change such as workforce impacts, relocation of operations and commodity price increases cannot be covered by insurance (KPMG, 2008:26).

Deloitte (2007:3,6) is concerned about the physical impact of rising sea levels, drought, increased storm intensity, more intense winds and extended summer heat

waves. These risk factors are likely to lead to flooding of facilities, plant shutdowns due to water constraints, production outages, as well as impairment of plant operations due to plants having been designed for historical weather conditions that have changed and are changing (Deloitte, 2007:3,6). Friend (2009:18–19) agrees and believes that climate change will affect companies in terms of locations for facilities, the cost of logistics, employee living conditions, more intense storms and shifts in resource availability.

Physical risks can also affect the security of energy supply to companies or create input price fluctuations (Phyper & MacLean, 2009:301–333). Physical risks can crystallise in higher maintenance costs for exposed infrastructure, loss of contract opportunities where infrastructure projects are stalled, credit risks for financiers, underwriting losses for insurers, unfavourable shifts in tourism and decreased feedstock for consumer products companies (Phyper & MacLean, 2009:301–333).

One of the significant assumptions that affect asset values is that with regard to depreciation of non-current assets. The rate of depreciation is dependent on factors such as the forecasted useful lives of assets taking into account the rate of deterioration and expected obsolescence (Glautier, Underdown & Morris, 2011: 146–147). It can be surmised that increased extreme events that affect non-current assets could create increased pressure to reduce the expected accounting useful lives of assets and thus accelerate depreciation. In addition, losses in non-current asset values will trigger immediate write-offs against income (Glautier *et al*., 2011:143). Current assets may not be spared from write-downs given that climate change events will also affect a company's consumer base. Companies should thus continue to consider typical sources of significant adjustments such as losses from the actual or potential default of debtors as well as inventory adjustments (Glautier *et al*., 2011:156–168).

3.3.1.2 Socio-economic effects – volatility in operating conditions

Companies in South Africa and other developing countries with a low adaptive capacity are particularly exposed to climate-change risk. Speth (2008:22–34) highlights climate-change effects that will significantly affect the developing world, such as displacement of as many as 850 million people due to a rise in the sea level;

loss of forests and fisheries; depletion of fresh water; increased burden of disease; the extinction of up to 30% of animal and plant species; and physical injury from heat waves, floods and fires. The effect of such developments will include conflict, humanitarian disasters and ecological refugees (Speth, 2008:28). Developing countries are particularly financially vulnerable due to inadequate availability of public services, limited financial buffers to withstand shocks from natural disasters, limited access to affordable credit and insurance, and limited links to global financial markets for transferring of risk (Stern 2006:99). Boardley and Schulze (2005:360) agree and indicate that in looking at vulnerability to climate change, susceptibility is influenced by socio-economic conditions, availability of natural resource capital, social inequities and adaptive capacities. Developing countries are particularly exposed to extreme weather events and this is exacerbated by challenges in factors such as technology, infrastructure, resources and stability (Boardley and Schulze 2005:360). It can be surmised that this will directly affect the human resource pool, consumer base and raw material availability of South African companies.

World Resources Institute *et al.* (2011:20–21) feel that climate change is a "threat multiplier" in that it creates dangerous interrelationships between existing risks and also creates new risks. This is even more relevant for supply chain and operational risks where water scarcity, for example, can have a domino effect that escalates into economic collapse and social unrest.

A climate shock such as a drought has an immediate downside effect on the value of societal assets and income, followed by a long period of recovery for communities and irreversible losses in lifetime earnings for the poor (Stern, 2006:101–102). This will pose a risk to business, given that annual economic output is a product of labour, environmental quality and capital. In responding to climate shocks, companies face mal-adaptation risks. For example, a company that aggressively secures water rights in a water-scarce region can easily face a backlash from the community and a public relations nightmare (World Resources Institute *et al*., 2011:29).

3.3.1.3 Access to human and physical resources

Systematic and cumulative changes in climate can tip over thresholds to the extent that human systems become inadequate, such as water availability and food

production (IPCC, 2007:365). Willard (2005:104–105) warns of market “discontinuity threats” that are difficult to predict and tame, in other words it could be in the form of a sudden irreversible shift of climate patterns such as a reversal of global ocean currents. Companies worst affected will be those who do not understand that business risks have evolved and that they cannot be treated traditionally without engaging stakeholders in their environmental and social responsibilities (Willard, 2005:104–105).

In addition to placing stress on shared resources, such community risks become business risks as companies are dependent on local services, employees, suppliers, customers and infrastructure to function (World Resources Institute *et al*., 2011:17). This can result in decreased availability and increased prices of core inputs such as water and energy, greater employee absenteeism and reduced productivity following severe climatic events (World Resources Institute *et al.,* 2011:19).

One of the risks of climate change that is more readily recognisable in Africa is water scarcity – with water already a scarce resource. Stern (2006:vi–vii) warns that climate-change effects are often mediated through water, and developing countries are likely to suffer the greatest impacts due to high rainfall variability and their high dependence on agriculture, which is more climate-sensitive than other industries. The ripple effect this causes will be higher water costs, caps on water use, community conflicts over resources, less water available for company activities, operational disruptions, economic growth constraints, higher water treatment costs and increased financial responsibilities to restore community water infrastructure (Ceres, 2009:4–8). Water scarcity due to climate change will affect all businesses as they will have to compete for this commodity, pay a higher cost, locate operations in alternative areas and invest in new technologies to use water more efficiently (World Resources Institute *et al.,* 2005:10,25).

3.3.1.4 Effects on the health of employees and consumers

A two-degree temperature rise will lead to impacts in Africa such as malnutrition from declines in food productivity, climate-related diseases such as diarrhoea and malaria (up to 60 million more people exposed to malaria), exposure of millions to coastal flooding, and abrupt large-scale physical impacts (Stern, 2006:57).

Even in countries with relatively strict pollution rules, such as North America, low air quality is still found to contribute to diseases such as asthma and chronic bronchitis (Speth, 2008:74). In 2007 for example, one third of Americans were living in areas where air pollution levels exceeded environmental protection standards (Speth, 2008:74). Willard (2005:97) illustrates the economic severity of air pollution by indicating an example of one province in Canada (Ontario) where air pollution is expected to cost US$15 billion annually by 2015 due to cardio-respiratory illnesses, hospital admissions, absenteeism, loss of life and the cost of suffering. This is similar to the global picture where Willard (2005:97) indicates that already in 2002, the annual mortality rate from air pollution was three million people and this exceeded deaths from causes such as car accidents and cancer. Once the public connect the dots between illness and the pollution from companies, this will severely damage company reputations (Willard, 2005:97).

3.3.2 Market risks: shifting consumer behaviour and changing competitiveness affect revenues

Market risks crystallise in reduced product demand, customer boycotts and sales restrictions (Willard, 2005:124).Companies face the risk of declining revenue due to changes in market risks as a result of climate-change, as outlined in the following sub-sections.

3.3.2.1 Green consumerism

Green consumers have been increasingly proven through various surveys to reward companies for their social performance and to punish other companies for poor environmental outcomes. Many green consumers are well-educated and wealthy consumers who are concerned about climate change, pollution and the depletion of natural resources (Willard, 2005:108–110).

From a consumer perspective, a shift to sustainability will firstly entail green consumerism and secondly, a drive to reduce consumption (Speth, 2008:156). Such trends will affect the product and service offerings of companies since the public may in future increasingly seek more authentic and lasting experiences (Speth, 2008:160). There is an increasing perception by consumers that the current levels of growth are uneconomic due to the ruthless pursuit of increasing the quantity of goods

rather than the quality of life (Speth, 2008:115). Speth (2008:108–109) says this has led to growth that is jobless, ruthless (mainly helps the rich), voiceless (does not promote democracy), rootless (harms culture), and futureless (uses resources required by future generations). Conceivably, companies who continue to measure their economic growth solely by the quantity of products sold will be caught unprepared as the public shift their desire to pursue sustainable growth.

A 17-country global survey, of developing and developed countries in Asia, Europe and America, by TNS Global (2008:3–4) indicates that 78% of respondents in a study felt that the natural environment is fair or poor, while 28% of respondents thought air pollution was the leading environmental problem people were concerned about. Accordingly, 40% of respondents indicated that they had changed their behaviour to benefit the environment, with 59% willing to pay extra for environmentally friendly products and 51% willing to pay extra for waste collection to be recycled (TNS Global, 2008:5–9). Of the respondents, 61% indicated that a company's environmental friendliness would influence their purchases of products or services, and 85% were willing to pay a 5% to 10% premium for 'green' products and services (TNS Global, 2008:10–18). As a result of their commitment to reducing environmental impact, market risks to climate-unfriendly companies may arise from the stakeholder group of "green" consumers and this can reflect in restricted sales, demand reduction and consumer boycotts (Willard, 2005:90).

The impact of economic development on the environment and society has been unprecedented, and this carbon-intensive development is fuelling the rise of green consumerism as concerns rise over resource limits. For example, from the 1890s to the 1990s, the world population grew four-fold whilst the world economy, energy use and carbon dioxide emissions grew by multiples ranging between 14 and 17 times (Speth, 2008:50). In the last 30 years since 1980, economic growth has become more eco-efficient with carbon dioxide emissions growing at approximately 10% below the rate of world population growth (Speth, 2008:50). However, this means the absolute burden of the economy on the environment is still increasing exponentially as gross world product is growing at two and a half times the rate of population growth (Speth, 2008:50). Such trends may therefore be increasing the concerns that green consumer stakeholders have.

Behavioural research suggests that stakeholder opinion has a significant weight on the decisions of companies to invest capital in low emissions infrastructure. Stakeholder opinion is ahead of factors such as subsidies, regulatory costs and mandatory disclosures respectively in influencing capital decisions (Deegan & Unerman, 2011:498–499).

Furthermore, climate change is likely to alter consumption patterns in the following three ways:

- as the hotness or wetness changes in a geographic region, the relevance and effectiveness of certain products will change;
- within developing countries, there could be a shift in spending power away from nonessential goods and services as consumers spend their money on adaptation; and
- decreased attractiveness of goods and services that waste scarce energy and water resources, especially where consumers are aware of climate change and feel companies have maladapted or have taken inappropriate action to address climate-change risks (World Resources Institute *et al.,* 2011:20).

3.3.2.2 International competitiveness

Raubenheimer (2011:15) poses the question “What if markets moved rapidly to the low-carbon economy, leaving us with stranded assets and unwanted high-carbon goods?” Perhaps companies in South Africa may face a risk of diminished competitiveness when compared to similar developing countries. Emissions per capita show a picture where South Africa was generating ten tons of CO_2 per person per year compared to a world average of five tons (excluding deforestation). Other developing countries such as Brazil, China and India reflected emissions per capita of five tons, four tons and two tons respectively (Raubenheimer, 2011:8–9). Furthermore, 42% of South African emissions are created in the production of goods destined for export. South Africa is therefore likely to face pressure to retain its international competitiveness through embarking on climate-change mitigation and adaptation programmes. This will increase production costs, such as for energy, which consumers will have to absorb. Compounding this, developed economies that

currently import from South Africa may decide to protect their industries, which face environmental regulations and taxes from countries, which do not have similar mechanisms (Draper & Mbirimi, 2010:249).

As far back as 2009 the European Union was considering imposing import taxation on goods produced in countries that have a high-carbon foot-print and have not committed to reducing emissions (Stoffberg & Prinsloo, 2009:74). Whilst these border carbon taxes have not yet been implemented, South African companies are at risk as the country is in the top 20 top emitters of greenhouse gases globally, generating over 200 tons more than the world average of approximately 500 tons of CO_2 for each million dollars of GDP produced (Raubenheimer, 2011:8–9).

3.3.3 Political risks: climate change may trigger policy changes and instability that can impede operations

Political instability is generally detrimental to company operations and those companies that are inadequately prepared to address sustainability risks and opportunities probably face greater challenges than well-prepared companies (Soyka, 2012:102–103). Once the reality of climate change hits and denial is no longer an option, this will trigger despair, grief, fear and anger at a political level (Gilding, 2011:100–101). Companies should be aware that this will trigger rapid and dramatic responses as well as social and political transformation to the environments in which they operate. Vulnerable areas such as sub-Saharan Africa will face challenges with national security, mass cross-border migration, resource competition, internal tensions and aggravation of current problems (Gilding, 2011:108).

Societal change is a significant force that fundamentally affects business performance and it can affect companies through changes such as demand, emerging preferences, ‘green’ competitors, the supplier landscape, new laws and regulations (Werbach, 2009:53).

Political instability and volatility are expected to continue in a number of emerging economies as sustainable development remains an unmet need and natural resources such as food and water become more constrained (Soyka, 2012:102–103). For example, in recent years, protests in developing countries erupted due to rising food prices that were partly blamed on mal-adaptation to climate change as United

States corn was controversially used for vehicle fuel production on the premise that bio-fuel is greener (Soyka, 2012:102–103).

3.3.4 Legal risks: climate change may trigger liabilities

Failure to comply with environmental laws and rules can attract legal liabilities for companies and their directors in certain instances. The three liability types according to Soyka (2012:80) are:

- criminal liability – where statute allows, in other words when facts are misrepresented or companies violate laws negligently;
- civil liability – this is the more common liability and monetary penalties, typically based on the value of damages or the company's improper economic benefit, may be accompanied by an injunction to stop legal violations; and
- financial liability – this comprises of penalties that are levied as per relevant laws and regulations (Soyka, 2012:80).

As additional legislation is put into place, the above will be followed by greater litigation risks as a result of actions against heavy emitters, actions based on government carbon controls, and scrutiny of carbon disclosures (KPMG, 2008:34). In future, shareholders may also pursue gross negligence claims against senior executives for not exercising their fiduciary duties in adapting to climate-change business risks (KPMG, 2008:35).

In the past century, asbestos and tobacco were key targets for corporate litigation, and now insurers suspect the next major lawsuits will target the big carbon emitters as signalled by the gathering pace of shareholder resolutions on climate change (Hitchcock & Willard, 2009:39–51). Whilst no major cases have been identified so far, in the future directors could be found liable in their own right should it be deemed that their judgements on climate-change matters were reckless and negligent (Hitchcock & Willard, 2009:39–51).

As shown by the asbestos and tobacco industry precedents, companies will be affected directly if countries and individuals take them to court to prove their accountability (Gilding, 2011:182). Legal action and campaigns will follow in addition

to scores of refugees, conflicts and even acts of terrorism, which countries and companies will have to deal with in the future (Gilding, 2011:182–183).

3.3.5 Energy risks: access to and cost of energy

As demonstrated in the sub-sections below, the use and cost of energy by companies is integral to understanding climate-change risks that can affect the sustainability of companies.

3.3.5.1 Access to energy

Access to energy is threatened by the convergence of three risks companies face whereby reliance on fossil fuel is equally threatened by either peak oil risk, geopolitical risk or climate-change environmentalism. Such risk convergence around energy issues illustrates that for companies, it is futile to debate about whether climate change is caused by human activity or not because whichever of the three risks is manifested will require significant adaptation in any case (Kunstler, 2005:147–184). These mutually reinforcing risks have far-reaching effects on global markets, the supply chain, financial markets, agriculture, manufacturing and transportation and, when crystallised, will set in motion unpredictable feedback loops for companies (Kunstler, 2005:61–99).

In 1949, a geologist called Hubbert predicted (and was subsequently proven correct) that at projected consumption and production rates, the United States would peak by 1972, given that oil discoveries had peaked in the 1930s (Kunstler, 2005:22–60). Hubbert's model surmised that peak production comes after approximately thirty years of peak oil discoveries, and his model thus implies that there are less than thirty years of oil production left as at 2012, if it is assumed that the global peak oil point was attained in the first ten years of the twenty-first century (Kunstler, 2005:22–60). Willard (2005:100) agrees that companies that are carbon intensive should be worrying about easily accessible oil running out given that supply is exceeded to fall below demand during the next ten years whilst energy demand will grow by up to 230% by 2050.

The lessons from the United States and the North Sea oilfields illustrate that peak oil is typically detected a few years after it has been reached and it is then followed by

significant declines in production. These lessons are ground for concern given that twenty-seven oil producing nations had already reached their own peaks by 2005 (Kunstler, 2005:22–60). Only 40% of the remaining oil lies outside the Middle East, which creates a further exposure to the geopolitical risk of the Middle East region – a region renowned for regular flashpoints (Kunstler, 2005:61–99).

3.3.5.2 Energy cost increases

Climate change and related energy risks will significantly affect systems that rely on distant supply chains and complexity (Kunstler, 2005:235–299). Energy prices are expected to rise due to increasing extraction costs, extreme weather events that disrupt production, demand and the activities of speculators. There remain grounds to believe that the oil price will sustainably rise above $150 a barrel in future (Phyper & MacLean, 2009:369–391). The dilemma of finite resources will be reflected in increasing prices of resources such as oil and food as has been the case since 2005 (Gilding, 2011:81). The impacts may significantly re-shape the business landscape and imperil the survival of many companies.

Olson (2010:3–22) says, “As long as energy prices remain unpredictable and long-term demand sustains heightened levels, initiatives that reduce energy consumption have stronger value propositions”. Kunstler (2005:100–146) indicates that whilst more climate-friendly energy sources are in the pipeline, such as hydrogen, solar energy and wind, they are still constrained by commercial scalability, reliance on fossil fuel for initial manufacture and the concept of ‘energy returned over energy invested’ (ERoEI), whereby a proportionally high level of energy is consumed to produce energy than what the end product would provide. Nuclear energy is probably the only exception to the ERoEI constraint; however, its use is limited to producing electricity as it cannot practically be used for powering vehicular transportation (Kunstler, 2005:100–146).

Kunstler (2005:1–21) warns that “even mild to moderate deviations in either price or supply will crush our economy”. Once the global oil production peak is reached, the remaining fossil fuel will be more expensive than current prices as it will be increasingly difficult to access, extract and refine – and this will stretch social and market systems to a breaking point (Kunstler, 2005:22–60).

3.4 RISKS RELATED TO THE RESPONSE TO CLIMATE-CHANGE

In the course of adapting to climate-change, companies face risks in respect of strategy, reputation, product offering, supply chain, compliance with new regulation and human resource capabilities. These risks are evaluated in the sub-sections below.

3.4.1 Strategic risks: inappropriate climate response strategies may diminish company sustainability

The combination of regulatory, technological and market uncertainty risks creates a strategic and scenario planning dilemma due to the high number and value of variables that should be considered (Deloitte, 2007:6). There are complexities around modelling low-probability, high-impact risks arising from climate change due to limited historical precedents (Deloitte, 2007:13). This affects infrastructure planning decisions as well as traditional control environment considerations such as segregation of duties, audit trails and data integrity (Deloitte, 2007:13–14).

Market, balance sheet, operating, capital cost and sustainability business risk will increase due to rising expectations from demanding stakeholders (Willard, 2005:124–125). Given the above pressures, there is a risk that incorrect climate-change response strategies are selected. Most companies claim to understand the link between sustainability issues and their corporate goals but less than half have an actual strategy in place (Phyper & MacLean 2009:85–103).

On the other hand, companies may select the right response strategy but this can be crippled by ineffective implementation due to failure to embed greening within existing processes, lack of compliance monitoring frameworks; and lack of ownership and incomplete information (Phyper & MacLean, 2009:85–103). Environmental risks may not be completely documented or could be a ‘side show’ where, for example, an environmental management system sits outside the mainstream enterprise resource planning (ERP) or the governance, risk and compliance (GRC) software (Phyper & MacLean, 2009:85–103).

3.4.2 Reputation risks: social license to operate, intangible values and stakeholder satisfaction

The reputation risks outlined below affect revenue-generation and the values of intangible assets.

3.4.2.1 Loss of social license to operate decreases ability to generate revenue

Erosion of trust and social license to operate could be one of the casualties of poor climate corporate citizenship and, whilst the effects are not easily quantified, can affect business partnerships, risks, interest rates and profitability of a company (Willard, 2005:103). Reputation, brand and credibility are sometimes the only certain differentiators a company has in a crowded market – these differentiators have to be enhanced and protected as a important corporate assets (WRI, 2005:24). Consequently, losing social license to operate due to degrading ecosystems can affect the ability to run a business successfully due to a lack of trust by stakeholder groups (WRI, 2005:24).

A social license to operate risk is an example of a phenomenon referred to as “flow-back non-financial risks” (Hardisty, 2010:73). An example of flow-back non-financial risks refers to a company that single-mindedly pursues an unsustainable but short-term profitable project to the extent that the company loses its social and regulatory license to operate due to the destruction of relationships with the community and regulatory bodies (Hardisty, 2010:81). If that happens, the flow-back non-financial risks can become financial risks as the company’s competitiveness is reduced (Hardisty, 2010:81). Soyka (2012:112) reminds that the concept of ‘social license to operate’ is not just theory but was discovered 15 years ago when some extraction-intensive industries increasingly realised that despite them having been awarded legal extraction or processing licences, they still could not operate because of community and non-governmental organisation resistance. ‘Social license to operate’ is therefore an intangible asset that, if maintained through social legitimacy, credibility and trust, allows a company to generate revenue in situations that would otherwise not be socially acceptable (Soyka, 2012:112–114).

Who accords social license to operate or gives unwritten permission to companies? Civil societies are influential in that it is the eighth largest sector globally and up to

43% of the population are activists to an extent (Willard, 2005:112–113). Unhealthy relationships with civil societies and non-governmental organisations due to environmental practices that are perceived to be poor can result in lost reputation, time and resources. Willard (2005:124) indicates operating risks can arise due to clean-up costs, changes to processes that require further capital and material/energy cost pressures.

There are also internal stakeholders that accord social license to operate. Activist shareholders are an example, as evidenced by annual general meeting resolutions that increasingly affect both sides of the balance sheet through increased remediation liabilities and reduced asset values (Willard, 2005:124).

In addition, there are a number of organisations and groups that are playing a major role in mainstreaming sustainability and creating pressure on companies – effectively creating another social license to operate hurdle. Kiernan (2009:155–175) highlights the following most influential organisations globally, namely

- the United Nations Environment Program's Finance Initiative (UNEP-FI), which represents financial institutions and raises awareness within the financial sector regarding sustainable investment;
- the Coalition for Environmentally Responsible Economies (CERES), which functions as a collective think-tank and advocate on sustainability;
- the Carbon Disclosure Project (CDP), which has elevated investor awareness of climate change by collating and reporting listed company performance on climate-change risks, opportunities, strategy, emission management, climate-change governance and greenhouse gas emissions accounting; and
- The UN Principles for Responsible Investment, which create accountability of signatories to stakeholders.

Pressures to be sustainable that create a reputation risk are not just unique to developed countries, and one may wish to consider developing countries such as South Africa. Baskin (2006:73–79) argues that there are various 'push' factors that

have significantly elevated sustainability in South Africa to developed market levels, and these include:

- corporate responsibility take-up is high in South Africa and as far back as 2004, already 65% of Johannesburg Securities Exchange-listed companies were reporting on sustainability;
- an active and informed civil society in South Africa, augmented by a democratic political system and a culture of audit and compliance;
- very high levels of social inequality as measured by the Gini index together with a perception of government under delivery of social services, thus creating social expectations on business; and
- benchmarks as set by major listed companies that have aspirations to operate globally (Baskin, 2006:71–79).

3.4.2.2 Impairment in the value of intangibles

As market capitalisation of companies is typically in excess of the net asset value of a company, companies that fail to keep their reputations intact also fail to maximise shareholder value as a decrease in reputation is directly correlated to a decrease in market value (Willard, 2005:58). Reputation reflects the value of intangibles and can constitute up to 40% of a company's market capitalisation. Minimising environmental risks contributes to enhancing reputation (Willard, 2005:59–63). Conversely, companies that are seen as perpetuating climate change suffer reputational damage, which can affect their revenue and stakeholder relations (Willard, 2005:95). KPMG (2008:32) broadly agrees and cites examples to illustrate that intangibles can form up to 70% of the value of a FTSE 100-listed company, up from 40% two decades previously. The brand of a listed company is likely the most significant asset and is therefore at impairment risk where companies are seen to address climate-change risks inadequately (KPMG, 2008:32).

3.4.2.3 Stakeholder dissatisfaction from lack of sustainability

Studies of stakeholder demands and reactions in relation to environmental performance information have demonstrated that stakeholders do want

environmental performance information in annual reports (Deegan & Unerman, 2011:408). Furthermore, share prices react, at statistically significant levels, to positive and negative disclosures of environmental information in company disclosures (Deegan & Unerman, 2011:409–410). Assuming that markets are efficient at pricing such disclosures, this suggests that investors believe that environmental matters are likely to affect the variability of future cash flows (Deegan & Unerman, 2011:446–454).

Deegan and Unerman (2011:398) also indicate that voluntary disclosure of environmental and other sustainability information is primarily motivated by the need to maximise profits given that reputation has an economic and income-generating value. Notwithstanding this, there are examples of companies that increase their reputation risks amongst their stakeholders, as indicated below:

- failure to engage with employees on sustainability matters (Soyka, 2012:115);
- ignoring the increasingly vocal environmental, social and governance (ES&G) expectations of customers (Soyka, 2012:115);
- paying insufficient attention to the capabilities of suppliers to meet upstream ES&G requirements (Soyka, 2012:116);
- not creating a symbiotic relationship with host communities and elected officials on environmental issues (Soyka, 2012:117);
- insufficient interaction with regulators to address their concerns (Soyka, 2012:118);
- persisting in a cycle of crisis, conflict or controversy; therefore, attracting media attention (Soyka, 2012:119);
- not recognising the perspectives of non-governmental organisations (NGOs) who feel that, as they represent ‘civil society’, their views are ‘legitimate and significant’ (Soyka, 2012:121–124); and
- inadequate responses to increasing investor and analyst interest in environmental, social and governance (ES&G) performance (Soyka, 2012:124).

3.4.3 Product risks: obsolescence and adaptation risks

The failure by companies to adapt their product profiles can lead to risks of obsolescence and reduced revenue due to inappropriate offerings.

3.4.3.1 Product obsolescence risks

Product obsolescence is a risk as the pace of changes in technology has accelerated and this affects the way companies produce, the information available for customers, differentiation from competitors and customer expectations of innovation (Werbach, 2009:53). There is a sense that companies are at a technological crossroads given the potential move from current fossil fuel energy sources and this creates uncertainty about which technologies to invest in as well as the impact on the value of current technologies into which companies have already sunk capital (Deloitte, 2007:5).

Signals that products face obsolescence risks, according to Esty and Simmons (2011:81–190), include:

- volume of energy used and resultant carbon emissions;
- polluting inputs used, polluting air emissions and environmental penalties;
- materials used (split between virgin and recycled material);
- waste generated from processes;
- freshwater used and discharged; and
- level of land used and restored.

3.4.3.2 Product adaptation risks

Whilst companies are always on an innovation curve that may accelerate with the adaptation to climate changes, companies face risks in deploying new technologies, such as:

- the initial high marginal costs during the learning curve;
- ‘free-riders’ who leave an innovator to prove commercial feasibility of a new market and then enter markets subsequently without incurring the development/exploratory costs;
- dependency and lock-in to established technologies;
- selling products initially at a loss, compounded by carrying unproven research costs and uncertainty over product take-up;
- knowledge spill-overs where, despite patent protection, certain technological information is lost in the public domain that other companies can take advantage of without development costs; and
- uncertainty over the extent to which government policies will bring in carbon price signals to influence product take-up (Stern, 2006:350–353).

Energy innovations face further specific risks such as:

- end products are homogeneous, such as electricity where carbon-free electricity is no different from fossil fuel electricity in the consumer’s experience (Stern, 2006:354);
- lack of awareness by companies about the full lifetime costs and benefits of conserving energy;
- lack of capital to fund the high upfront costs of energy innovation; and
- complex and uncertain decision-making over what energy will cost in future, in the light of climate change (Stern, 2006:380).

In looking at adaptation risks and product innovations that are designed to specifically address climate change, it is useful for this study to consider the clean-tech sector. Whilst there are opportunities, companies that decide to invest in clean-tech may face the following risks:

- Funding may be difficult to access. Due to the financial crisis, funding has been diverted to more mature and less risky ventures that do not start out with a negative cash flow (Jolly, 2010:32).

- Companies tend to be risk averse and prefer to invest in products that are proven (Jolly, 2010:32).

- Certain markets can have lengthy lead times to generate sales, such as those that require government approvals. Government subsidies may also change and this can undermine the business case for a clean-tech investment (Jolly, 2010:33).

- Skills may not exist in the required form and may need to be retrained or applied to new situations (Salomone, 2010:58).

- Sensitivity to taxation, which should be considered as clean-tech, requires investment in research and development and new equipment (Salomone, 2010:59).

- Intellectual property (IP) created with clean-tech may be inadequately protected and businesses may not be cognisant of their IP rights. There is a risk that competitors go on the offensive with their IP rights, forcing a company to defend itself by cross-licences (Sutcliffe, 2010:74–75).

- Even with the right technology, companies could follow inappropriate business models. Opportunities overlooked could include product design for other companies, own manufacture, distribution, licensing out, servicing of products, leases and other revenue streams (Wheatland, 2010:209–210).

- Markets are dominated by existing players who use older technologies. New technologies therefore have the hurdle of achieving “transformational and disruptive success” (Wheatland, 2010:210).

- Inadequate understanding of markets can lead to businesses misjudging the size of markets, customer appetite and competitor agility (White, 2010:215).

3.4.4 Supply chain risks: price volatility, threats to supply and failure to achieve company objectives

Soyka (2012:101–102) suggests that future resource constraints arising from climate change may be beyond the scope of the redundancies companies have built into their logistical operations to minimise disruptions. The sources of input price volatility are increasing and, where this is beyond company hedging capabilities, it leaves companies with the dilemma of accepting lower margins or reducing production and consequently sales (Soyka, 2012:102).

The supply chain is increasingly seen as a 'chain of uncertainty' as it carries risks in terms of its climate-change objectives (Phyper and MacLean, 2009:189-212) – this is summarised in Table 3.2 below:

Table 3.2: Impact of climate-change risks on supply chain

Company objective	Drivers of risk
Reduce costs	• Volatile costs of energy, fuel and similar resources • Additional costs of monitoring equipment, permits and fees relating to air emissions • Penalties, product obsolescence and loss of revenue due to non-compliance
Fulfil sustainability commitments	• Relationships with stakeholders such as government and local communities may be impacted by the commitment to the environment • Supply chain environmental footprint may be below stakeholder expectations
Practice green procurement	• Failure to demonstrate compliance with legislation • Challenges in demonstrating management of energy and raw material usage by suppliers and not passing down of cost savings down the value chain to the customer
Meet 'eco-design' criteria for products and meet product performance standards	• Not meeting customer and legal expectations for green products • Non-achievement of 'lean' principles

Source: Adapted from Phyper and MacLean (2009:189–212)

3.4.5 Compliance risks: new and existing compliance requirements

In the realm of climate-change, lack of compliance is an area that can lead to penalties and threats to business sustainability. This sub-section delves into the compliance risks that can arise.

3.4.5.1 New compliance uncertainties arising from changing regulation and policy

KPMG (2008:30) feels that climate change is seen as a serious market failure, which requires governmental correction through traditional legislation (permits and energy-efficiency requirements) and market-based regulation (carbon taxes, cap-and-trade schemes and fuel taxes). KPMG (2008:30) anticipates regulation at an international level (United Nations Framework Convention on Climate Change), at regional levels (e.g. EU Emission Trading Scheme), at country levels and at city levels. Companies face uncertainty about their ability to comply, procedures and internal controls required, tax and accounting effects as well as dealing with differing treatments across different countries (Deloitte, 2007:5).

According to Speth (2008:84), current regulations over environmental matters barely cover half the problem. For example, Speth (2008:84) illustrates that a regulation that covers 80% of a problem, is adopted by 80% of companies and 80% of those companies succeed in implementation - achieves a net result of 51.2% effectiveness. Therefore, a significant increase in environmental regulation and enforcement seems very likely as climate-change effects become more visible. Unfortunately, governments tend to intervene incorrectly and create “perverse subsidies that further distort prices that are already misleading” (Speth, 2008:91). Unintended consequences from incorrect regulation can lead to overconsumption of polluting resources and underutilisation of more environmentally friendly resources (Speth, 2008:91). This pattern of unintended consequences will produce a future for companies where regulations will go through several iterations before they achieve the intended purpose.

In addition to regulation, companies may also be pressured by voluntary accords due to risks of sanctions by industry associations, the need to satisfy stakeholders, customer requirements, avoidance of increased borrowing rates and preventing

increased insurance premiums (Willard, 2005:74–75). The CPSL (2009:33) has outlined that governments are likely to use their influence using policy mechanisms such as their purchasing power, setting minimum standards, subsidy reform, support for discovery of greener technologies, technology transfer, editing of consumer choices and mandatory carbon disclosures. Ecosystem goals are also expected to become an integral part of development planning and bank financing (WRI, 2005:22–23). Companies may be subject to compliance that may also be imposed non-legally using tools such as industry codes of conduct, voluntary standards (such as ISO – the International Organisation for Standardisation), and supply chain obligations to address environmental, social and health footprints (Soyka, 2012:81–85). Stock exchange listing requirements are also relevant for compliance. Both the Australian Stock Exchange and the Johannesburg Stock Exchange require integrated reporting of environmental, social and governance issues on a 'comply or explain' basis (Soyka, 2012:259–261).

Companies that are driven by regulations in a reactive manner will end up misdirecting their efforts and waste money on lawyers and lobbying instead of spending it on design and marketing (Friend, 2009:31–34). Friend (2009:31–34) feels that green regulations are inevitable but can become a major risk area if companies:

- fail to assess emerging regulations through looking at trends in other parts of the world;
- do not engage stakeholders such as government, regulators and consumers when planning product redesigns;
- lack scenario planning techniques to map and project future regulatory systems so as to test the potential effect on business strategies and products; and
- wait for regulations to confirm known problems and therefore lose competitive advantage.

3.4.5.2 Existing regulatory risks in developing countries such as South Africa

In South Africa, offenders that commit environmental offences can already face administrative and criminal measures under the National Environment Management

Act 107 of 1998 (NEMA) as well as related Acts which include the National Environment Management: Biodiversity Act 10 of 2004, the Air Quality Act 39 of 2004 and the Protected Areas Act 57 of 2003 (Craigie, Snijman & Fourie, 2009:53–54). Although penalties are currently not significant in view of the benefits that can be derived from damaging the environment, future amendments to NEMA will increase the sanctions by imposing penalties for rehabilitation costs, third-party civil damage compensation, financial gains that offenders derived from environmental offences and prosecution costs (Craigie *et al.,* 2009:53–54).

Besides NEMA, there are other ways of influencing environmental compliance as summarised below:

- **Voluntary compliance**. Voluntary compliance measures include public voluntary programmes, negotiated agreements with public authorities, unilateral commitments and private agreements with civil society (Lehmann, 2009:274).

- **Self-regulation**. Such approaches are developed unilaterally by industry and include examples such as industry codes of practice, certification and labelling schemes. Self-regulation is starting to gain traction in some South African industries (Lehmann, 2009:275–276). The environmental standard ISO 14001 is an example of self-regulation where companies are certified through the South African Bureau of Standards (SABS).

- **Firm-specific self-regulation**. Companies may adopt environmental management systems (EMSs) to reduce carbon emissions, waste and pollution as a result of stakeholder pressures. In South Africa, EMSs are more prominent in companies whose energy intensiveness is in the public eye (Lehmann, 2009:276–277).

  Market-based incentives are used to influence market forces and can be categorised into positive market-based instruments and negative market-based instruments (Paterson, 2009:300).

- Positive market-based instruments comprise of:

- Tax benefits that can be used to encourage pollution reduction and energy/resource-efficient technology through accelerated depreciation allowances, income tax exemptions for environmental activities, property tax reductions for sustainable land use and waiver of capital gains tax and transfer duties (Paterson, 2009:300).

- Deposit refund schemes which encourage the recycling of products such as plastic, glass and paper through payment of a deposit at collection points (Paterson, 2009:301).

- Direct subsidies that are granted for environmentally/socially friendly activities that are otherwise not economic. These could include activities such as renewable energy, pollution abatement and waste minimisation (Paterson, 2009:301). South Africa has a renewable energy subsidy scheme that is administered by the Department of Minerals and Energy (Paterson, 2009:317).

- Negative market-based instruments impose costs and comprise of:

  - Emission, effluent and disposal charges based on the 'polluter-pays' principle (Paterson, 2009:302).

  - User charges imposed by municipalities that levy a charge for environmental externalities to influence more reasonable consumption (Paterson, 2009:302).

  - Licence fees for activities that damage the environment (air pollution licences for example), extract material from the environment or create negative impacts (such as transportation that pollutes) (Paterson, 2009:302–303). The Air Quality Act 39 of 2004 allows for fees to be levied in future for atmospheric emission licences (Paterson, 2009:321).

  - Product taxes that are levied at the point of sale for products with an external environment cost such as packaging, fuel and motor vehicles. This can serve to reduce consumer demand (Paterson, 2009:303). South Africa charges fuel levies and has introduced taxes on vehicles that contribute to air pollution (Paterson, 2009:322–323)

- Performance bonds enforce compliance with prescribed conditions that are linked to environmental objectives (Paterson, 2009:303). In South Africa, performance bonds have been introduced for various environmental permits (Paterson, 2009:325).

Regulatory incentives offer a reduction of regulatory, administrative, reporting and other obligations in return for proven environmental performance (Paterson, 2009:304–305). Information-based incentives influence consumer and producer behaviour through mandating the publication of environmental performance, also known as eco-labelling (Paterson, 2009:305).

South Africa also has other policies that potentially offer incentives, rewards and penalties to companies for environmental management (Paterson, 2009:308–312). Those relevant to mitigating or adapting to climate change include the:

- White Paper on Environmental Management Policy for South Africa (1998);
- People-Planet-Prosperity: A strategic framework for sustainable development in South Africa (2006);
- National Climate-change Response Strategy (2004);
- White Paper for Sustainable Coastal Development in South Africa (1996);
- National Water Resource Strategy (2004);
- National Waste Management Strategy (1999);
- White Paper on Energy Policy (1998);
- White Paper on the Renewable Energy Policy for the Republic of South Africa (2004);
- Energy Efficiency Strategy of South Africa (2005); and
- A Framework for Considering Market-Based Instruments to Support Environmental Fiscal Reform in South Africa (2006)

3.4.6 Human capital risks: capabilities and adaptability of human resources influence company resilience

The rapid pace of changes associated with the sustainability imperative may exceed the company's human capital resilience and this may reflect in failed execution of good sustainability calls, lag in staff capabilities, mismatch in values and culture, staff disenchantment and inappropriate talent management (Soyka, 2011:96–98).

As technical skill requirements evolve, companies will face challenges around:

- recruitment and retention of workers who understand new requirements;
- education and training of employees who are entrenched in outdated equipment, products, tax and accounting principles; and
- health and safety issues due to new and more frequent threats to employees (Deloitte, 2007:7).

Corporate social responsibility that does not engage human resources through employee engagement is nothing more than a public relations exercise (Business & the Environment Programme, University of Cambridge and World Business Council for Sustainable Development, 2009:3). The human resource risks include the following:

- there is empirical evidence that potential employees would not apply for a job at a company that is perceived to be socially irresponsible;
- if companies do not attract people who can create competitive advantage, learn from stakeholders and create effective partnerships, they will be constrained in responding to sustainable development imperatives;
- failure to align employee incentives to sustainability objectives; and
- failure to nurture sustainability core competencies that require a mindset that considers the external context, creates a responsive internal focus, understands the stakeholder approach, fosters dialogue and partnerships, triggers learning and influences action (Business & the Environment Programme *et al.*, 2009:3–20).

3.5 FINANCIAL AND ACCOUNTING RISKS

This section covers the climate-change risks that have a direct impact on access to finance, financial performance and the usefulness of financial information.

3.5.1 Capital risks: access to capital and suboptimal use of capital

Climate-change affects access to capital and the deployment of capital, as illustrated below.

3.5.1.1 Reduced access to debt and equity capital

Companies may increasingly find access to capital from banks constrained if they are not perceived as sustainable. As future cash flows become more uncertain, capital allocation is increasingly attracted to businesses whose future risks and potential liabilities are well understood from an environmental and social perspective (WRI, 2005:25). Companies that are exposed to future decrements to enterprise value due to ecosystem risks, and whose cash flow models are contingent on implementing future technological and management capacity to manage such risks, will be forced to pay relatively higher rates to attract capital (WRI, 2005:25).

The financial sector is increasingly considering investments that are more sustainable in the long term and which have a focus on social and environmental outcomes. This is more so crucial given that 50% to 90% of a company's true market value is in intangible assets that are more susceptible to sustainability risks and opportunities (Willard, 2005:114–117).

Banks increasingly believe that managing social and environmental risks in their lending will strengthen and protect their portfolios through decreased nonperforming loans (IFC, 2007:8). Banks perceive that borrowing companies who do not address social and environmental risks pose the following risks that could taint them by association:

- direct liability for social and environmental damage;
- increased credit risk;
- devaluation of collateral assets;

- reputational effect of negative publicity;
- disruption of operations;
- environmental legal issues; and
- inability to adapt to changing markets for goods and services (IFC, 2007:40–43).

Access to affordable finance by companies is a risk as lenders are increasingly considering social and environmental risks when they consider project financing, using frameworks such as the United Nations Principles for Responsible Investment, Socially Responsible Investing and the Equator Principles (Wilhelm, 2009:105–124). Banks have adopted a number of voluntary sustainability frameworks (IFC, 2007:28).

Another reason for funders increasingly considering sustainability principles is the concept of fiduciary duty, which was not fully appreciated previously. This was perhaps due to a misinterpretation of fiduciary duty, which refers to managing assets with the utmost care, prudently, avoiding excessive risk, avoiding excessive costs and to the best degree of effort (Soyka, 2012:210). Fiduciary duty was assumed to exclude overt environmental and social considerations as it was felt that these actually reduce value by creating additional costs (Soyka, 2012:210). However a 2009 study of investment law in advanced capital markets that was conducted by the United Nations Environment Programme Finance Initiative (UNEP FI), revealed that environmental, social and governance issues are not merely acceptable considerations for fiduciaries, but they "must be considered when and where they are relevant to *any* aspect of investment strategy" (Soyka, 2012:212). Such environmental, social and governance (ES&G) issues were found to be essential when evaluating risks and opportunities as they can be material and pose long-term systemic risk (Soyka, 2012:213).

Glautier *et al.* (2011:408–409) indicate that a company's total risk is the sum of its business risk and financial risk. In other words, the greater the business risk a company faces through variability of business activities and profits, the lower the financial risk that company can carry in the form of borrowing (Glautier *et al.,* 2011:409). Applying this concept to climate change suggests that a company with unmitigated climate risks cannot sustain as much long-term debt as it otherwise would in normal circumstances. Such a constraint could create solvency and long-

term financial sustainability issues when a company has reduced ability to meet current liabilities as they fall due (Glautier *et al.,* 2011:408).

3.5.1.2 Sub-optimal use of capital due to mal-adaptation to climate change

Where capital has been allocated towards adaptation to climate change, this may also carry material financial risks.

Table 3.3 as created by Stern (2006:409) illustrates this conundrum:

Table 3.3: Finding a balance between risks and costs spent on climate change

Cost of planning for climate change	**Risks of climate change**	
	Low	**High**
Low	Adaptation action or inaction has a low risk either way	Clear case for adaptation: plan for climate change
High	Adaptation costs not congruent to the risks faced. Companies may accept the risk of inaction but still face the uncertainty	High risk for planning purposes and significant business value at stake

Source: Adapted from Stern (2006:409)

Adaptation financial risks are exacerbated by:

- information on climate-change projections and effects that may not be of sufficient quality for to do cost-benefit analysis;
- adaptation benefits may accrue to greater society and therefore a company may not have exclusive control and benefit over its financial investment;
- inability to capitalise financial outlays for balance sheet purposes as adaptation costs are intended to protect an asset rather than extend its utility and useful life; and

- residual scientific uncertainty over the future impacts of climate change and consequently whether adaptation has been appropriate for the future unknown events (Stern, 2006:411–413).

3.5.2 Financial information risks: completeness and certainty of information used for decision-making

Decision-making is premised on the availability of reliable and complete information – an assumption that climate-change can diminish as indicated below.

3.5.2.1 Reliance on incomplete information due to ignoring sustainability matters

The practice of accounting cannot be separated from accountability and responsibility over environmental performance (Deegan & Unerman, 2011:401). Hitchcock and Willard (2009:245–264) warn that companies that have not embraced sustainability and rely on a traditional understanding of accounting are at risk of distorting their true performance and thus management decisions:

- Traditional accounting and economics typically value natural assets and systems at a nil value and therefore the fact that resources are being depleted, on which the same company will rely in future, is not considered.

- Sustainability involves the concept of risk avoidance (such as environmental liabilities and insurance risk) and traditional financial decision tools only account for direct financial effects.

- Traditional accounting ignores the benefits, as expressed in intangible assets that sustainability creates.

- Discount rates that are used for financial analyses create a skewed result or asymmetry that is biased towards present generations and places less value on the value of natural assets to future generations.

- Companies typically have internal conflicts or distortions where there are different persons accountable for capital budgets and operational budgets. This creates a disincentive whereby capital budgeting avoids additional capital outlay that would

actually result in lower operational budgets after asset commissioning (Hitchcock & Willard, 2009:245–264).

Currently, the only environmental financial information that is compulsorily disclosed is the environmental liabilities that meet recognition criteria per accounting standards and any direct environmental costs incurred (Soyka, 2012:203). This reduced focus therefore creates a risk that environmental issues may be overlooked by investors and the directors responsible for investee companies.

Bartelmus (2003:50) agrees and says that financial information distortions arise as environmental expenditures and liabilities are not commonly accounted for. Full cost pricing would demonstrate hidden externalities (Bartelmus, 2003:91). Full costs cannot be ignored forever as regulatory instruments such as pollutant taxes will increasingly force environmental costs to be internalised (Bartelmus, 2003:102).

3.5.2.2 Uncertainties over costs of adapting to climate change

Conversely, when companies have decided to invest in sustainability projects, a common challenge they face is that information on environmental and social risks tends to be underdeveloped and is not monetised (Epstein, 2008:103–123). This creates a risk that investment criteria such as payback periods and net present value of discounted cash flows may not be achieved by sustainability projects. What contributes to this risk? Firstly, when sustainability investment projects are regulatory in origin, companies tend not to analyse the full spectrum of economic, social and environmental costs and benefits – often the objective is just to meet the minimum emission level at the least cost (Epstein, 2008:103–123). Secondly, the nature and timing of environmental and social costs and benefits are difficult to monetise as they are subject to future climate-change awareness and stakeholder pressures, future technologies and future government regulations (Epstein, 2008:103–123). There are three different types of costs that decision-makers may not be tracking correctly:

- current and future costs related to past operations – pollution claims, product liability and newly discovered environmental impacts can often be overlooked, and even once they are identified, they can distort current financial performance;

- current costs related to current operations – current costs can easily be concealed within overhead costs and may be allocated using inappropriate cost drivers or in some cases may not be allocated to any activities, processes or products; and

- future costs related to current operations – future environmental liabilities are difficult to predict and estimate, especially those that will be affected by changing social, legal and technological structures, and to some degree, decommissioning, restoration and product liability costs (Epstein, 2008:103–123).

3.5.3 Asset and liability risks: unfavourable changes to values

Climate-change may lead to the risk of reduced asset values and increased values of liabilities, as is outlined below.

3.5.3.1 Impairment of asset values

Whilst a sudden shift to climate-related strategies will create innovation, sunk capital in carbon intensive assets and assets in obsolete business models will result in significant financial losses and insolvencies (Gilding, 2011:95).

Bartelmus (2003:49) indicates that damage to the environment can affect asset valuations as a result of reduced productivity. This stems from impacts to the resource base of production, the negative effect of employee health arising from environmental issues, and unfavourable price movements of products (Bartelmus, 2003:49). Bartelmus (2003:49) further indicates that environmental impacts can be priced into affected goods and services, such as property, travel and labour, leading to price differentials in comparison to goods and services that are not affected. This can also have an effect on asset valuations (Bartelmus, 2003:49). These risks will consequently impact on profitability.

Soyka (2012:104–105) expands on fixed asset impairment by emphasising that impairment is a material risk for businesses with significant invested capital and where usability of assets is affected by new regulations and direct environmental impacts. Vulnerable industries are those whose fixed assets have very long lives and payback periods, are expensive to redesign and commission, and cannot be practically moved (Soyka, 2012:104–105). Companies operate with inherent capital constraints and thus rely on investment appraisal techniques such as payback,

internal rate of return and net present value to guide their asset investment priorities prior to commissioning assets (Ogilvie, 2009:322). Such investment appraisals make certain assumptions about optimum asset replacement cycles – assumptions that disruptive climate change may distort, creating a series of events that leads to asset impairment.

3.5.3.2 Increases in liabilities

Actual or contingent losses also arise where compensation has to be made for environmental damage where there is willingness or obligation to pay (Bartelmus, 2003:49). The range of costs companies can incur is wide and includes fines, clean-up costs, lawsuits, asset value reduction, product recalls, weather impacts and comparatively higher energy, production and supply chain costs (Phyper and MacLean, 2009:31–73). Ogilvie (2009:52) warns that contingent liabilities that arise from environmental issues such as pollution emissions are not adequately addressed, poorly disclosed, may be incomplete and are unreliably quantified. Activist shareholders will increasingly force companies to accept balance-sheet risks such as impairment of asset values, liabilities from environmental action (toxic torts) and remediation liabilities (Willard, 2005:90).

Kiernan (2009:123–154) paints a similar picture and outlines the following environmental and social risks that have a liability impact on companies:

- operational risks such as product liabilities, delayed permits, the consequences of cancelled or delayed projects and the consumption of management resources;
- litigation, contingent liabilities and decommissioning liabilities that can negatively affect balance sheets and market value; and
- increases in provisions for capital costs due to expenditure on redesigning products, retrofitting assets and incorporating pollution control as a result of environmental regulation.

3.5.4 Income statement risks: direct costs arising from climate-change

In addition to affecting financial position, climate-change can lead to a range of additional costs that reduce financial performance.

3.5.4.1 Escalations in insurance costs

The cost of insurance premiums is expected to increase as insurers increasingly consider climate mitigation plans and climate-change exposures when they renew policies (Wilhelm, 2009:125–132). Climate change will force insurance companies to hold more capital to cover extreme losses – for example, an increase in storm intensity by 6% as well as increases of 1 in 100 year events would require over 90% increases in insurer capital requirements (Stern, 2006:135–136). This would have spill-over risks to other sectors such as higher reinsurance prices and reduced financing from banks, and would eventually result in insurers transferring risk back to business (Stern, 2006:135–136).

As underwriters of risk, insurers are a useful barometer of climate-change risk. From 2005 to 2008, the number of insurers offering climate-friendly products and services grew from virtually nil to 250 globally, including South African insurers (Mills, 2009:3,81). Climate change is seen by insurers as their top risk, which also has the effect of compounding other risks (Mills, 2009:8–9). Insurers are accordingly creating new insurance terms and policy exclusions that are intended to encourage companies to reduce carbon emissions as well as to prepare better for the adverse impacts of climate change (Mills, 2009:24).

3.5.4.2 Conversion of the cost of carbon to an income statement cost

Greenhouse gas emissions have a social cost. This cost will eventually become a true financial cost once companies have to undertake mitigation and adaptation initiatives (Hardisty, 2010:101). Once society is no longer willing to bear the social consequences or cost of carbon, it will make companies bear the cost. It is therefore prudent for emitters to consider signs of future financial costs for carbon (Hardisty, 2010:101).

There are various examples and indicators of the cost of carbon (Hardisty, 2010:84–86), for instance:

- Canadian tax of CDN$12/tCO2e (dollars per tonne of carbon emitted);
- average price till 2009 of the EU Emissions Trading Scheme of about US$20 to US$25/tCO2e; and

- UK government shadow price for carbon of US$50/tCO2e (as at 2007 with a 2% annual escalation).

By comparison, National Treasury (2010:9) proposed in a discussion paper that a carbon tax be introduced in South Africa that will initially value carbon at R75 per tonne of carbon emitted, increasing to R200 per tonne over a set time. If introduced, the value of this tax will eventually approximate the "external damage costs of carbon" (National Treasury, 2010:10).

Hardisty (2010:182–183) therefore indicates that, whilst the costs of externalities vary and are uncertain, they will increasingly become important considerations for sustainable decision-making. The marginal abatement cost of carbon is the cost of reducing emissions and this will gradually increase towards the social cost that incorporates the full social or damage value of emissions (Hardisty, 2010:182–183).

How will externalities such as carbon costs become real costs for businesses? A typical government policy response to an externality such as climate change would be to calculate a carbon price to reflect the damage and then to introduce taxes for emitters to absorb the external social cost of their emissions, restricting quantities of emissions, cap-and-trade schemes and assigning property rights (to e.g. emission limits) that can be traded or bargained (Stern, 2006:310–311). Businesses with assets that have very long lives, such as plant and buildings, may face exposures as investment decisions may not anticipate the implications of absorbing future carbon prices (Stern, 2006:325).

According to Phyper and MacLean (2009:301–333), cap-and-trade schemes affect businesses by putting a cap on the level of greenhouse gases and creating a new input cost (or trading opportunity). Furthermore, there is an increasing move to increase duties on carbon-intensive imports by certain jurisdictions (Phyper & MacLean, 2009:301–333). Such moves make climate change an income statement problem rather than just an environmental issue.

The financial implications of cap-and-trade include the cost of reducing emissions and of buying allowances as well as income from selling allowances and tapping into any regulatory incentives that may be in place (Wilhelm, 2009:75–90). Logically,

companies that are under-prepared will inevitably be at a financial disadvantage when cap-and-trade mechanisms are introduced.

The risk of valuation and modelling errors increases as issues relating to climate change, such as emission allowances in cap-and-trade schemes, may not be accurately associated with underlying assets and instruments (Deloitte, 2007:7). This can be exacerbated by volume risk where there are uncertainties in the volume of input/energy that revenue-generating assets will demand, as a result of variables such as heat and changes in use patterns (Deloitte, 2007:7). Companies that use new instruments, such as carbon markets in cap-and-trade schemes and in the clean development mechanism, are also exposed to market risk due to adverse changes in market prices and the uncertainty inherent to immature carbon markets (Deloitte, 2007:5–6).

3.5.4.3 Adaptation costs

There are potentially hidden overhead costs in adapting to climate change such as –

- upfront costs incurred before installing new technology or practices such as process redesign and obtaining bids for equipment;
- costs incurred in the course of compliance such as dealing with regulators, inspections, labelling, research and public disclosure;
- back-end costs that are due at the end of equipment productive lives such as shutdown and scrapping;
- contingent costs/liabilities where adaptation activities are uncertain regarding their extent and cost or where unforeseen incidents arise; and
- image and relationship costs incurred in improving the sustainability profile of the company (Soyka, 2012:90–93).

Ogilvie (2009:51) has a similar view and projects that companies will increasingly have to incur costs and account for environmental issues such as environmental taxes, environmental factors that affect investment appraisal, costs of pollution

controls, changes in product material content, and the financial impact of greener consumer preferences.

3.6 SUMMARY AND CONCLUSION

Chapter 3 established that there are 15 categories of risk, as a result of climate change, that can impair the performance and sustainability of companies. The risks that companies are exposed to are determined by market trends, relative sensitivity to threats that can erode long-term value and industry-specific challenges. The risks identified were split into three groupings, namely external risks, risks related to the response to climate change, and financial risks. The risks discussed in Chapter 3 are significant in that they can materially affect the assets, liabilities, revenue and cost structures of companies.

The primary risk category consists of physical risks arising from climate change as they set in motion a series of events that can impair the asset bases of companies, reduce production levels, create volatile socio-economic conditions and reduce access to resources required for operation. Such physical risks trigger responses by stakeholders that manifest, firstly, as market risks when consumers assign blame to companies. Secondly, political risks arise once regulators feel obliged to take action against companies that contribute to climate change or are vulnerable to its effects. The wave of such market and political stakeholder dissatisfaction exposes companies to reputation risks where they can lose their social license to operate and suffer impairment of intangible assets that are vulnerable to market sentiment. Reputation loss and doubts whether companies' carbon-dependent business models are still appropriate create a financing risk as equity or debt capital is rerouted to more responsive companies.

A secondary effect of concern over climate change is the increasing push for companies to switch to climate-friendly sources of energy. This can fundamentally threaten a company whose business model is dependent on carbon energy. Energy risk is compounded by the fact that non-renewable energies, such as oil, are predicted to reach their availability peak within a short time frame.

Companies face a number of conflicting options when they decide whether or not to respond to climate-change risks. This creates a risk that companies may adopt an inappropriate strategy. A risk that is related to this decision-making process is the quality of information available for decision-making. Whereas financial information is generally of good quality due to numerous built-in controls over capture and compilation, the information available for making decisions on material environmental and social matters can be subjective and qualitative as sustainability reporting is still in its infancy. Inappropriate strategies can also lead to compliance risks if companies are not sufficiently prepared for the new regulations and policies that are expected to drive the response to climate change.

The value chain of companies revolves around production of goods and services as well as the supply chain. In this value chain, companies face climate-change risks of products and production methods becoming obsolete, product mal-adaptation, volatility of raw material prices, and threats to supply. Companies are also reliant on the quality and availability of human capital to operate effectively. Human capital risks arise due to climate change as personnel may no longer meet the new capabilities required to operate in an environment where business models have adapted and employees have to respond to new risks.

Lastly, Chapter 3 reflected on the direct impacts of climate change to financial statements. Climate-change risks can lead to impairment of asset values and increases in liabilities. In addition, there is a risk of direct costs that are expected to arise from climate change. Such costs include escalating insurance costs due to physical risks, carbon costs that will be created through new regulations, and adaptation costs incurred in responding to climate change.

The next chapter will proceed to explore opportunities arising from climate change, which are the flip-side to climate-change risks.

CHAPTER 4

OPPORTUNITIES TO ENHANCE RETURNS AND SUSTAINABILITY AS A RESULT OF ADAPTING TO CLIMATE CHANGE

4.1 INTRODUCTION

Chapter 3 analysed the sustainability risks related to climate change. The converse of risk is opportunity. In enhancing returns and creating sustainable enterprises, companies should identify the specific opportunities that are relevant to their particular strategies and circumstances. Consequently, Chapter 4 establishes and evaluates the specific opportunities that arise to companies as a result of adapting to climate change.

Chapter 4 broadly surmises how sustainable companies can create incremental returns through identifying and pursuing opportunities. Companies that aspire for sustainability can develop strategies for climate-change opportunities that will entail considering future expansion and product developments, analysing what industry peers are doing, forecasting future environmental and market behaviours and deciding on adaptation responses (Stoffberg & Prinsloo, 2009:98). This may precipitate competitive advantages arising from climate change.

The chapter proceeds to establish the categories of opportunities that require further study. Each opportunity category is subsequently analysed in the remainder of the chapter.

4.2 OPPORTUNITY CATEGORIES

Financial return is a logical consequence of opportunities pursued by companies. In order to evaluate the opportunities arising from or associated with climate change, the next section seeks to establish the relevant opportunity categories, so as to facilitate further analysis.

Phyper and MacLean (2009:10–27) outline a money trail that is driving returns from green opportunities. Opportunities that can create financial returns range from solutions that can make marginal changes to climate change to the ones that can change the market fundamentally (Jolly, 2010:6). Table 4.1 below outlines various categories of opportunities arising from climate change.

Table 4.1: Survey of climate-change opportunities

Principle	**Opportunity categories**
Green business is good business (Friend, 2009:6–7)	• Improved operating margins through waste elimination • Increased revenue through satisfying customer expectations • Reduced risk to workers, customers and communities • Pursuit of innovation • Shielding companies from regulator interest • Market access and social license to operate • Employee attraction and retention
Benefits from implementing sustainability (Hopwood *et al.,* 2010:11–15)	• Winning and retaining customers • Competitive advantage, innovation and new products • Attracting, motivating and retaining staff • Managing risk • Driving operational efficiencies and cost reduction • Maintaining licence to operate • Accessing capital • Reputation and brand
Competitive advantages (Stoffberg & Prinsloo, 2009:98)	• Strategic • Regulatory • Technological • Competitive and reputational • Strategic, branding and product
Global low-carbon and environmental market (Carbon Trust, 2011:3)	• Reduction of operating costs • Increase in sales whilst creating new revenue streams • Strengthened reputation and customer loyalty • Regulatory and standards compliance • Improved employee effectiveness

In view of the types of opportunities identified in this section, this chapter will therefore proceed to examine the following categories in further detail:

Enhancement of value creation capabilities

1. Financial performance
2. Strategy
3. Business model
4. Finance

Expansion of revenue sources

5. Markets
6. Reputation
7. Products
8. Technological innovation
9. Compliance

Improvement in efficiency and cost base

10. Cost reduction
11. Production

Increase in competitive advantage of support functions

12. Supply chain
13. Human capital
14. Information technology
15. Non-financial information

The above 15 categories of opportunities are analysed in the remainder of this Chapter.

4.3 ENHANCEMENT OF VALUE CREATION CAPABILITIES

The section below evaluates the positive impact of adapting to climate-change on financial returns, strategic opportunities, business models and attraction of finance.

4.3.1 Financial performance: demonstration of higher returns by sustainable companies

Soyka (2012:269) states that there is empirical evidence to suggest financial value is created by considering sustainability, and reaches the following conclusions:

- indicators of return on assets, return on sales and return on equity have been found to improve for companies that have significantly reduced pollutant emissions (Soyka, 2012:269);
- there is a positive correlation between low emissions and a high net margin (Soyka, 2012:269–271);
- prospective environmental liabilities and asset impairments are often not recognised on the balance sheets of companies, for example, when there are new regulations pending whose effects would be material (Soyka, 2012:271);
- companies that do more than basic compliance to environmental standards have higher market values and thus a higher intangible value (based on the Tobin's Q measure of intangible asset value) (Soyka, 2012:271–273);
- there is a positive relationship between eco-efficiency and operating performance, and a similar relationship between eco-efficiency and company valuation (Soyka, 2012:271–273);
- cost of equity capital is lower for companies that focus on environmental, social and governance practices and this is reflected in a positive beta (less share price volatility) as well as increased cash flows (Soyka, 2012:273–277);
- cost of debt capital comes at a premium for environmentally weak companies and their bond ratings are typically lower (Soyka, 2012:277–279); and

- there are demonstrated share price movements from positive and negative environmental and social events (Soyka, 2012:280).

The causality of sustainability performance drivers that leads to enhanced company returns is illustrated in Figure 4.1 below:

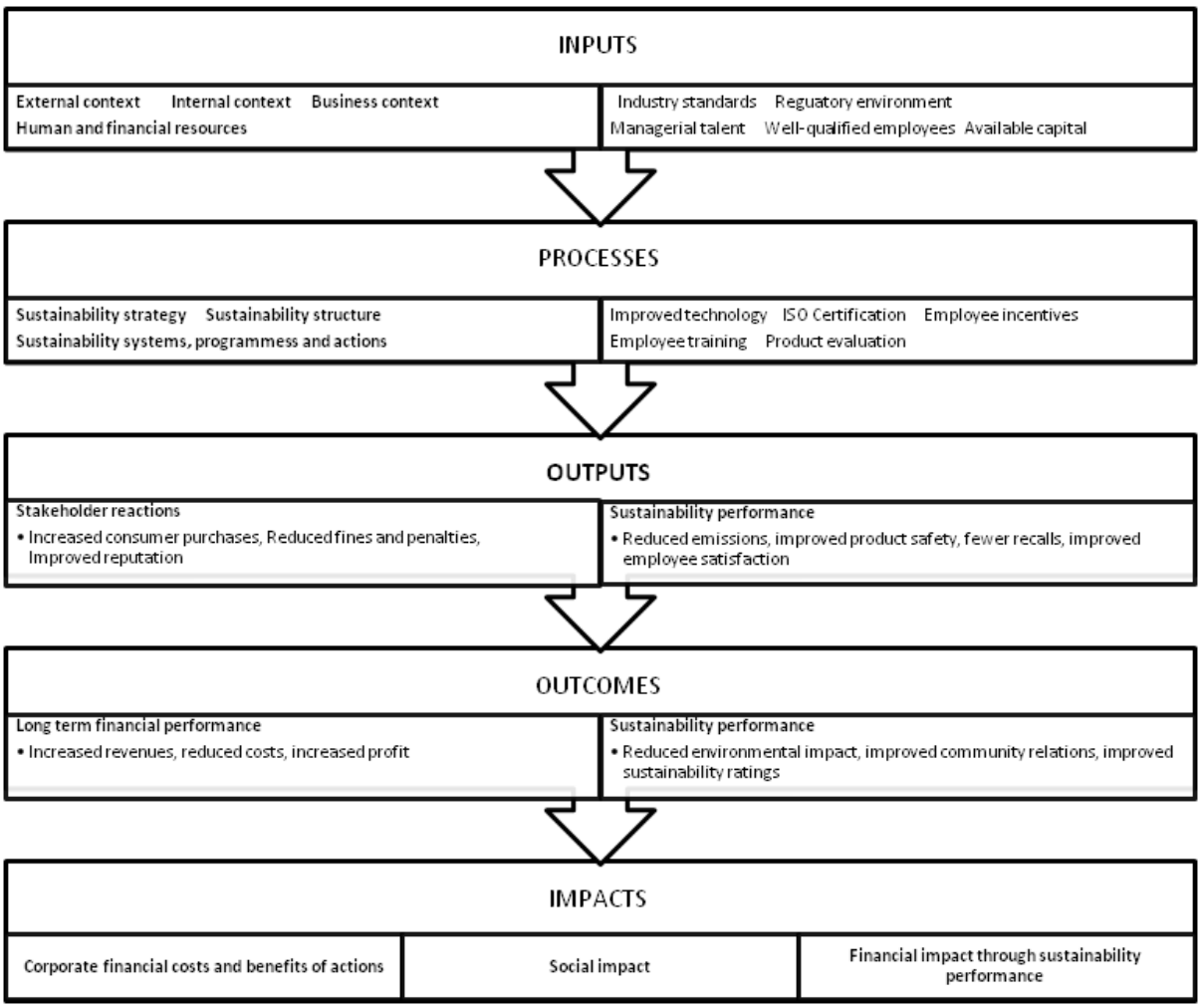

Figure 4.1: Enhancement of returns as a result of sustainability performance

Source: Epstein (2008:33–57 and 163–196)

How does sustainability create financial performance? Lowitt (2011:51–84) outlines the following outcomes of sustainability programmes:

- Increasing revenue by charging premium prices for products that are not only less harmful but which deliver demonstrable cost savings for customers.

- Increasing revenue through higher volumes sold through branding, reinforcing solution sustainability and the connection between company deliverables and customer needs, through:
  - new solutions to existing customers;
  - new solutions to new customers;
  - existing solutions to existing customers; and
  - existing solutions to new customers.
- Reducing production expenses, as carbon-reduction efforts often go hand in hand with cost-saving programmes, efficiency initiatives, finding energy alternatives and/or re-examining logistics.
- Reducing material and component costs through using less virgin materials, which cost more per unit than recycled materials.
- Reducing labour costs by obtaining employee commitment to achieve sustainability goals.
- Enhancing asset value by upgrading tangible assets (for example, energy-efficient buildings have a greater value due to lower use and maintenance expenses).
- Enhancing the value of intangible assets by rejuvenating brands and corporate logos with credible sustainability messages (Lowitt, 2011:51–84).

Whilst the case can be made for greater financial performance, one of the challenges with green investments is that the time frame for getting to a break-even return on investment can be longer than the appetite of some companies (Olson, 2010:43–58). Olson (2010:43–58) also says that this dilemma can be resolved by considering factors such as:

- once break-even point is reached, the benefits tend to be a constant stream (e.g. on solar equipment where there are no further electricity bills);
- product differentiation that will lead to market share, brand loyalty and higher margins in the future;

- greater predictability over future costs unlike the fluctuating costs of carbon resources;
- soft benefits such as environmental protection, employee morale and societal goodwill; and
- avoidance of regulatory action and penalties as well as tapping into government incentives.

4.3.2 Strategic opportunities: effects on performance from climate-change strategic payoffs and enhanced business capabilities

The section below outlines climate-change opportunities that comprise of specific strategic payoffs as well as positive changes to business capabilities.

4.3.2.1 Strategic payoffs and enhanced opportunities arising from climate change

Epstein (2008:249–260) reiterates that there is a clear link between sustainability and company value and summarises this by demonstrating the payoffs of sustainability performance as per Table 4.2 below:

Table 4.2: Strategic payoffs arising from climate-change investments

Payoff	Details
Financial payoffs	1. Lower operating costs 2. Greater revenue 3. Reduced administrative costs 4. Reduced capital costs 5. Stock market premiums
Customer-related payoffs	1. Enhanced customer satisfaction 2. Greater product innovation 3. Increases in market share 4. Enhanced reputation 5. New markets

Payoff	Details
Operational payoffs	1. Innovation within processes 2. Gains in productivity 3. Lower production cycle times 4. Higher resource yields 5. Reduced waste
Organisational payoffs	1. Greater employer satisfaction 2. Enhanced stakeholder relations 3. Reduction in regulatory intervention 4. Risk reduction 5. Increased organisational learning

Source: Epstein (2008:249–260)

The payoffs referred to above crystallise as new business opportunities are harnessed. New business opportunities arise as companies respond to ecological pressures and/or the changes in consumer preferences (WRI, 2005:27). Examples of such opportunities are shown in Figure 4.2 below:

New Business Opportunities	Examples of business opportunities	
	government incentive programs	low-input organic farming
	waste recovery technologies	solar energy
	fuel cells	low-emission engines
	lighter and stronger materials	efficient lighting
	ecotourism	new energy sources
	new transport technology	new building technology

Figure 4.2: Business opportunities related to climate-change adaptation

Source: Adapted from: WRI (2005:27–29)

Opportunities for climate-change strategies (eco-advantage initiatives) should be designed to complement a company's core objectives, to make bottom-line sense and to demonstrate why they should be implemented instead of other potential investments that are competing for limited capital (Esty & Simmons, 2011:36–58).

Esty and Simmons (2011:36–58) indicate a number of success factors in generating feasible returns on climate-change responses:

- Proposals should generate business value and not be framed as philanthropy. Business value is generated through reducing regulatory and market risks, cutting costs, growing revenue, and building intangible brand value.

- Costs and benefits, whether direct or intangible, should be analysed across the whole product/service life-cycle and value chain.

- Potential risks should be examined based on various potential scenarios, including the risk of inaction.

- Financial models should take into account non-financial benefits and go beyond traditional return on investment (ROI) models so as to give a clear picture of trade-offs as well as show a clear net present value outcome. Performance indicators such as return on resources (ratio of profit or revenue to resource inputs) can be used to highlight opportunities. Case studies to support the climate-change strategy should show clear bottom-line benefit.

When a business asks itself where it will compete, what makes it different, and how it will make money, it can find that sustainability is an intelligent choice (Fisk, 2010:36–49). As an intelligent choice, sustainability strategies seek to decouple financial growth from the rate of growth in the use of materials and energy (Gilding, 2011:58).

4.3.2.2 Effect of sustainability on business capability and diversification of sources of capital available

Financial returns can be enhanced through companies creating new business capabilities. As outlined further in this subsection, this has the added effect of increasing the types of capital into which companies can tap for value creation.

Firstly, Olson (2010:59–84) says that once a company has defined a green strategic vision and related imperatives (such as reducing carbon emissions by a certain percentage or becoming an industry leader in sustainable business practices), it should identify the desired ‘green business capabilities’ to enable this (such as energy efficiency opportunities for buildings and operations). These green business

capabilities should be mapped and prioritised in a framework that considers the filtering criteria of strategic fit, revenue benefit, cost savings, environmental impact improvement, operations risk reduction, compliance contribution and timing (Olson, 2010:59–84). This method will ensure that green opportunities selected will be those that can make a tangible addition to the company's triple bottom line. Olson's (2010:85–102) 'green sigma' methodology starts with quick wins that make existing products and operations more carbon-efficient, followed by tackling future strategic opportunities. Deploying such practices decreases process variability and makes business outcomes more predictable (Olson, 2010:107–122).

Once companies have created green business capabilities, there are five different types of capital that they can consider so as to ensure true value creation (CPI, 2008:3). The "five capitals" are summarised in Table 4.3 below:

Table 4.3: Five capital types that enable value creation for companies

Capital	**Value creation**
Natural capital	The economic system of a company relies on the natural system and companies are increasingly recognising the need to nurture natural capital, as a vital and limited resource, through reducing waste and becoming more efficient. Enhancing environmental reputation creates an asset, even if it does not reflect on the balance sheet.
Human capital	Individuals provide physical and intellectual capabilities into a company and are also consumers and suppliers of products. There are many examples of companies that are using sustainability initiatives to harness their internal human capabilities. This requires product and process innovations, creative supply chain strategies and engaging local communities.
Social capital	Social capital underpins the ways in which companies and society operate and work together. Climate-change adaptation/mitigation initiatives are being used by companies to create reservoirs of goodwill and at the same time building the capacities of the rest of society.
Financial capital	There is increasing reward potential and scope in deploying capital into environmentally friendly investments such as clean technology. Funders are increasingly willing to commit capital for environmental and social opportunities that can have a significant impact on the earnings and sustainability of companies.

Capital	Value creation
Manufactured capital	For manufactured capital to continue harnessing new opportunities, CO_2 emissions per unit of output should be reduced through new products, addressing resource efficiency and complying with new legislation.

Adapted from: CPI (2008:3–118)

Decision-making models such as environmental and resource economics (ERE) acknowledge that economic activity is reliant on the environment and see the environment or natural capital as a separate, distinct provider of services such as resources, absorption of waste, recreation and life-support. As sustainability is enhanced, it has a closer decision-making model link to ecological economics (EE), which sees the economic subsystem as constrained within a finite ecological system that provides different forms of capital (Burns & Weaver, 2008:256). EE indicates that the economic and ecological subsystems are reciprocal and assists companies in considering environmental externalities so as to make profits more sustainable (Burns & Weaver, 2008:256).

4.3.3 Business models: value creation capabilities arising from responding to climate change

According to Ogilvie (2009:57–58), real sustainability entails structural changes to value chains and business models. Unfortunately, many companies miss this point and when they are put under pressure by stakeholders, their first line of defence is to publish sustainability reports (Ogilvie, 2009:57–58). Olson (2010:23–42) observes that green strategies cut across the whole company's strategy including market positioning, products, channels, business partners, people competencies, locations, operations, technology and infrastructure. There are already examples of companies that have successfully implemented new business models, which have helped in dealing with economic recessions, have complemented technological upgrades and reinvigorated mature markets (Olson, 2010:23–42). Such innovation ranges from altering product ingredients and offering substitutes through to new innovations and new markets (Olson, 2010:23–42).

Lowitt (2011:209–220) agrees with the pervasive impact of sustainability on business models and suggests that since World War II there have been four shareholder and employee-driven game-changing business imperatives that have necessitated fundamental changes to core business processes, namely quality, business process re-engineering, globalisation, and the Internet. In the same vein, sustainability will be the fifth business imperative and will prove to be disruptive whilst it elevates broader stakeholder interests. Lowitt (2011:209–220) reiterates that early adopters of sustainability will travel quicker up the learning curve of adapting their business models and will be more agile than late adopters.

Fisk (2010:91–104) broadens the discussion on business models and explains that sustainable innovation can occur at six levels in a company in Table 4.4 below:

Table 4.4: Climate-change innovation across the company value chain

Innovation	**Focus areas of innovation**
Process	Efficiency, waste and entire value chains
Product	Differentiation through sustainable products and services
Market	New markets, needs and wants of consumers
Brand	Communication of higher purpose and sustainable practices of company
Business	Overhaul of business purpose, business model, stakeholders and success metrics
Strategic	Fundamental change of the entire business direction

Source: Fisk (2010:91–104)

The above therefore suggests that it is worth assessing climate-change opportunities from a value chain perspective. Analysing carbon emissions of a company's value chain is important in assessing opportunities and the way vulnerabilities to regulations and market movements can be addressed (Hoffman & Woody, 2008:26–37). This entails ongoing measurement of three categories of emissions, which comprise of direct emissions, indirect emissions from purchased energy sources and other upstream/downstream indirect emissions (Hoffman & Woody, 2008:28–37). This information can then be used to gauge how operations and sales will be affected

and the resultant impact on bottom-line, competitive positioning, product margins and residual risks. Such a value chain approach can also help identify cost decreases when competitors face cost increases, avoid being seen as a late performer and gain recognition (Hoffman & Woody, 2008:28–37).

In adapting its business model to address climate-change opportunities, a company can follow opportunistic or protective strategies, and both strategies assist in managing risk and in capitalising on opportunities (Epstein, 2008:58–84). Long-term positive financial outcomes are the result of sustainability performance, which is based on sustainability strategies, structures and processes that consider a company's external and internal context (Epstein, 2008:33–57).

In summation, Epstein (2008:85–102) suggests that robust sustainability programmes bring all the key departments of a company into play to harness their collective strengths:

- marketing – analyses consumer preferences for sustainable goods;
- research and development – examine how to use resources with less impact, new sustainable products, and how to minimise unused waste;
- procurement – purchases sustainable raw materials and packaging that have low environmental impacts and are sourced from responsible factories;
- production – enhances process efficiency safely and reduces costs of energy and resource use;
- sales – packages and distributes whilst identifying the way in which products can be distributed to customers with the least environmental, social and economic impacts;
- legal – researches and shares information on sustainability legislation;
- management accounting – provides information that can assist with costing products, designing processes and investing capital; and

- financial reporting and auditing – provide complete, relevant disclosures for external users to evaluate a company's current and future outlook (Epstein, 2008:85–102).

4.3.4 Finance: broader value creation base through attraction of capital

Access to capital is perceived to be easier for sustainable companies. Such companies benefit from lower borrowing costs and greater access to debt and equity financing (Hopwood *et al.,* 2010:14). Investors are attracted to sustainable companies as they are 'future-proof', create 'reputational capital' for investors, have more comprehensive risk and opportunity profiles, comply with their fiduciary duties, and are more likely to achieve superior financial returns in the medium to long term (Kiernan, 2009:1–18). What is the logic behind this? With 20% of a company's value being tangible value, the other 80% comprises of intangible value such as management quality in managing complex future issues (such as enviro-social), strategic governance capability and agility, ability to create capital/goodwill with stakeholders, management of human capital, and environmental brand equity and credibility (Kiernan, 2009:1–18).

In the competition for capital, a sustainable company will be able to answer questions such as the following to show how it manages risk and protects capital better than companies that have not adapted to climate-change (Kiernan, 2009:73-96):

- How will climate-induced water deficits affect companies that are water reliant, given forecasts that by 2025 a third of the global population will be in water-scarce areas?

- Which companies will be able to diversify energy production assets into non-fossil fuel sources?

- Which companies will be most successful in creating new financial and insurance products to address climate change?

- Which companies are best able to access customers at the base of the income pyramid in developing countries?

- How will companies active in Africa deal with the environmental and other social issues affecting their productive labour base?

- Which companies will succeed in creating low-pollution and next-generation products, such as vehicles?

- Which resource-extracting company will deal best with a marketplace that is more and more sensitive about sustainable renewable resource use?

4.4 EXPANSION OF REVENUE SOURCES

The range of opportunities for enhancing revenue includes tapping into green consumers, capitalising on enhanced reputation, deploying new products, technological innovation and realising opportunities from compliance. These opportunities are explored in this section.

4.4.1 Market: opportunities arising from green consumers and green marketing

As expounded below, climate-change opportunities can diversify revenue sources and enhance the sales value propositions of companies.

4.4.1.1 Targeting green consumers to diversify revenue sources

Hopwood *et al.* (2010:11) demonstrate that eco-friendly products can attract customers, irrespective of whether those customers are individuals, businesses or governments. Different surveys conducted in 2008 by the European Commission and TNS Research concluded that between 45% and 94% of respondents across developed and developing countries were agreeable to buying and paying more for environmentally friendly products (Hopwood *et al.,* 2010:11). Green consumerism is also influenced by multi-national companies setting increasingly higher standards for themselves, an increasing middle class as well as energy constraints (Phyper & MacLean, 2009:157–181). Sustainable product sales are growing at double-digit levels year on year, albeit from a small base (Hitchcock & Willard: 2009:227–242). By the year 2013, 30% of all products are likely to be sustainability-oriented products and this trend will also be apparent in emerging economies (Esty & Simmons,

2011:268–286). Companies therefore stand to enhance sales through providing authentically greener products.

Esty and Simmons (2011:268–286) however caution that products must first meet price and performance requirements before customers are willing to consider any premium for a product being green. Green products have previously had a price premium over conventional products but this is narrowing as the message moves from a novel concept towards mainstream volume and efficiency (Phyper & MacLean, 2009:157–181).

Sustainable market leaders are using environmental sustainability to capture customers, useful in markets where products are commoditised and it is difficult to use price as a differentiator (Lowitt, 2011:31–50). Customer centricity is often an ambition for companies and by embedding sustainability into the value chain customer focus is by default enhanced due to the sustainability lenses that inherently examines the needs of stakeholders (Lowitt, 2011:141–177). Sustainable products have appealing emotive messages in that they are “not only good, but are better and do good” (Fisk, 2010:36–49).

4.4.1.2 Use of green marketing to differentiate the sales value proposition of companies

Green marketing describes company actions that benefit the environment (Friend, 2009:73). According to Friend (2009:80), green marketing targets a global market size of over US$200 billion (as at 2009) that comprises of consumers in the category of LOHAS (Lifestyles of Health and Sustainability). How does a company tap into this growth industry? Marketing of sustainability goods and services, provided it is not ‘green-washing’, is a key tool to uncover real customer needs and unlock the following benefits:

- re-energising struggling businesses and their employees that could not distinguish themselves, through implementing sustainability-based product differentiation;
- first-mover advantage and the positive press that can be associated with it; and

- creation of emotional appeal to environmentally friendly and socially responsible products, if companies place the right bets (Hitchcock and Willard, 2009:227–242).

Tapping into green marketing opportunities entails understanding what the sustainability value proposition is, whether it is relevant to customers, how it compares to competitor offers and the link to customers' buying behaviours (Esty & Simmons, 2011:268–286). To assist in defining this, materiality assessment is a process used to prioritise sustainability issues. The intersection between issues that are highly important to the business (such as growth and profitability) and those that are highly important to customers (such as green production) demonstrates the highly material issues that will trigger a journey to better performance and strategy (Lowitt, 2011:85–112).

Friend (2009:78–79) warns though that green messages can be diluted by misleading customers ('green-washing') through concealing hidden trade-offs, unverifiable claims, vagueness, claims that are irrelevant and falsehoods. Phyper and MacLean (2009:157–181) also lament that the challenge for companies is how to tackle these opportunities genuinely whilst competitors 'green-wash', i.e. make false claims which include:

- claiming a product is green based on a narrow attribute to the exclusion of more important factors;
- making claims that are not substantiated;
- making vague claims whose true meaning can be misunderstood; and
- distracting customers through true but irrelevant claims or not highlighting the greater environmental harm that is caused by a product.

Notwithstanding the challenges of 'green-washing', the concept of green marketing is accelerating and is different from conventional marketing as it talks to cradle-to-cradle products rather than cradle-to-grave, flexibility rather than one size fits all, education on a product's benefits rather than selling, pro-activity rather than

reactivity, higher product performance, and greater cost-effectiveness for the consumer (Phyper & MacLean, 2009:157–181).

4.4.2 Reputation: social license to operate and reputational capital created from enhanced environmental reputation

Social license to operate is a pre-requisite for generating revenue. Companies with a positive impact on the environment and social spheres of sustainability can benefit from a license to operate that is manifested in government permissions and contracts, community support through customer and employee relationships and the absence of negative campaigns that target the company from social movements (Hopwood *et al.,* 2010:14). A resilient company will engage stakeholders such as policy makers, investors and communities so that a climate of inefficiency, suspicion and conflict is transformed into partnerships, transparency and license to operate (World Resources Institute *et al.,* 2011:28).

Adapting to climate change offers an opportunity for companies to enhance their reputations and corporate citizenship through measures such as:

- enhancing the link between business activities and corporate social responsibility strategies, especially in developing countries; and

- demonstrating a new vision of social and environmental accountability through adaptation measures that are pro-active, documented and adequately publicised among key stakeholders (World Resources Institute *et al.,* 2011:23).

Once companies have greened their operations and market offerings they can increase their competitive advantage by communicating their sustainability credentials (Carbon Trust, 2011:15–18). It is expected that sustainable companies have a relatively higher reputation capital than companies that have not embraced sustainability (Epstein, 2008:163–196). Reputation capital is crudely measured by subtracting the net liquidation value of assets from a company's market value of shares (Epstein, 2008:163–196). Reputation capital can then be refined by separating off-balance sheet intangible assets that can be recognised separately (Epstein, 2008:163–196).

Deegan and Unerman (2011:268) postulate that positive accounting theory views accounting as playing a role in lessening agency costs of companies. Accordingly, accounting disclosure policies and accounting techniques are actively used to influence stakeholder relationships on the premise of legitimacy theory and stakeholder theory (Deegan & Unerman, 2011:320–321). Based on legitimacy theory, companies wish to be perceived as operating within societal boundaries so that they can access resources and support for operations in the context of communities that value issues such as environmental performance (Deegan & Unerman, 2011:325–333).

Stakeholder theory is similar but acknowledges that a company needs different social licenses to operate for different stakeholder groups (Deegan & Unerman, 2011:348). Based on this theory, companies respond to the demands of key stakeholders, as demonstrated in accounting and environmental disclosures, to enhance viability and success that flows from receiving social license to operate (Deegan & Unerman, 2011:348–353).

4.4.3 Products: revenue enhancement arising from climate-friendly product enhancements

Willard (2005:148–150) conservatively estimates that companies can increase their revenue by at least 5% through new revenue streams, premiums charged on green products and sales to ‘green’ consumers. Companies can become part of the “new adaptation marketplace” (WRI, 2011:23) by building entirely new products and services from a foundational level and considering climate risks when they do market analysis. A resilient company will manage risks of supply chain disruption and obsolete products and instead create new logistics models and new markets to meet emerging demand (WRI, 2011:28). Studies have shown that companies that are pro-environment do better than other companies (MacCracken, Moore & Topping, 2008:221). In deploying new products, it is important to communicate a clear value proposition to customers that is focused on desired outcomes such as reduced carbon footprint, greater productivity, enhanced efficiency, reduced waste, compliance with new climate change-driven legislation, new solutions and other drivers (White, 2010:215–216).

Esty and Simmons (2011:190–204) show that ecological product design leads firstly to cost savings and cost-efficiencies in the production life-cycle and then creates revenue and profits from greener products. There are already examples of top multinationals each generating US$1 billion to US$50 billion in selling green products (Esty & Simmons, 2011:190–204). Green products offer benefits such as reduced wastage; less reliance on scarce resources; reducing regulatory exposures; and enhanced product durability (Esty & Simmons, 2011:190–204).

Benyus (1997:4–5) suggests that reaching the petrochemical limits of our ecosystem implies that the next opportunities will be to learn from nature – natural designs are much more elegant and come at minimal cost to the planet. Examples of such bio-mimicry include:

- agriculture that does not depend on fossil fuels (used for pesticides, annual seeding, weeding, fertiliser, excessive tilling, etc.) as a result of using techniques such as perennials as opposed to annual crops, poly-culture where mixed symbiotic plants ‘pay their own nitrogen bills’, perma-culture where farms are designed to be self-supporting, and regenerative agriculture that increases the efficiency of nutrient and energy flows (Benyus, 1997:30–50);

- life-friendly manufacturing processes that do not “heat, beat and treat” (Benyus, 1997:97) but manufacture at room temperature without high pressures;

- an ordered hierarchical structure where nature uses mathematical repetition at multiple levels to produce materials that have precision, strength and flexibility (Benyus, 1997:99–100); and

- self-assembly, which requires creating objects from ground up instead of taking bulk materials and carving them into shape, thus leaving waste (Benyus, 1997:103–104).

Friend (2009:103) summarises nature’s design principles that are relevant for companies seeking opportunities, as identified by Benyus and other academics. These are indicated in Figure 4.3 below:

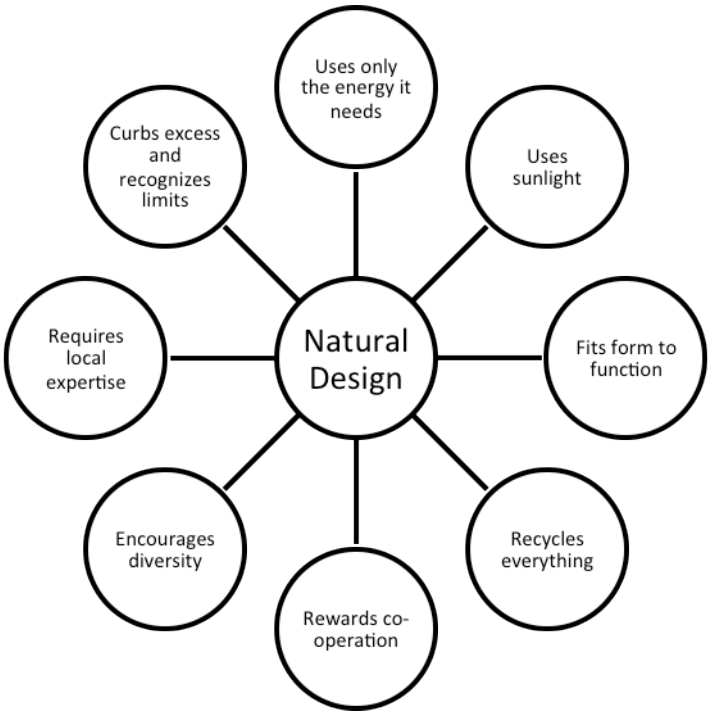

Figure 4.3: Natural design principles as a guide

Source: Friend (2009:103)

'Design with nature' is a related concept to bio-mimicry and requires companies to adapt to the natural conditions around them without sacrificing the traditional 'design for profit' principles (Friend, 2009:113–116). The 'design with nature' constraint can actually encourage innovation as it requires the use of practices such as closing material loops by using materials that can be reused or readily absorbed by nature (Friend, 2009: 113–116).

In summation, ten lessons that companies can apply to create opportunities from addressing climate change are:

- using waste as a resource by recycling and moving to closed loops instead of linear production where raw materials are used and excesses abandoned as unusable waste (Benyus, 1997:254–256);
- pre-competitive co-operation where companies in the same industry create arrangements to reuse parts from each other (Benyus 1997:259);

- gathering and using energy efficiently by removing energy leaks from e.g. using inefficient light bulbs and lack of insulation (Benyus, 1997:261–262);

- focusing on optimising rather than maximising throughput, given that 85% of manufactured items are rapidly destined to be waste. This would require shifting company focus from selling as much as possible to maintenance of goods with longer lives (Benyus, 1997:263–264);

- fitting form to function by doing more with less (dematerialisation), in other words using less material to build lighter multi-functional products (Benyus, 1997:264–265). Dematerialisation could also result in "leasing as a way of life" (Benyus, 1997:265), which will incentivise companies to create more durable products instead of selling products that have planned obsolescence;

- reducing pollution and emissions during production and storage (cheaper than cleaning up afterwards) and reducing energy use by initiatives such as decentralising energy production (Benyus, 1997:267–268);

- substituting renewables for non-renewables and not using renewables at a faster pace than they can renew themselves (Benyus, 1997:268–271);

- remaining in balance with the biosphere, especially in our production of carbon dioxide (Benyus, 1997:271);

- running on information by consumers and governments obtaining, rewarding and penalising companies based on the feedback on the effects they have on the environment and vice versa (Benyus, 1997:273–275); and

- "shopping locally" (Benyus, 1997:276–277) by obtaining inputs locally and manufacturing as close to the place of consumption as possible.

4.4.4 Technological innovation: creation of new ventures as a result of clean technology

When the response to climate change comes, it will be so significant in scale that most companies' business models will not be able to ignore it. Gilding (2011:135–141) envisions a rapid five-year adaptation scenario that includes a 50% reduction in

logging. closure of 1 000 coal plants, retrofitting 1 000 coal plants for carbon capture and storage, erection of wind and solar plants in every town, massive recycling initiatives to limit the use of virgin materials, 50% replacement of carbon-emitting cars and planes, and the use of bio-fuels/methane. The scale of such a change will create significant business opportunities for companies that can feasibly get new technologies to market rapidly.

Stern (2006:348–39) refers to Freeman's (1992) work entitled *The economics of hope* to illustrate the four types of technological change that companies can aspire to, and further outlines the three stages of the innovation process (see Figure 4.4 below):

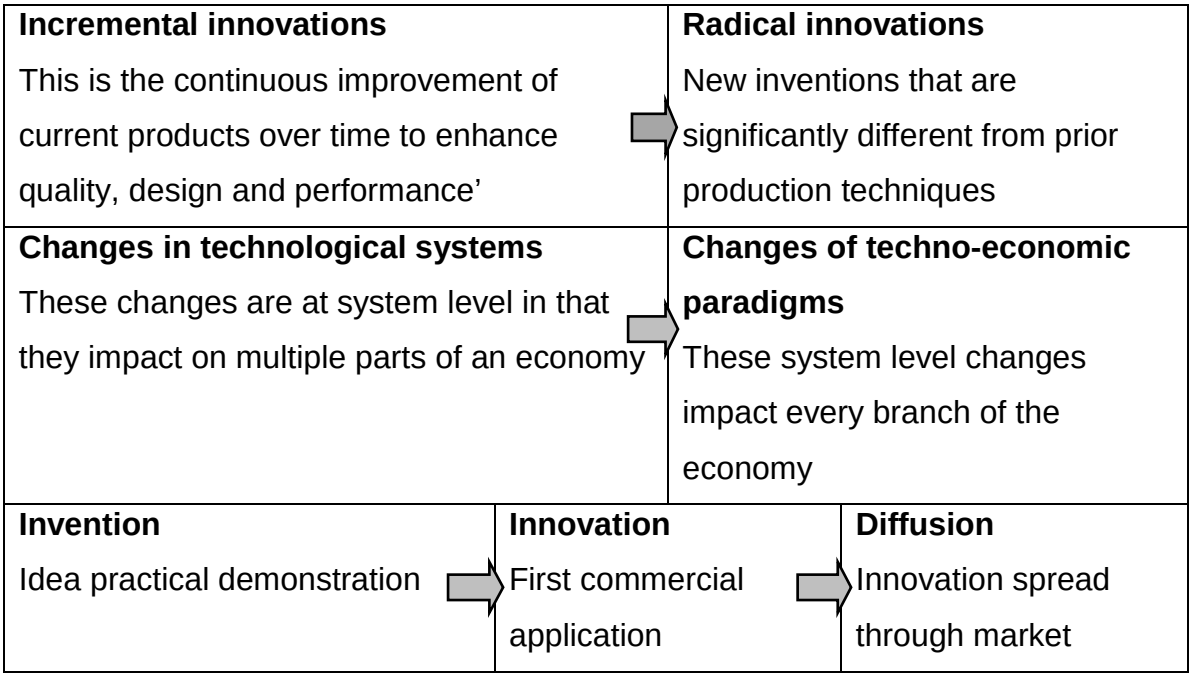

Figure 4.4: Technological innovation related to climate change

Source: Adapted from Stern (2006:348–349)

The forces that drive technological changes include consumer market pull, technology push based on research, government policy interventions, and business community investments (Stern, 2006:349). Companies are obliged to keep innovating as there are high profits during the phase where new products have now taken off and competition also forces companies to keep abreast of competitors (Stern, 2006:349).

There are technological innovation opportunities within emerging markets, such as South Africa, for companies that decide to take on environmental and social sustainability challenges as the examples below illustrate (Kiernan 2009:97–122):

- targeting, in a climate-friendly manner, the emerging markets untapped opportunity of the 4 billion people who live at the base of the pyramid on less than $1 000 per year by converting them into consumers and productive employees; and

- investment in infrastructure, in a manner that considers environmental impacts and climate-change adaptation.

Investment in clean technology will result in much lower renewable energy costs that in turn will result in even poor communities having significant access to energy sources they previously did not have as well as reduce financial dependence on purchasing carbon energy sources (Gilding, 2011:116). This will create immense new product opportunities economically for companies in Southern Africa. In twenty years' time, the world's top companies will be the new names that are currently innovating technologically (Gilding, 2011:156). Leading South African companies should therefore realise that their domination at the top is not assured. Whilst carbon-intensive companies assume that their continuity is assured because of the size of the fossil fuel industry and the vast reserves of coal, oil and gas, Gilding (2011:160) illustrates that this is a false premise by quoting the adage "the stone age didn't end because we ran out of stone". Eventually new technologies will bloom that will make carbon-intensive production unattractive and an increasingly more expensive option.

Clean technology business is expected to grow by 30% per annum (Jolly, 2010:13–15). This compares to the 1990s compound growth in personal computing of up to 20% per annum. Clean energy investment was US$150 billion per annum in 2009 and was projected to grow to over US$1 trillion per annum, or 6% of the global GDP, by 2030 (Jolly, 2010:13–15). This growth is partly driven by domestic policies on climate change, of which there had been in excess of 500 climate policy announcements from July 2008 till 2010. It is also driven by competition for resources and market dominance, with China, for example, having invested the most money in clean energy finance and investment in 2009 in a move that was interpreted as

pursuing green economy dominance (Jolly, 2010:13–15). Companies that succeed will be those that work with governments, and anticipate policy developments and government incentives (Jolly, 2010:13–15).

According to the CPSL (2009:65–108), energy production is the largest source of carbon emissions and there are nine major technologies that are available which can reduce the carbon intensity of energy production, namely carbon capture storage, wind power, solar power, biomass, geothermal energy, wave power, tidal power, hydroelectric power, and nuclear power (CPSL, 2009:65–108).

The advantages of alternative energy include safety, world-wide availability in different forms (solar, wind or waves), minimal costs for generation, avoidance of the current government costs to eliminate the geopolitical risks of oil (which are paid by taxpayers) and global energy security (Gilding, 2011:166–168). Furthermore, renewable energy prices are certainly expected to follow a downward trend whereas carbon fuels will inevitably increase in price due to supply issues and rising difficulties in extraction (Gilding, 2011:168). Accordingly, renewable energy investments overtook new fossil fuel investments in 2008/2009, which shows that investors are aware of this and that business cases for certain new technologies have already been proved (Gilding, 2011:168).

4.4.5 Compliance: creation of new opportunities through early adaptation to new regulations and policies

Regulations will reward many first-mover companies who have developed environmentally and socially leading solutions that the markets are not ready to embrace fully and reward fairly yet (Gilding, 2011:154). ‘Going green’ provides the opportunity to develop compliance management systems, track compliance burdens for each product and proactively respond to future environmental regulations (Esty & Simmons, 2011:287–296). Further, compliance investments generate company understanding of regulatory compliance upstream and downstream within their suppliers, customers and industry, helping to reduce unforeseen exposures (Esty & Simmons, 2011:287–296). Responsive companies will avoid the risk of a politician changing the value of a company’s assets overnight without warning or competitors

and interest groups being left to guide the rules only in their favour (Hoffman & Woody 2008:73–84).

Companies that operate under good environmental regulation are more likely to have a competitive advantage as this will create a structure within which new business models could function (Gilding 2011:145). Regulations will create a system where companies could be held accountable, environmentally damaging products could be rejected, companies could be penalised fairly for failing to manage climate-change risk, and an enabling environment could be created for more sustainable companies (Gilding, 2011:147).

Impacts of climate change on policy and strategy can be divided into anticipatory and reactive policies (Bartelmus, 2003:84–85). Anticipatory policies are forward-looking and focus on the socio-economic aspect of environmental matters such as rising costs, environmental effects that threaten survival and violations of intergenerational equity principles. Reactive policies deal with consequences that have materialised such as clean-up of environmental degradation (Bartelmus, 2003:84–85). Whereas reactive policies focus on rehabilitating natural assets, anticipatory policies lead to investments in investigating and implementing processes that are environmentally robust and save resources (Bartelmus, 2003:90).

World Resources Institute *et al.* (2011:46–53) identifies a number of reactive and anticipatory actions that governments are likely to follow for encouraging private sector adaptation to climate change. Such actions could create opportunities for companies as indicated in Table 4.5 below.

Table 4.5: Opportunities arising from government climate-change actions

Policymaker catalyst	Government actions that can create opportunities for companies
Build a foundation for private sector investments and action	Demonstration of policy and financial commitment to adaptation through climate-change legislation, climate-change action plans and allocating public funding for adaptation.
	Engaging businesses as stakeholders to government by mobilising private sector strengths and assets, including private sector representation in climate-change dialogues and sharing private sector expertise in building up climate resilience.
Align public and private adaptation interests	Stimulate adaptation market by using financial and risk-reduction incentives (loans, capital, tax credits, credit guarantees, innovation competitions and infrastructure funding guarantees).
	Create policy tools and regulatory frameworks to guide companies, create a level playing field, decrease risk and uncertainty, and promote business decision-making that promotes sustainability. This can be done by incorporation of climate-change evaluation into project appraisals, environmental impact assessments, government procurement from the private sector, fostering technology diffusion obligating companies to internalise the costs of ecosystem degradation, and encouraging disclosure of climate-change risks.
Promote best practices and collaboration	Generate and disseminate climate-change information so that businesses have the information resources to make decisions on climate adaptation investments. Information includes research on anticipated magnitude, frequency and impact of climate change per region, specific community adaptation needs that the private sector can fulfil, costs and benefits of adaptation, public financing available, and the estimated value of services that the ecosystem provides.
	Create and structure public-private partnerships (PPPs) to complement initiatives by combining the social responsibility and accountability of the public sector, with the efficiency and entrepreneurial abilities of the private sector, and the drive of civil society.

Source: Adapted from World Resources Institute et al. (2011:46–53)

4.5 IMPROVEMENT IN EFFICIENCY AND COST BASE

Adaptation to climate-change can lead to enhanced efficiencies and reduced cost structures of companies, as the section below elaborates.

4.5.1 Cost reduction: effect of carbon efficiency on the cost base of companies

Linking carbon reduction to corporate strategies creates financial benefits when areas such as transportation, energy, material usage and waste are addressed (Wilhelm, 2009:25–40). Reducing environmental impact and carbon emissions can result in cost savings of approximately 20% of operating costs (Carbon Trust, 2011:5). This can be done through reducing heating costs by better regulation of heating systems, reducing lighting costs through technology improvements, and improving the energy efficiency of equipment. Furthermore, targeting wastage can also reduce carbon emissions through monitoring indications of excessive consumption, minimising waste through elimination by reusing, recycling and disposal, and reducing water consumption due to its carbon cost and increasing scarcity (Carbon Trust, 2011:10-11). Esty and Simmons (2011:125–142) highlight numerous examples of businesses reducing resource use and costs by 25% to 50% through carbon-reduction initiatives.

Willard (2005:129) summarises six cost-reduction bottom-line benefits of adapting to client change. Furthermore, the effect of these cost reductions is enhanced by increases in productivity and revenue/market share (Willard, 2005:129). These bottom-line benefits are quantified as follows:

- Reduced recruiting costs create a one percent saving in expenses given that a significant portion of potential employees would rather work for companies with a good sustainability reputation and who have similar values to them than climate-unfriendly companies. In this case, good talent is therefore hired more quickly and easily (Willard, 2005:133,138–139). The one percent is computed by considering hiring expenses, preferences of talented candidates and the typical rate of recruitment.

- Reduced attrition of good talent results in a two percent saving in expenses due to lower costs spent in training and in finding replacements (Willard, 2005:140–141). The two percent saving considers retention rates of employees who profess to be concerned about corporate social responsibility.

- For a manufacturer, five percent of expense reductions are typically realised from eco-efficiency practices such as reuse of waste, more efficient materials that require less volume to be used and redesign of manufacturing processes (Willard, 2005:144–145).

- Commercial sites can also save 20% of selling, general and administrative expenses through water, heating, cooling and other operating costs that can be created through educating employees and green design of buildings (Willard, 2005:145–147).

- A five percent saving is possible on risk-related expenses such as insurance premiums, liability provisions and interest for loans through sustainability initiatives (Willard, 2005:150–152).

- A 10.5% gain can be realised in increased productivity by companies with a sustainable development ethos, and this results from increased creativity, innovation, individual productivity from personal values of employees, enhanced workplace conditions, lighting and greater teamwork (Willard, 2005:142–143).

Quality management is increasingly seen as a way of reducing emissions and costs at the same time (Horngreen, Datar & Foster, 2005:660). This translates into increased or preserved revenues, greater market share and sustained profits. Such benefits arise from reduced direct or indirect costs of quality in relation to prevention, appraisal, internal failure and external failure costs (Horngreen *et al.,* 2005:661–662). Internal failure costs that trigger avoidable emissions are spoilage, rework and machine use whilst external failure costs include warranty repair costs (Horngreen *et al.,* 2005:661–662).

4.5.2 Production: cost-reducing efficiencies and waste reduction related to climate-friendly production

Companies that become climate-friendly can reduce their costs and minimise waste through adapting production techniques.

4.5.2.1 Efficiencies created through adapting production processes

Stern (2006:218–225) indicates that carbon emissions can be addressed by considering production efficiencies and low-carbon technologies whose relatively high cost is expected to fall over time due to learning, innovation and economies of scale. Creative destruction of fossil-based production technologies will be useful in helping companies see previously hidden inefficiencies and spur breakthrough innovation, investment and growth (Stern, 2006:273). Green inefficiencies typically manifest in other challenges such as overproducing, inefficient product motion, defects, over-processing, delays between processes and an unproductive culture (Esty & Simmons, 2011:221–244).

The CPI (2007:8) highlights that there is a socio-environmental cost differential between sustainable and unsustainable production. This socio-economic cost is concealed through externalities. As this cost differential is narrowed, there will be an increasing move towards sustainable production due to savings and resource inefficiencies, stronger cost control and penalty avoidance, and increased customer demand and favourable market forces. This is reinforced by voluntary standards, legislation, incentives and penalties (CPI, 2007:9–10,15–16).

Esty and Simmons (2011:221–244) explain that green manufacturing naturally dovetails into existing process improvement programmes such as digital manufacturing; automation; 5S programmes (sort, set in order, shine, standardise, sustain), just-in-time manufacturing/delivery, cellular manufacturing, total productive maintenance and lean six sigma (minimal process variability). Emerging ‘sustainable consumption and production’ techniques include technology innovation and design, enhancing resource productivity and efficiency, life cycle assessment, closed loop production to address waste, sustainable procurement, and customer engagement (CPI, 2007:11–14).

Product design is the most important stage at which to embed sustainability principles that will subsequently lead to carbon efficiency in the manufacturing and use of a product (Hitchcock & Willard, 2009:55–80). Design for environment (DfE) is one example of front-end design that selects materials with the lowest impact, greatest recyclability, reusability, and least mass to minimise pressure on environmental resources extracted and transportation costs (Hitchcock & Willard, 2009:55–80). Life cycle assessment (LCA) goes beyond DfE by examining the environmental impact at each stage of a product's life cycle, starting from raw material extraction through to manufacture and shipping, and culminating in the end of a product's useful life after the consumer (Hitchcock & Willard, 2009:55–80). This implicitly reduces the costs to a consumer and hence can assist in carving out new markets.

Whereas LCA focuses on environmental impacts, life cycle costing (LCC) comes alongside it by evaluating the costs of a product from the research and development phase through to production, use and disposal (Hitchcock & Willard, 2009:55–80). Life cycle costing is particularly relevant to reducing environmental costs as such costs are normally committed during the product and process design stages (Horngreen *et al.*, 2005:436–437). Like activity-based costing, information from LCC is tremendously useful to decision-makers and users of products for establishing the lowest cost products (Hitchcock & Willard, 2009:55–80).

4.5.2.2 Reduction in wastage as a by-product of emission reductions

Certain new production practices can eliminate both unnecessary waste and carbon emissions. This reduces production costs. Zero waste strategies entail splitting throughput into two components, namely product output and non-product output (which can be as high as 94%). Secondly, this is followed by reducing the non-product output through techniques such as continuous measurement, process efficiency and using waste as feedstock (Friend, 2009:43–46). There are clearly costs associated with the non-product output that decision-makers should be aware of.

Edwards (2005:97–101) advocates the use of green design decisions to conserve energy by fostering reusability of products and services. Such 'cradle-to-cradle'

design entails licensing rather than selling durable products so that at the end of their use they are sent back to the manufacturer for reuse in the techno-sphere (Edwards, 2005:101–102). Phyper and MacLean (2009:111–138) are also supportive of cradle-to-cradle manufacturing as it is more profitable and beneficial than traditional methods and they feel that this will gain traction as the cost of resources increase and there is increasing awareness of the eco-efficiency concept. 'Green chemistry' is a similar concept of avoiding waste and is a cost-effective manufacturing technique that uses technology to build products from the ground up rather than through the normal reduction methods. This reduces waste and emissions by avoiding unnecessary by-products that can often be many times the volume of the final product (Hitchcock & Willard, 2009:55–80). Such mindsets mean corporate social responsibility moves from being a line function and becoming embedded holistically in product sourcing, design and customer experience (Phyper and MacLean, 2009:111–138).

Hitchcock and Willard (2009:153–164) say that waste "can be defined as something you paid for that you pay again to get rid of". A bold evolution of the 'zero defects' quality movement is the 'zero waste' production principle, which recognises that any waste is money lost and therefore seeks to find a use for any by-products, emissions and energy created during production – which can make up as much as 94% of a final product (Hitchcock & Willard, 2009:55–80).

Lean practices target waste and this has the environmental and financial effects as outlined in Table 4.6 below:

Table 4.6: Reduction of carbon emissions and financial losses through lean practices

Process-driven waste	Carbon effect eliminated through lean practices
Overproduction	Greater facility requirements and obsolete scrap that increases disposal requirements
Waiting	Underutilised human and machinery capacity; greater facility requirements
Excessive Inventory	More heating, lighting and utility needs; greater facility requirements

Excess motion and transportation	Increased energy usage within facilities and to facilities
Rework	Additional emissions from re-processing products
Over-processing	Processing does not add value and wastes energy
'Utilisation of intellect'	Slow processes and rework consume extra energy due to poor process planning

Source: Adapted from Olson (2010:107–122)

As a further extension to waste management and the life cycle approach, extended producer responsibility (EPR) is a relatively new concept that makes a company responsible even for the disposal of a product once such product reaches the end of its useful life (Hitchcock & Willard, 2009:55–80). EPR for electronic waste (e-waste) is an example of an externality being passed back to companies by municipalities that could no longer afford the cost and challenges of disposing of e-waste (Hitchcock & Willard, 2009:55–80). Whilst some companies view this as an extra cost and risk, it has benefits such as creating refurbishment business opportunities and reducing production costs through the reuse of components (Hitchcock & Willard, 2009:55–80). Cost reduction and reduced environmental impact are achieved through product take-backs where manufacturers collect used products and packaging to re-inject into the manufacturing process (Friend, 2009:89). Product take-backs can be done through in-store collection, mail-in or third-party collection, which this requires upfront planning of the product take-back mechanism at the product/distribution channel design stage (Friend, 2009:91–92).

Some companies take the product take-back concept even further through the 'product-to-service' concept, also known as "servicising" (Friend, 2009:93–94). Selling a service rather than a product is about "doing more with less" (Friend, 2009:93–98) and this results in less resource use per customer, creates repeated business, lowers total costs of ownership, reduces waste, increases profit margins and makes a company's capital use more efficient. According to Friend (2009:96), this works well for products that:

- have long product lives;
- require regular upgrades;

- pose challenges for their disposal after use;
- have relatively high initial costs; and
- have high requirements for technical knowledge.

4.6 INCREASE IN COMPETITIVE ADVANTAGE OF SUPPORT FUNCTIONS

In the shift to climate-friendly business, it is useful to consider the impact this has on support functions such as supply chain, human capital, information technology and performance management.

4.6.1 Supply chain: opportunities for leaner and more responsive supplier chains through carbon management

Carbon management in supply chains entails the following activities with related benefits:

- measuring of carbon emissions, which entails creating a carbon footprint through analysing activity data for areas within scope which will be used to create a baseline – this enhances the ability to identify the most effective ways of reducing emissions as well as opportunities for cost savings (CPSL, 2009:15–16);
- reducing carbon emissions based on typical hotspots and customer priorities – thus actively generating cost savings, preparing for potential regulation and qualifying for applicable incentives (CPSL, 2009:22–23);
- setting up frameworks, policies and procedures for credible carbon management – thereby maintaining credibility of initiatives with customers as well as sustaining identified cost savings (CPSL, 2009:31–32); and
- extending carbon management down the supply chain – thus helping to obtain a full view the entire product life cycle which creates the platform to reduce costs (CPSL, 2009:46).

In responding to climate change, the supply chain is an area that can be significantly shifted from being just a cost centre, as Table 4.7 below shows:

Table 4.7: Creation of competitive advantage through supply chain

Traditional supply chain	Sustainable supply chain
Integration and collaboration within the company	Cross-enterprise integration that collaborates with other parts of the value chain
Physical efficiency	Supply matched with market demand (similar to just in time)
Supply focus	Demand focus
Products designed within the company	Design is collaborative with suppliers and concurrent with new designs in the other parts of the external supply chain
Focus on cost reduction	Focus on new business models
Focus on mass market offerings	Focus on tailored offerings

Source: Hitchcock and Willard (2009:55–80)

There is an upside to driving sustainable supply chain activities through sourcing greater quality inputs that also enhance efficiency and reduce costs (Esty & Simmons, 2011:205–220). Furthermore, transport costs are reduced, inventory management is enhanced and the company's brand is enhanced through a better customer experience. Sustainable sourcing helps to manage downstream risks in terms of supplier shortcomings and also benefits smaller suppliers in the community through the practice of buying locally (Esty & Simmons, 2011:205–220).

4.6.2 Human capital: creation of competitive advantage and organisational learning as a result of climate-change investments

The sub-sections below outline the role human capital plays in enhancing financial returns for climate-friendly companies.

4.6.2.1 Creating competitive advantage through human capital

Sustainable organisations can better attract, motivate and retain staff as there is a proven direct relationship between sustainability performance, employee engagement and satisfaction and financial performance (Hopwood *et al.,* 2010:11–12). Various studies show that highly engaged employees outperform those who are

not and that the share prices of their companies rise significantly faster than comparative averages (Friend, 2009:165). Adapting to climate change requires a change in the DNA of the company, as expressed through its culture, policies and habits (Friend, 2009:166).

'Innovate or die' is becoming a popular proverb in business circles, with companies increasingly seeking to optimise their 'return over cash invested versus time to realise returns' curves so as to get viable climate adaptation ideas out to market (Phyper & MacLean, 2009:301–333). It is increasingly seen that embedding sustainability has a direct and positive impact on employees' ability to innovate and create value (Phyper & MacLean, 2009:339–356). Companies with a discernible green culture stand out from their peers (Olson, 2010:23–42). Table 4.8 below summarises the approach and benefits to this:

Table 4.8: Human capital benefits of green culture

Culture change	**Techniques**	**Benefits**
Lead by example	Leadership sponsorship and visibility in green initiatives	Enhanced understating of new corporate goals
Install appropriate tools	Alternatives to transport arrangements	Supports change and creates accountability
Provide training	Link the concept of climate change with corporate action	Strengthens efficient use of resources
Measure and report performance	Reporting tools on environmental key performance indicators (KPIs) such as fuel consumption and electricity use	Provides a base to set improvement targets and for recognition of advances made
Make it everyone's responsibility	Defining and tracking environmental stewardship in roles of employees	Generates new ideas and contributes towards revenue generation and cost reduction
Communicate with the workforce and others	Communicate about future plans and past successes	Examines trends, new technologies and competitor responses

Source: Adapted from Olson (2010:23–42)

Hitchcock and Willard (2009:167–180) suggest that a sustainability programme is a much more powerful motivator than programmes like total quality management that just focus on making the company better. This is because sustainability folds in employees' latent concerns about making the world better in dealing with issues such as climate change and poverty. Greening initiatives have been demonstrated to boost employee satisfaction, talent attraction, retention, productivity and innovation of energy saving projects with high returns on investment (Hitchcock & Willard, 2009:167–180). Aligning sustainability strategy with performance evaluation systems not only shifts behaviours within a company, but can create improved financial, operational and sustainability performance (Epstein, 2008:125–142).

4.6.2.2 Organisational learning – generation of business benefits through creation of new competencies

It is expected that new competencies will be required to execute green strategies and companies will accumulate intangible benefits from re-skilled workforces and new talent (Olson, 2010:43–58). To match this, new technologies are being deployed that, in complementing green strategies, will increase the efficiency and effectiveness of business activity and simultaneously reduce waste" (Olson, 2010:43-58). Accordingly, companies stand to benefit from such multi-pronged investments.

'Organisational learning' is an increasingly popular concept as it is felt that companies that learn rapidly have a competitive advantage as they are well prepared to address social and environmental challenges, now and in the future (Epstein, 2008:198–222). Successful sustainability programmes build up company knowledge assets or core capabilities in four dimensions:

- skills and knowledge – expertise, qualifications and corporate knowledge of employees;
- physical technical systems – documented and codified systems that embody corporate knowledge, such as databases and software;
- managerial systems – knowledge that is embedded in decision-making systems; and

- norms and values – screening and control mechanisms that direct employees in their achievement of organisational strategy (Epstein, 2008:198–222).

4.6.3 Information technology (IT): use of it to reduce costs and as an enabler for sustainability

Section 4.6.3 provides an analysis of the role that IT plays in creating opportunities for companies.

4.6.3.1 Reduction in IT costs and emissions

Esty and Simmons (2011:169–189) flag IT infrastructure as an opportunity to be tackled due to its significant energy costs and greenhouse gas emissions. There is a spotlight on IT as it is responsible for 2% of global climate emissions, and this is growing as data centres proliferate, in addition to the concerns over e-waste given that computers have short useful lives before they become obsolete (Hitchcock & Willard, 2009:203–214).

IT can also be used to de-materialise operations by being a mode for transitioning to a paperless environment to save on paper costs, increase accessibility and free up paper filing space (Hitchcock & Willard, 2009:203–214). IT can facilitate sustainability savings in other areas through automation, digitalisation and video conferencing (Esty & Simmons, 2011:169–189). Opportunities also exist to improve the efficiency of IT systems and data centres, reducing e-waste, fostering eco-innovation and identifying IT-based revenue opportunities (Esty & Simmons, 2011:169–189).

4.6.3.2 IT as a sustainability enabler to companies

Friend (2009:161–163) sees Information Technology (IT) as an important enabler to improved environmental and financial performance by enhancing awareness over risks and opportunities. The role that IT can play is demonstrated in Figure 4.5 below:

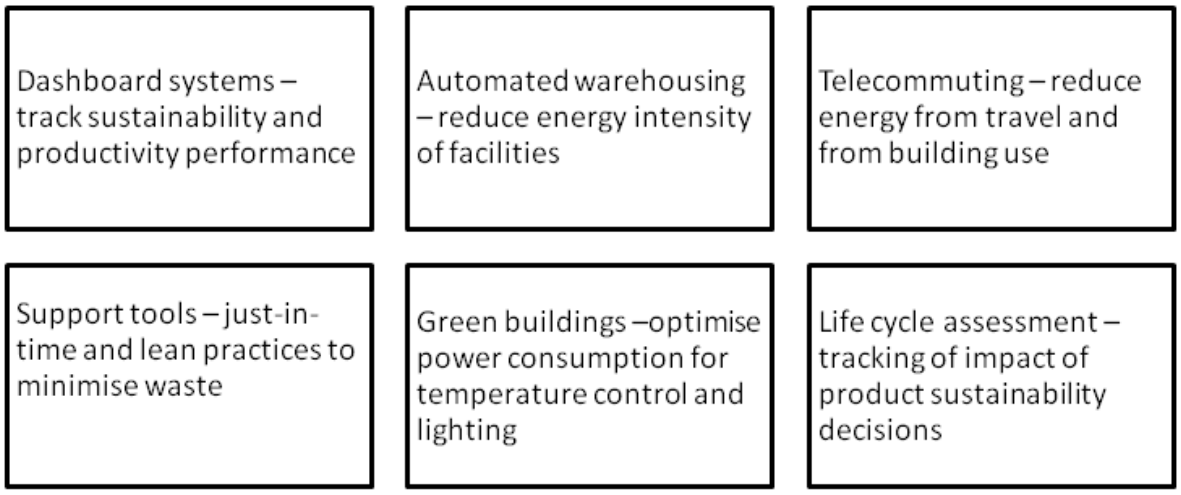

Figure 4.5: The role of IT in enabling sustainability

Source: Friend (2009:161–164)

In future, IT will increasingly be used for real-time energy monitoring and to support sustainable product design (Hitchcock & Willard, 2009:203–214). IT sustainability solutions are being seen in diverse areas such as farming, traffic management and logistics (Esty & Simmons 2011:169–189). IT can drive new revenue streams through deploying sustainability solutions. Climate-change response initiatives typically go hand in hand with instrumentation technology, i.e. tools that incorporate sensors, imaging and information monitoring, which are used to track and manage resources throughout the product life cycle (Olson, 2010:123–140). Such instrumentation offers myriad benefits such as selling the underlying technology, improving the way companies operate, reducing costs and greater environmental benefits (Olson, 2010:123–140). Instrumentation creates the platform for a more agile business such as rapidly assimilating external events, real-world-aware data processing, predictive modelling, and integrated analysis of internal/external trends (Olson, 2010:123–140).

Olson (2010:157–174) identifies seven types of technologies that create opportunities in the adaptation to climate change and these are outlined in Table 4.9 below:

Table 4.9: Technologies that create climate-change opportunities

Technology	Use
Macro-level environmental models	Uses sensors at a country, industry or utility level to form the link between real-world-awareness and business decisions/processes
Transformation methodologies	Efficiency and waste reduction based on methodologies (supported by relevant tools) such as Green Sigma, lean practices, product life-cycle management, total quality management (TQM), design for manufacture (DFM) and shared services
Diagnostic tools	Assessment tools for measuring carbon emissions and maturity models to assess progress towards environmental sustainability
Targeted point solutions	Target specific environmental issues in an industry
Technology for alternative energy production	Energy from alternative sources besides fossil fuels such as solar, wind, water, biomass and waves
Technology for efficient energy use	Enhances energy efficiencies in the use of buildings, operations, production processes and other infrastructure
Technology for natural resource management	Focuses on recycling, disposal and reclamation to reduce waste and end-of-line environmental impacts

Source: Adapted from Olson (2010:157–174)

4.6.4 Non-financial information: use of broader information sources to enable more sustainable decision-making and maximise stakeholder value

Sustainability and climate-change considerations can lead to a more comprehensive set of information for decision-making that can enrich existing financial information. These considerations are outlined below.

4.6.4.1 Use of sustainability information to create advantages in decision-making

A company that makes use of environmental and social information will typically adopt a longer-term perspective to creating financial returns, pursue eco-efficiency to optimise costs, liabilities and revenue, practice life-cycle analysis to manage its entire

supply chain, and rigorously manage risks to intangible assets – whether on or off-balance sheet (Soyka, 2012:234–235). Companies that wear a 'sustainability lens' have an advantage in that they can navigate the unseen profit, value and risk drivers that others cannot (Friend, 2009:184–188).

Kiernan (2009:73–96) postulates that there are shortcomings with traditional accounting information as a few key assumptions can materially shift the results, for example, the treatment of share options, nonrecurring items, value of goodwill, pension fund actuarial liabilities, treatment of research and development costs, unsold inventory valuations, and depreciation rates. Building on this, Kiernan (2009:73–96) laments the failure of accounting to account for intangibles that influence the greatest part of a company's valuation, such as human capital, social and environmental matters. Kiernan (2009:73–96) feels that this is unsurprising as double-entry bookkeeping was invented in the 15th century by an Italian monk and mathematician when economic value was primarily created through tangible assets, before today's world where 80–85% of true business value resides in intangibles.

It is therefore useful to explore potentially unrecognised intangible information such as environmental, social and governance issues – particularly in the light of financial statements now only capturing 15% of the value of a major modern entity (Soyka, 2012:221). Kiernan (2009:73–96) suggests that using sustainability information will alleviate the deficiencies of traditional accounting in providing a more comprehensive view of a company's current and future state of affairs.

Opponents of sustainability may typically espouse that market participants already have sufficient information to guide their decisions. According to Kiernan (2009:73-96), whilst the efficient markets hypothesis believes in the efficiency of markets and that share prices fully price in all key company information, it can be argued that, in the absence of credible environmental and social company information, information is not equally available to market participants. Behavioural finance demonstrates that this shortcoming is exacerbated by investors' herd mentality that will tend to filter new information to avoid changing existing beliefs (anchoring), inertia to changing beliefs (conservatism), making decisions on inadequate information (availability bias), putting greater weight on recent experiences (recency bias), and overconfidence bias (Kiernan, 2009:73–96). This shortcoming however demonstrates an arbitrage

opportunity for companies that overcome the market inefficiency on sustainability matters to create above average financial returns (Kiernan, 2009:73–96). Understanding how a company's strategy, management quality, positioning on enviro-social factors, people, governance, technology and innovation have changed in a quarter is a more reliable predictor of sustainability than the quarterly financial result (Kiernan, 2009:73–96).

4.6.4.2 Maximisation of stakeholder value through broader measures of performance

Epstein (2008:143–162) believes that sustainability performance can be measured, even if imprecisely, to evaluate the benefits derived, incorporate externalities and assist decision-making regarding trade-offs. Knowing the values, costs and liabilities attributable to sustainability considerations facilitates a better understanding of the stakeholder value that is at risk (Epstein 2008:143–162).

Given that ecosystems provide services that benefit mankind, they may be viewed as environmental assets that have an economic value (Hardisty, 2010:12–14). Monetisation reveals the externalised costs that businesses may be ignoring and provides a more realistic view of the true costs of business activities (Hardisty, 2010:12–14). This can help businesses make more sustainable decisions. This leads to companies being able to protect their reputations better than before, and they can prepare themselves better to survive future shocks and prepare their products for a future society that will demand more sustainability than in the past (Hardisty, 2010:12–14).

The following measures can be used to assign values to stakeholder interests and thus create a base for improving performance:

- valuation of environmental resources using concepts such as willingness to pay, costs of reducing damage, costs of treating damage, market values, pricing based on surrogate markets that are traded competitively and passive use values (Epstein, 2008:143–162);

- environmental and economic sustainability assessments (EESA) to integrate sustainability into decision-making. This entails valuing financial, environmental

and social assets, followed by calculating traditional and socio-economic net present values. Such information is used to evaluate projects and investments in a manner that considers all variables, whether financial or non-financial (Hardisty, 2010:62–63);

- metrics for tracking carbon metrics in relation to financial metrics and therefore encourage efficiency through company value chains. Such metrics include return on sustainability (ROS), return on carbon (net income/CO_2), debt to carbon (debt/total CO_2), carbon to equity (total CO_2/equity), CO_2 emissions per employee, CO_2 to price per share, and net income to energy consumed (Wilhelm, 2009:41–58);

- activity-based costing (ABC) for improving decision-making by creating a better understanding of company costs, including environmental and social costs. ABC creates a cause-and-effect analysis that motivates decision-makers to find alternatives that lower costs (Epstein, 2008:103–123);

- Life-cycle costing (LCC) that monetises social and environmental costs, both internally and externally to create cost information that guides environmental efficiency of products. LCC information can be integrated into an accounting framework such as full cost accounting (FCA) that incorporates sustainability principles into all key investment and product decisions (Epstein, 2008:103–123); and

- return on investment (ROI) calculations that are adapted to monetise the net present values of previously unquantified risks and the returns from related environmental and social opportunities. This creates a financial reference point that can be used to aggressively track ROI on virtually all of a company's activities, including those activities that were traditionally excluded from ROI measurements (Epstein, 2008:163–196).

The above measures will assist companies to reduce sustainability risks to an acceptable level, reconsider cost structures, and obtain a broader understanding of their value drivers.

4.7 SUMMARY AND CONCLUSION

Chapter 4 identified 15 categories of opportunities that can create financial returns and enhance sustainability of companies in the course of adapting to climate change. Opportunities identified have four key positive effects, namely enhancement of the value-creation capabilities of companies, expansion of revenue sources, improvements in efficiency and cost bases, and providing competitive advantage from support functions.

Firstly, Chapter 4 outlined that it has been proved empirically that sustainable companies generate higher returns. Higher returns were shown to be generated through enhanced financial, customer, operational and organisational performance. Companies seize on opportunities to enhance their business models and attract more capital as a result of sustainability.

Secondly, companies that respond to climate change have opportunities to generate increased revenue. New revenue sources include the green consume' market through which companies can differentiate their sales value propositions from competitors. Opportunities also arise as a result of new compliance requirements. This creates opportunities for companies to revisit their product portfolios and pursue technological innovation that opens up new markets, such as the 'clean technology' sector. It was also clear from the literature review that establishing a good corporate reputation underpins any attempt to enhance revenues as companies require a social license to operate.

Thirdly, Chapter 4 demonstrated that initiatives that set out to decrease carbon emissions have the dual effect of reducing the cost base of companies. This is primarily as a result of reduced resource use. Efficiencies are created when production processes are improved due to green manufacturing being synonymous with many other forms of process improvement techniques.

Lastly, it was apparent that the competitive advantage of support functions such as supply chain, human resources and information technology is enhanced through adapting to climate change. Such support functions become more responsive and customer-focused. Furthermore, new competencies are created in the process of adaptation. It was also noted that once support functions start to capture reliable non-

financial information on environmental and social matters, this creates useful information for decision-making.

CHAPTER 5

EMPIRICAL RESEARCH AND METHODOLOGY

5.1 INTRODUCTION

Chapter 2 established that climate change is a significant issue for companies and Chapters 3 and 4 then explored the risks and opportunities to companies as a result of climate change. Given the aforementioned, it is critical to examine empirical evidence to support or refute the views and conclusions from the previous chapters.

The research problem of this study was to ascertain whether climate change has an impact on the risks, returns and sustainability of selected South African companies. This required an assessment of the published performance of companies, in comparison to the level of response they have adapted to climate change.

The foundation for this assessment is contained in this chapter as it discusses the research methodology that has been used in this study. The results of the research methodology followed will be analysed in Chapter 6.

5.2 RESEARCH VARIABLES

The central hypothesis to this study is that climate change has a material impact on the risks and returns of leading companies in South Africa. To analyse this, the independent variable examined was climate change, in particular, the extent of climate-change risks as well as the response by companies to climate change. The dependent variables were identified as the risks and returns of companies, for which relevant indicators will be identified. The independent variable is the factor that is selected to determine the effect it has on the other (dependent) variables or phenomena being studied (Welman & Kruger, 1999:13–14). Once an independent variable is identified, it is important to evaluate whether it is the cause or consequence of other variables and research typically distinguishes between independent and dependent variables (Welman & Kruger, 1999:13–14). Logically,

the null hypothesis is that there is no relationship between climate change and the risks or returns of companies.

5.3 RESEARCH METHODOLOGY

The research method selected was historical analysis, which made use of quantitative secondary data through secondary analysis. Sources of relevant secondary data included organisations that collate information on:

- climate-change responses, risks and opportunities of companies; and
- the financial performance of listed companies.

Historical or analytical research focuses on finding new interpretations of existing information (Welman & Kruger, 1999:13–14). Historical research locates sources, evaluates them and interprets them in a way that will determine causal explanations (Welman & Kruger, 1999:21). Secondary analysis refers to utilising data that has been collected by other organisations and researchers (Bryman & Bell, 2007:326). Its advantage is often the high quality of data sets available, minimal costs, ability to study sizeable populations and the opportunity for longitudinal analysis (Bryman & Bell, 2007:328–331). Repko (2012:249) similarly indicates that secondary analysis is useful for identifying group tendencies and notes that it is very useful for establishing correlations. Repko (2012:37–39) adds that certain complex problems such as global warming, where one looks at both earth science and economical disciplines, require revolutionary insights to change the way we think and a balance between creative, analytical and practical intelligence.

Primary analysis, such as the use of interviews and questionnaires, was considered as a research method. However, major listed companies have already disclosed comprehensive climate-change information to bodies such as the Johannesburg Stock Exchange's Socially Responsible Investment Index (JSE SRI Index) and the global Carbon Disclosure Project (CDP). Therefore, whilst primary analysis would allow further analysis during interviews, it would not add significantly to the existing body of knowledge and would be seen as a duplication of effort by respondents. Secondly, information on the dependent variables, as manifested in the financial performance of listed companies, is widely available and broadly analysed.

5.4 POPULATION

The term ‘population’ refers to a complete group that shares some common characteristics (Zikmund, Babin, Carr & Griffin, 2010:385). In defining the population, the following factors were considered:

- Within South Africa, information on concepts such as financial performance, market value, returns and risk (such as the beta coefficient concept explored in paragraph 5.6.2.6) is consistently available for companies that are listed on the Johannesburg Stock Exchange (JSE).

- The largest companies on the JSE by market capitalisation typically set the trend for the rest of the JSE and are more likely to have analysed sustainability risks such as climate change.

- As climate change is a relatively new concept, few companies have fully explored its effect on their businesses. The Carbon Disclosure Project (CDP) was found to hold the most significant and comprehensive collection of self-reported company climate-change data. The JSE SRI also includes climate change in its analysis. However, this is not as comprehensive as the CDP as the JSE SRI broadly looks at other sustainability indicators and does not provide information on climate change separately.

- For South Africa, the CDP was found to have selected the top 100 companies, listed on the JSE, based on market capitalisation as at 30 November 2011. Furthermore, another 13 companies outside of the JSE top 100 sample had voluntarily disclosed climate-change information to the CDP (CDP, 2012:30). According to the CDP (2012:30), it appears that the level of climate-change reporting outside of the JSE is low.

Based on the above, the population was defined as the top 100 JSE companies per the CDP, as well as those that have voluntarily disclosed climate-change data to the CDP in the years 2011 and 2012.

5.5 SAMPLE AND SAMPLE SIZE

Given that the population as defined above was sufficiently small, the entire population of JSE-listed companies that have disclosed climate-change data to the JSE was selected for study. This comprised of a census, which is an enumeration of an entire population where data is gathered for all parts of a population (Bryman & Bell, 2007:182).

The sample size was determined as 70 after considering the following factors:

- 78 of the JSE 100 provided information to the CDP whilst 22 declined to participate;
- of the 78 above, eight companies did not make their records public;
- another five companies were excluded, largely because their records were contained in the UK and Australia sections of the CDP and one company's records could not be located for subsequent financial analysis;
- two companies' responses were already included in their parent companies' responses; and
- eight companies that were not in the JSE 100 but voluntarily disclosed were included.

The above sample size appeared to be adequate for analysis to be undertaken. Welman and Kruger (1999:64–65) recommend that a sample should comprise of at least 25 units of analysis as a general rule and it should highlight that the greater the proportion of sample and sample size, the lower the standard error.

The list of the 70 companies that comprise the population is indicated in Appendix A.

5.6 SECONDARY ANALYSIS OVERVIEW

In summary, the empirical research was performed by comparing the climate-change performance, risks and opportunities of companies to their historical and projected financial performance. The process is indicated in the steps outlined below:

- obtained access to the CDP database and analysed the reports of the 70 selected companies so as to extract climate-change data;

- obtained access to the McGregor BFA database through the UNISA library and extracted financial data and statistics for the 70 companies indicated above. McGregor BFA is a provider of financial data feeds and analysis tools with a database of JSE company information for the last 40 years; and

- compared the information as per steps 1 and 2 above to determine correlations in order to confirm or disprove the hypothesis of this dissertation.

The next part of this chapter provides more detail on the indicators studied for climate-change data and for financial data

5.6.1 Climate-change data

CDP reports were obtained for each of the 70 selected companies as reported in 2011 and 2012. Reporting is typically done for the previous year, i.e. 2012 reports refer to 2011 company information. CDP questions were selected for analysis and an evaluation of the questions was conducted. The CDP questionnaire consisted of questions and requests for information relating to climate-change governance, strategy, emissions reduction targets and initiatives, communications, climate-change risks. climate-change opportunities, emissions methodology, emissions data, energy usage, emissions performance, and emissions trading. From the 103 questions encompassed by the CDP questionnaire, ten questions selected for the empirical research were as follows:

- questions that provided an indication of the extent to which climate-change performance was embedded in the company (such as incentives for climate-change performance and formal target setting for emissions reduction); and

- questions that related directly to climate-change risks and opportunities in accordance with Chapters 3 and 4 respectively.

The questions that were not selected for analysis were those that were not relevant to this study (e.g. detailed analysis of emissions and emissions trading activities) or

questions where positive or negative answers did not necessarily reflect climate-change performance (e.g. communication with regulators).

The selected questions are listed in Table 5.1 below:

Table 5.1: Questions selected to analyse climate-change data

Question Number	CDP Reference	Investor CDP 2012 question
	Governance	
1	1.2	Do you provide incentives for the management of climate-change issues, including the attainment of targets?
2	2.2	Is climate change integrated into your business strategy?
	Targets and initiatives	
3	3.1a	Did you have an emissions reduction target that was active (on-going or reached completion) in the reporting year?
	Climate-change risks	
4	5.1	Have you identified any climate-change risks (current or future) that have the potential to generate a substantive change in your business operations, revenue or expenditure?
	5.1a	Please describe your risks driven by changes in regulation
	5.1c	Please describe your risks that are driven by changes in physical climate parameters
	5.1e	Please describe your risks that are driven by changes in climate-related developments
5		For all of the risks identified, please provide the following details: • Risk driver • Description • Potential impact • Time frame • Direct/indirect

Question Number	CDP Reference	Investor CDP 2012 question
		• Likelihood of impact • Magnitude of impact
	Climate-change opportunities	
6	6.1	Have you identified any climate-change opportunities (current or future) that have the potential to generate a substantive change in your business operations, revenue or expenditure?
	6.1a	Please describe your opportunities that are driven by changes in regulation
	6.1c	Please describe the opportunities that are driven by changes in physical climate parameters
	6.1e	Please describe the opportunities that are driven by changes in other climate-related developments
7		For all of the opportunities identified, please provide the following details: • Risk driver • Description • Potential impact • Time frame • Direct / indirect • Likelihood of impact • Magnitude of impact
(Included in questions 10 and 11 per Table 5.3 on page 129)	Emissions data	
	8.2a	Please provide your gross global Scope 1 emissions figure in metric tonnes CO_2e
	8.3a	Please provide your gross global Scope 2 emissions figures in metric tonnes CO_2e
	Emissions performance	
	13.1	How do your absolute emissions (Scope 1 and 2 combined) for the reporting year compare to the previous year?

Based on the above, information was prepared for analysis as follows:

- **yes** or **no** answers were coded as 1 or 0; and
- risks and opportunities were converted for numerical analysis as per Table 5.2 below.

Table 5.2: Conversion of qualitative responses for numerical analysis

Risk or opportunity impact as reported	**Coding**
Low	1
Low-medium	2
Medium	3
Medium-high	4
High	5
Risk or opportunity likelihood as reported	**Coding**
Unlikely or very unlikely	1
About as likely as not	2
More likely than not	3
Likely	4
Very likely	5
Virtually certain	6
Time frame of risk or opportunity as reported	**Coding**
Current	1
1 to 5 years	2
6 to 10 years	3
More than 10 years	4

Further to the above, quantitative analysis was conducted to assess whether there were relationships between climate-change governance, risks and opportunities. Subsequently, climate-change performance data was compared to financial data as further elaborated below.

5.6.2 Financial data

Which financial data indicates a company that is performing well, manages its risks appropriately and earns an adequate return? As there is no single financial ratio that can capture sustainable financial performance, multiple indicators were identified. To provide context to the indicators selected in relation to the central hypothesis of this dissertation, it is important to understand what returns and risks are. Moles, Parrino and Kidwell (2011:244–249) explain that total returns are a sum of capital appreciation and income earned whilst an investment is held. Returns create economic value and, to state the obvious, most stakeholders have an interest in a company creating value as they all derive cash flows out of a company's productive assets, whether they are shareholders, employees, suppliers or government (Moles *et al.,* 2011:4–6). On the other hand, risk is the converse of return and ultimately serves to constrain the future cash flows of a company (Moles *et al.,* 2011:782–783). Moles *et al.* (2011:244–275) state that higher risks correlate with higher expected returns and suggest measures such as share price standard deviation, relative comparisons, calculating the probability of achieving outcomes, and using the capital asset pricing model, which quantifies the relationship between risk and expected return. Moles *et al.* (2011:143–150) favour peer group analysis but caution against relying on a single ratio due to potential distortions. Logically, the use of diverse financial indicators is required to test against the independent variable of climate-change performance.

These indicators are explained below, as well as the relevant hypothesis in relation to the climate-change data. For brevity, the various climate-change indicators will be referred to as 'climate-change performance indicators'.

5.6.2.1 Analysts' recommendations

Equity analysts or brokers summarise their opinions about companies into buy, sell or hold recommendations for shares (Moles *et al.,* 2011:333). Such brokers are in regular contact with all players in the market and therefore have an informed view on the value of shares. Accordingly, analysts' recommendations were averaged for each company and the average sell, hold or buy result was compared to climate-change performance data to evaluate whether there is a correlation.

5.6.2.2 Weighted average cost of capital (WACC)

The cost of capital demonstrates the rate of return that debt and equity investors require from their investment in a company, based on their view of the risk versus return trade-off (McGuigan, Kretlow & Moyer; 2009:398–399). A comparison was made between WACC and climate-change performance data to assess whether WACC differs for climate-change performers.

5.6.2.3 Internal rate of return (IRR)

Internal rate of return (IRR) is one of the most common measures used for evaluating investments (McGregor BFA, 2012d:2). IRR measures the annual rate of return in relation to the amount invested, and demonstrates whether shareholder value is created or destroyed (Gitman, Smith, Hall, Lowies, Marx, Strydom & Van der Merwe, 2010:394–396). IRR for each company, as retrieved from the McGregor BFA database, was compared to climate-change performance data to identify whether any correlation exists.

5.6.2.4 Market value to book value (M/B ratio)

The market value to book value ratio (M/B ratio) compares the market value of a firm's shares to its shareholders' funds, per ordinary share (Gitman *et al.,* 2010:60). Gitman *et al.* (2010:60) indicate that companies that are expected to earn higher returns relative to their risk typically sell at higher M/B ratio multiples. The empirical research compared M/B ratios to climate-change performance data.

5.6.2.5 Analysts' forecasts of earnings per share growth over the next three years

Analysts regularly provide forecasts of earnings per share (EPS). This information is useful in predicting companies that are likely to have higher returns, as McGregor BFA (2012a:2) indicates that such analysts specialise in industries, have knowledge of economic conditions and have access to company leadership in order to form reliable estimates. McGuigan *et al.* (2009:276) agree that consensus analyst forecasts of growth have proved to be the most accurate estimates and are "an excellent proxy for growth expectations of investors" (McGuigan *et al.,* 2009:276).

Consensus EPS forecasts were obtained for each company, averaged and compared to climate-change performance.

5.6.2.6 The beta coefficient

The beta coefficient is a useful measure of non-diversifiable risk and assesses the responsiveness of a share to changing market conditions (Gitman *et al.,* 2010:226–228). Beta is calculated by comparing return volatilities or standard deviations to the JSE all-share index (McGregor BFA, 2012b:5). Idealistically, a company with a relatively higher beta is more responsive to changing market returns and thus more risky than low beta companies (Gitman *et al.,* 2010: 226–228). Accordingly, beta coefficients were compared for the sampled companies to assess whether a relationship exists between beta and climate-change performance.

5.6.2.7 Price/earnings to growth (PEG) consensus ratio

PEG is the ratio of a company's price/earnings (PE) ratio to its future annual earnings per share growth as projected by analysts (McGregor BFA, 2012a:3). A PEG value of 1 implies a fairly valued company. A PEG value of between 0 and 1 suggests that a company might produce higher returns as it may be undervalued in relation to its expected growth (McGregor BFA, 2012a:3–4). A relationship was investigated between PEG ratios and climate-change performance.

5.6.2.8 Du Pont return on equity

The Du Pont model measures return on equity (ROE) by considering net profit, asset turnover and financial leverage (McGregor BFA, 2012c:2–3). This ratio is higher for companies that have greater net returns, use resources and capital more efficiently, and successfully manage a higher financial risk than other companies (McGregor BFA, 2012c:2–3). The Du Pont model was also considered appropriate to probe the relationship between financial performance and climate-change performance.

5.6.3 Comparison of climate-change data and financial data

Based on the climate change data questions in 5.6.1 and the financial data indicated in 5.6.2, the following questions were derived to identify relationships between the various sets of information:

Table 5.3: Questions selected to analyse climate-change and financial data

Question Number ***(Numbering continued from Table 5.1)***	**Question**
8	Is there a correlation between climate change risks and climate change opportunities?
9	Are companies that improve their response to climate change likely to attract better ratings from equity analysts than those that do not make improvements?
10	Do companies that reduce emissions attract better ratings from equity analysts than companies that do not reduce emissions?
11	Is there a relationship between climate change performance indicators and decreases in carbon emissions?
12	Is there a relationship between climate change performance indicators and WACC?
13	Is there a relationship between climate change performance and IRR?
14	Is there a relationship between climate change performance and the M/B ratio?
15	Do equity analyst predictions of future EPS show a link to climate change performance
16	Is there a correlation between companies that have indicated high climate change opportunities and the beta coefficient?
17	Is there a relationship between climate change performance and the price / earnings to growth analyst consensus ratio?
18	Do climate change risks and opportunities bear a correlation to return on equity?

5.7 STATISTICAL ANALYSIS TECHNIQUES EMPLOYED

Techniques employed for statistical analysis were primarily:

- contingency tables (also known as pivot tables), which describe the relationship between two nominal variables (Keller, 2005:52);

- simple regression analysis, which quantifies the relationship between a single independent (explanatory) variable with a dependent (response) variable (Albright, Winston & Zappe, 2004:548–550); and

- the chi-squared test for independence, which empirically tests whether there is dependence between selected attributes (Albright *et al.,* 2004:522). The chi-squared test supplemented the contingency tables referred to above as it quantified whether trends observed between climate-change performance and financial performance were statistically significant or not.

5.8 LIMITATIONS OF THE EMPIRICAL RESEARCH

The limitations of the empirical research are as indicated below:

- **Limited size of population**

The extent of visible and uniformly structured reporting of climate-change information, risks and opportunities within the JSE appears to be largely concentrated on the largest companies by market capitalisation. Whilst more companies prepare integrated reports, these vary greatly in terms of content.

- **Limitations of secondary analysis**

Inherent limitations of secondary analysis could be the complexity and understandability of data, absence of key variables and lack of control over data quality (Bryman & Bell, 2007:334–336).

- **Limitations of quantitative analysis**

Correlations established from statistical analysis cannot be used as evidence of a causal relationship in the absence of a plausible theory or other methods (Repko, 2012:249).

- **Challenges in inferring climate change as a causality variable**

Even if the study concludes that companies that respond to climate change perform better than those who do not respond, it is difficult to infer what came first: their response to climate change or their financial performance. Climate change is just one

risk out of a myriad of variables that influence the results of companies. Welman and Kruger (1999:72–73) warn that to infer causality, cause must precede the effect – which can be difficult to ascertain as causal factors are often ongoing without conclusion at an identifiable point in time.

5.9 SUMMARY AND CONCLUSION

Historical analysis of quantitative secondary data was selected to determine whether climate change has a material impact on the risks and returns of companies in South Africa. A population of 70 JSE-listed companies was selected. The population units were those JSE top 100 companies that have disclosed climate-change data to the CDP as well as other companies outside of the JSE top 100 that voluntarily disclosed information to the CDP. The sampling method was defined as a census as all the units of the population for whom data was available were included in the study.

It was determined that secondary analysis is useful for studying a sizeable population, for identifying tendencies and for establishing correlations. Primary research in the form of interviews was not selected as a research method as it was determined that there was sufficient and appropriate official company information for the purposes of the study. Climate-change data was extracted from the CDP database to obtain information on the independent variable. This data was then compared to the dependent variable of financial data, based on information sourced from the McGregor BFA database. Climate-change data and financial data indicators that were relevant to the research problem were identified in Chapter 5. The chapter also determined the statistical analysis techniques to be employed. There were inherent limitations to the empirical research and these related to the limited population size (in relation to the JSE), limitations of secondary analysis and challenges in inferring a causal relationship purely from the quantitative analysis.

CHAPTER 6

ANALYSIS OF EMPIRICAL RESEARCH FINDINGS

6.1 INTRODUCTION

The aim of this chapter is to analyse the empirical research findings resulting from the historical analysis of the sample of 70 selected JSE-listed companies. This analysis will serve to empirically confirm or refute the literature review findings that were outlined in Chapters 2 to 4. The analysis is presented through charts and tables in which trends and relationships are explored.

The chapter commences with an examination of trends within the climate-change data as explained in section 5.6.1 of Chapter 5 in relation to the questions on climate-change risks and opportunities. In this regard, the impact, likelihood and time frame of climate-change risks and opportunities are firstly examined to determine whether climate change is a significant and immediate risk for companies. Secondly, the climate-change data is compared to the financial data referred to in section 5.6.2, namely analysts' recommendations, weighted average cost of capital, internal rate of return, market value to book value, earnings forecasts, beta coefficients, price /earnings (p/e) to growth ratios and return on equity. This comparison seeks to establish whether climate-change risks, opportunities and performance bear a correlation to financial performance. The chapter concludes with a summation of the key conclusions.

The climate-change data was based on CDP information disclosed in the year 2012, with 2011 information used as a comparative where trend analysis was applicable. Financial data was also based on the latest information disclosed by selected companies in 2012. As noted in Chapter 5, company annual financial reports and CDP disclosures are typically in respect of the year preceding the disclosure year. Financial data was extracted as at 14 November 2012 and therefore information on forecasts and share prices is the latest available information as at that date.

The information analysed was based on the research instrument questions outlined in Chapter 5 as per Table 5.1 and Table 5.3.

In certain cases, the current chapter uses the term **'leading climate-change performers'**. 'Leading climate-change performers' as defined in this study were those that answered positively to all three of the questions below:

- **Question 1** – Do you provide incentives for the management of climate-change issues, including the attainment of targets?
- **Question 2** – Is climate change integrated into your business strategy?
- **Question 3** – Did you have an emissions reduction target that was active (on-going or reached completion) in the reporting year?

6.2 RESEARCH FINDINGS

In this section, the questions are discussed individually and reported in the relevant figure.

6.2.1 Impact of climate-change risks and opportunities

Question 4: Have you identified any climate-change **risks** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Question 6: Have you identified any climate-change **opportunities** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Questions 5 and 7: Please provide the following details: magnitude of impact.

The aim of the above questions was to establish whether companies considered the impact of climate change to be significant to their businesses. For each risk or opportunity identified, companies selected from five possibilities, namely 'low', 'low-medium', 'medium', 'medium-high', and 'high'. The average impact for each company was calculated. Figure 6.1 summarises the results.

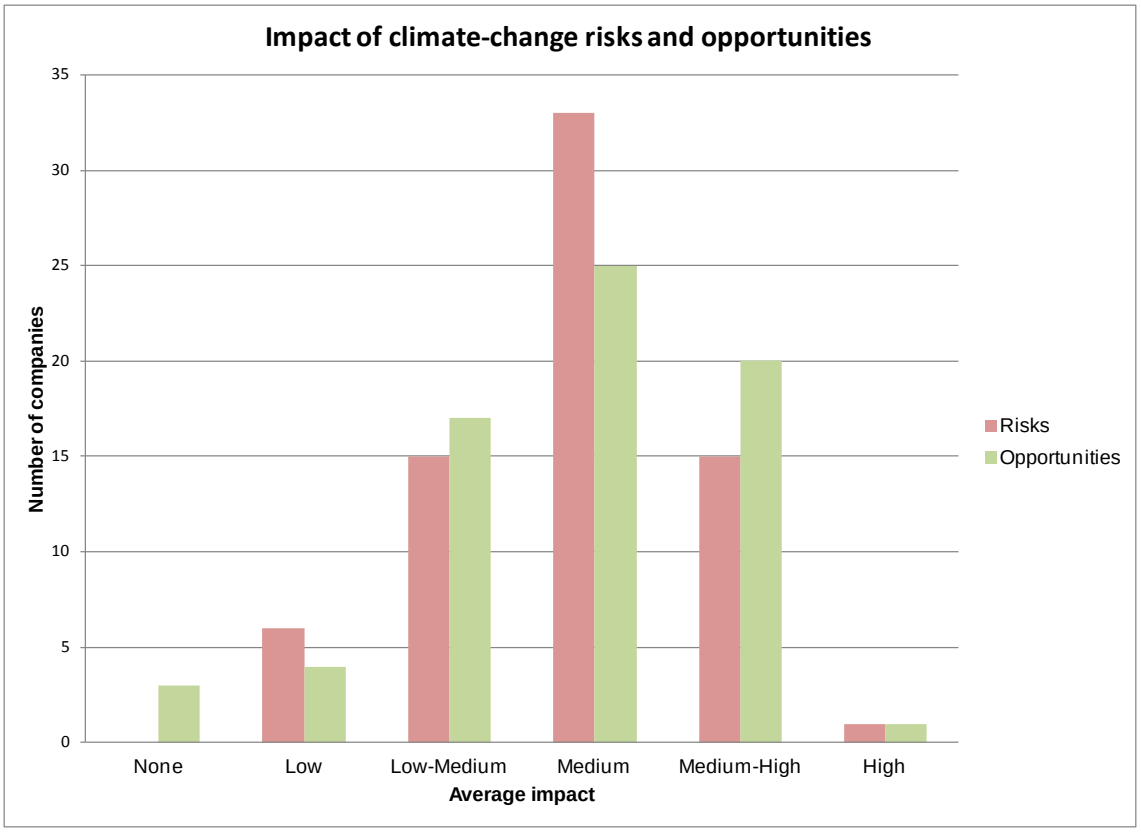

Figure 6.1: Impact of climate-change risks and opportunities

Risks

The results in Figure 6.1 above illustrate that 70% of companies rated the impact of climate-change risks as medium, medium-high or high. Only six of the 70 companies felt that the impact of climate-change risks was between none and low.

Opportunities

Almost similarly, the results in Figure 6.1 show that 65.7% of companies rated the impact of climate-change opportunities as medium, medium-high and high. Only seven of the 70 companies felt that the impact of climate-change opportunities was between none and low.

The above means that most companies have forecasted that climate change would have a significant impact on their operations, revenue or expenditure.

6.2.2 Likelihood of climate-change risks and opportunities

Question 4: Have you identified any climate-change **risks** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Question 6: Have you identified any climate-change **opportunities** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Questions 5 and 7: Please provide the following details: likelihood of impact.

The questions above established the extent to which companies felt the risk of climate change was likely to crystallise. The purpose was to conclude on whether the phenomena of climate-change risks is probable. For each risk and opportunity, companies selected from six likelihood choices, namely 'unlikely, 'about as likely as not', 'more likely than not', 'likely', 'very likely' and 'virtually certain'. The average likelihood of each company was calculated. Figure 6.2 summarises the results.

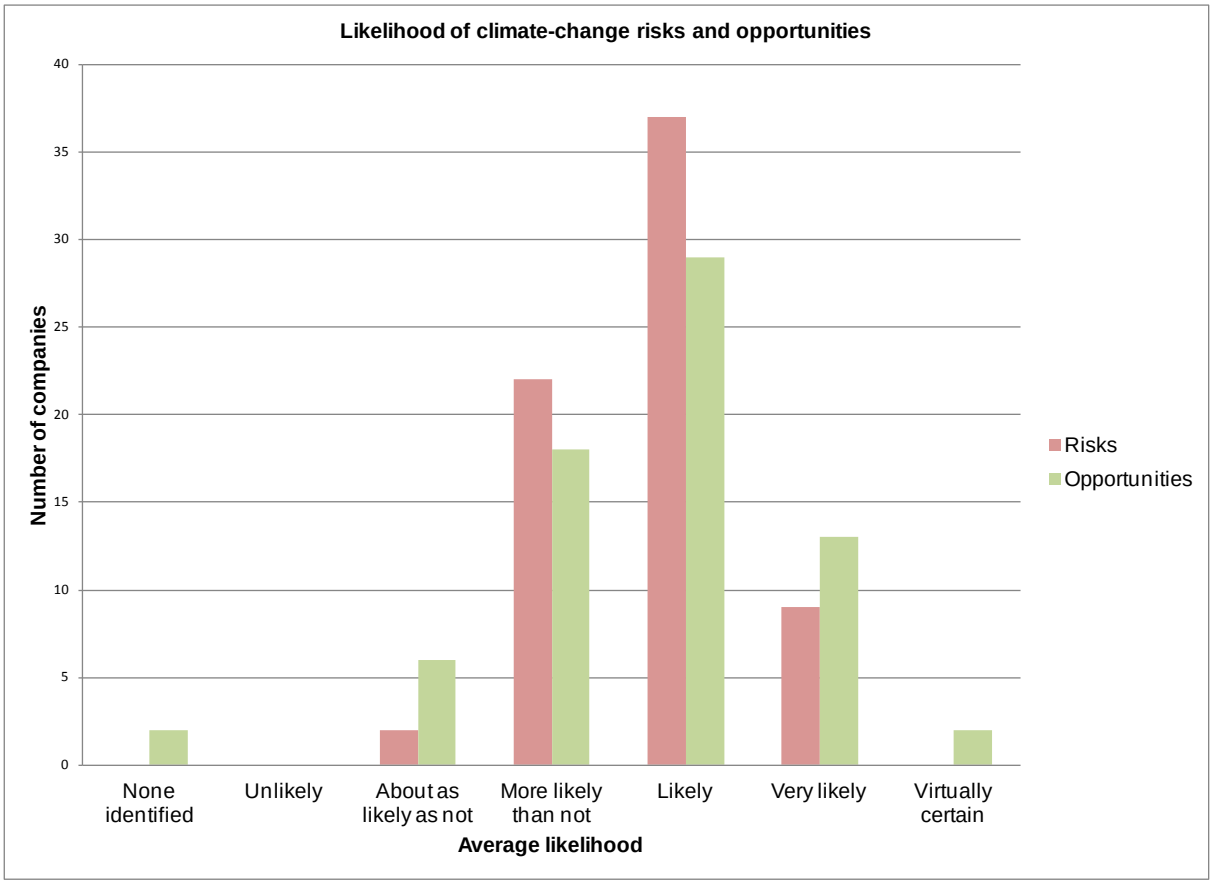

Figure 6.2: Likelihood of climate-change risks and opportunities

Risks

The results in Figure 6.2 indicate that 66% of companies believed that the risk of climate change was likely, very likely or virtually certain.

Opportunities

The likelihood of opportunities revealed a similar trend with 63% of companies stating that climate-change opportunities were at least likely.

It can be surmised that there is a high probability of climate-change risks and opportunities affecting the operations, revenue or expenditure of companies.

6.2.3 Expected time frame of climate-change risks and opportunities

Question 4: Have you identified any climate-change **risks** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Question 6: Have you identified any climate-change **opportunities** that have the potential to generate a substantive change in your business operations, revenue or expenditure?

Questions 5 and 7: Please provide the following details: time frame

The objective of the above questions was to establish how imminent the risks of climate change were for the participating companies. For each risk or opportunity, the companies selected between ‘current’, ‘one to five years’, ‘six to ten years’, and ‘more than ten years’. The average time frame of each company was calculated. Figure 6.3 summarises the results.

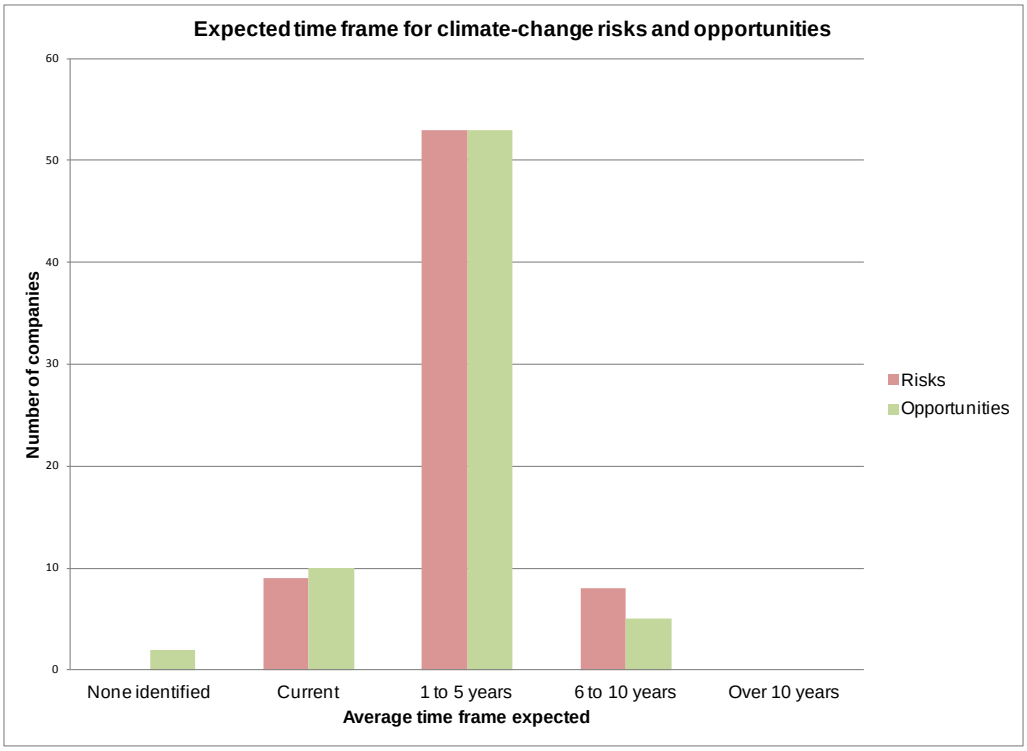

Figure 6.3: Expected time frame for climate-change risks and opportunities

Risks

Figure 6.3 above demonstrates that only 13% of companies felt that climate-change risks and opportunities were already occurring. Of the participants, 76% expected climate-change risks and opportunities to start occurring within one to five years.

Opportunities

Similarly, Figure 6.3 also illustrates that 14% of companies felt that climate-change opportunities were 'current'. The results showed that in less than five years, 90% of participating companies expected to face climate-change opportunities.

6.2.4 Relationship between climate-change risks and opportunities

Question 8: Is there a correlation between climate change risks and climate change opportunities?

In this question, the relationship between climate-change risks and opportunities was examined, namely are companies that face climate-change risks also likely to create opportunities? The total risk and opportunity of each company were calculated by

computing the product of the risk impacts and likelihoods. This was then plotted on a scatter-plot diagram and the Microsoft Excel Statpro add-in was used to calculate the statistical correlation. Figure 6.4 below illustrates the results.

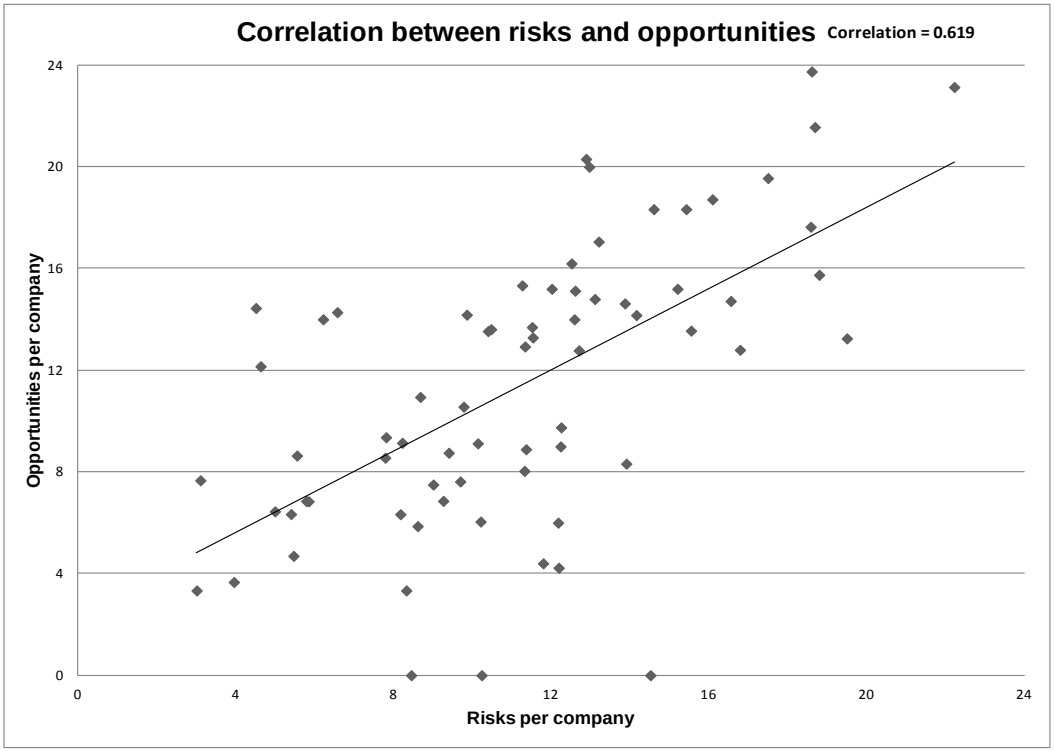

Figure 6.4: Correlation between risks and opportunities

As per Figure 6.4, there is a strong positive linear relationship between risks and opportunities. In other words, 61.2% of the changes in opportunities can be predicted based on changes in risks. Without concluding on cause and effect, the first observation deduced from this relationship is that companies that face high climate-change risks in relation to other companies are likely to perceive greater opportunities.

Further exploration of this linear relationship was conducted by isolating companies that were leading climate-change performers.

It was observed that:

- Leading climate-change performers were 2.3 times more likely than others to indicate high risks whose impact was at least ‘medium’ and whose likelihood was at least ‘likely’

  (chi-test of independence, p = 0.03/significant 96.5% confidence*)*;

- Leading climate-change performers were only 1.18 times more likely than others to indicate high opportunities whose impact was at least ‘medium’ and likelihood was at least ‘likely’

  (chi-test of independence, p = 0.61/very low 38.5% confidence); and

- In 67% of instances for all 70 companies selected, climate-change risks were forecasted to crystallise before climate-change opportunities are pursued.

The above leads to the second observation for the risk versus opportunity comparison, which is that, as companies improve their response to climate change, they are more likely to detect greater risks rather than greater opportunities. Also, risks are expected to materialise earlier than opportunities. Another way of expressing this is that most companies expect climate change to be firstly a downside risk before they start to generate returns from responding to climate change.

6.2.5 Impact of improved climate-change performance on equity analyst recommendations

Question 9: Are companies that improve their response to climate-change likely to attract better ratings from equity analysts than those that do not make improvements?

This question explored whether there is a relationship between improving climate-change performance and the recommendations of equity analysts. The three indicators of climate-change performance that were used, were as per the definition of leading climate-change performance in section 6.1:

- Do companies have integrated climate change into their business strategies?
- Do companies have incentives for the management of climate change?
- Have companies adopted emissions targets that were active in the current year?

The indicators of climate-change performance were compared between 2011 and 2012 to identify companies that have improved by adding one or more indicators. This was then compared to the average sell, hold or buy recommendations from equity analysts. The results are illustrated in Figure 6.5.

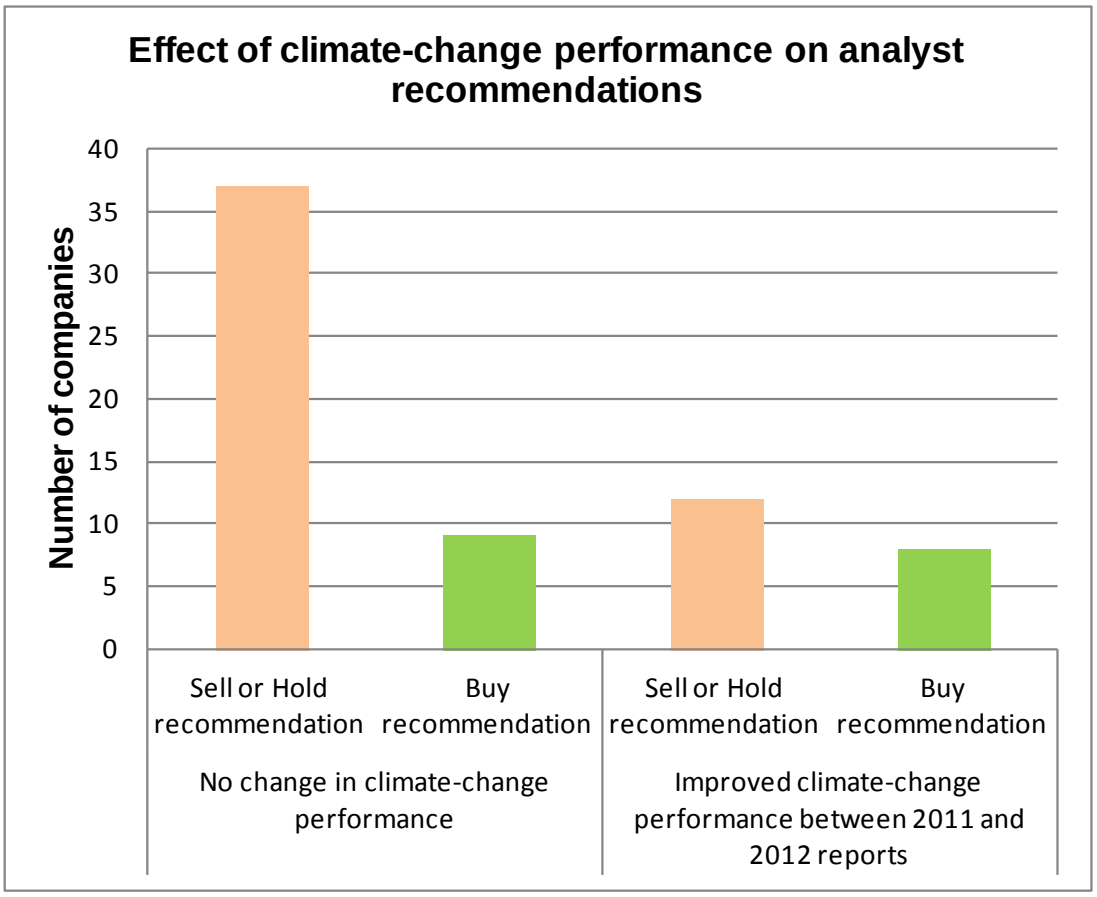

Figure 6.5: Effect of climate-change performance on analyst recommendations

The analysis per Figure 6.5 revealed that 47% of companies that had improved their climate-change performance in the previous year had a 'buy' recommendation. Conversely, only 24% of companies whose climate-change performance had not changed attracted a 'buy' recommendation. The chi-test for independence revealed a

value of 0.081, i.e. there was an 8% probability that this was a random trend. Therefore, companies that had improved climate-change performance appeared to have a statistically significant greater likelihood of a 'buy' recommendation than those that had not improved their climate-change performance and the results were statistically significant.

A further analysis of the results revealed that, for companies that were already leading climate-change performers in 2011 and 2012 and had no change, there was no relationship with analysts' recommendations, suggesting that this had already been factored in during previous years.

6.2.6 Impact of carbon emissions decreases on equity analyst recommendations

Question 10: Do companies that reduce emissions attract better ratings from equity analysts than companies that do not reduce emissions?

This question explored whether companies that succeeded in decreasing their carbon emissions were likely to attract better ratings from analysts and thereby deduce whether reducing carbon emissions is recognised by the market. Companies that decreased their emissions between the 2011 and 2012 CDP reports were identified. Thereafter, these identified companies were compared to the recommendations made by equity analysts as shown in Figure 6.6 below.

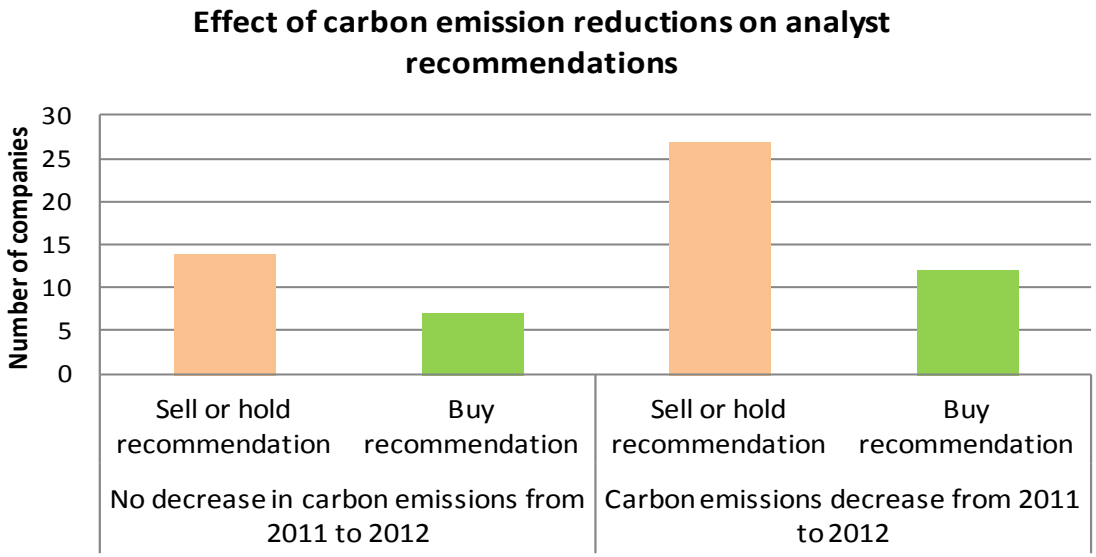

Figure 6.6: Effect of carbon emission reductions on analyst recommendations

As per Figure 6.6, 31% of companies that decreased emissions attracted a “buy” recommendation whilst 33% of companies that did not decrease emissions attracted a ‘buy’ recommendation. This difference was insignificant and the chi-test result indicated an 84% probability of randomness, in other words, there is no apparent relationship. The lack of relationship may indicate that decreasing carbon emissions were either not pertinent or not visible information to equity analysts. It was interesting that analysts appeared to recognise indicators of climate-change performance but not decreases in carbon emissions. The next question explored this further.

6.2.7 Impact of climate-change performance on carbon emissions decreases

Question 11: Is there a relationship between climate-change performance indicators and decreases in carbon emissions?

This question was a follow-up to 6.2.6 and sought to deduce whether climate-change performance indicators influence carbon emissions. As per section 6.1, the three indicators of climate-change performance that were used were –

- Have companies integrated climate change into their business strategies?
- Do companies have incentives for the management of climate change?
- Have companies adopted emissions targets that were active in the current year?

Companies that exhibited all three indicators were categorised as ‘leading climate-change performers’ and were compared to those that had achieved reductions in emissions.

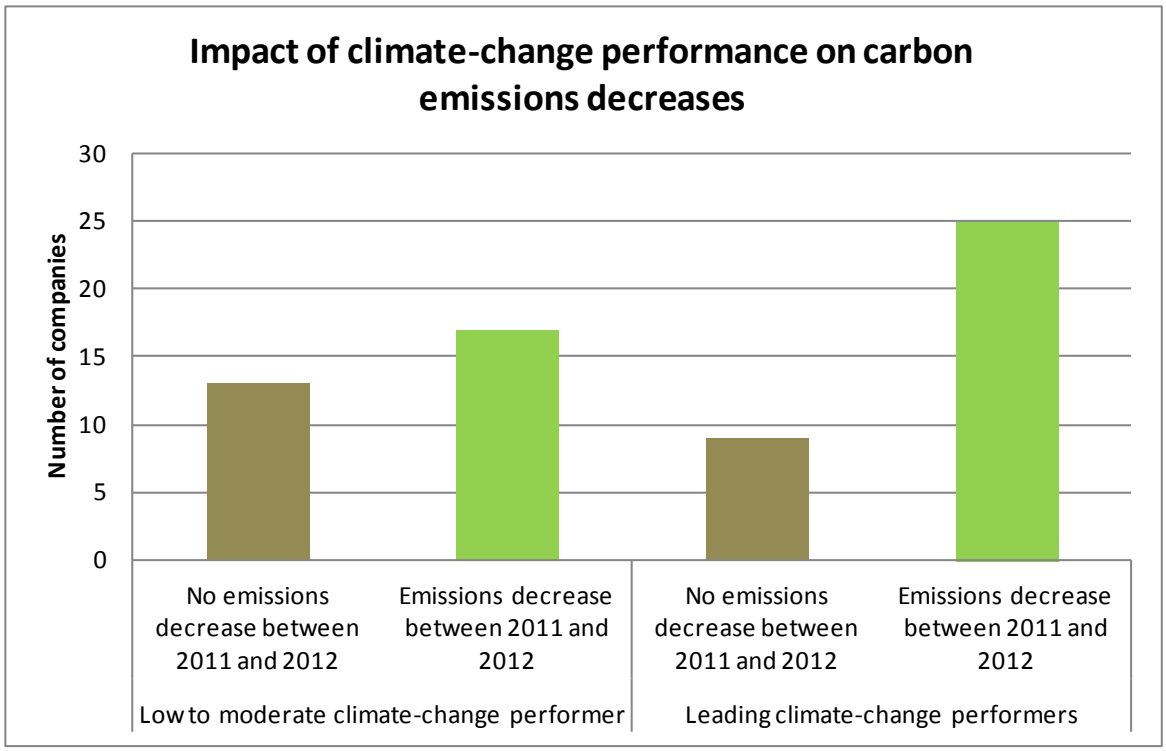

Figure 6.7: Impact of climate-change performance on carbon emission decreases

Of the leading climate-change performers, 74% demonstrated a decrease in emissions, whereas 57% of low to moderate climate-change performers registered emissions decreases. The chi-test of independence indicated a result of 0.1564 or 15.64% probability that the relationship between these variables was random. Normally, a chi-test value above 0.1 suggests that dependence between variables be rejected as statistically insignificant as it indicates a lower than 90% confidence level. Therefore it appears unlikely that leading climate-change performers will always have decreases in carbon emissions. To investigate this phenomenon further, a comparison was conducted between the variables of companies setting emissions targets and those that have realised decreases in emissions. It was noted there was no relationship between these variables (chi-test of independence = 0.958/negligible 4% confidence level).

Why is this the case? A cursory review of CDP disclosures revealed that in a number of cases companies reported that they were more carbon-efficient than in previous years but they did not reflect decreases in the gross value of carbon emissions due to factors such as acquisitions and significant organic business growth. Gross carbon

emissions do not seem to be a useful indicator for the market, in isolation, of whether a company is successfully managing its climate-change risks.

6.2.8 Relationship between climate-change performance and the cost of capital

Question 12: Is there a relationship between climate-change performance indicators and the weighted average cost of capital (WACC)?

This question sought to deduce whether there was a dependent relationship between climate-change performance and WACC. Two indicators were appraised to assess whether there was a relationship with WACC being lower than the median of the sample of 70 companies:

- leading climate-change performers as defined previously in 6.1
- companies that indicated that their climate-change risks were high (impact at least 'medium', likelihood at least 'more likely than not' and time frame of risk less than five years)

The results are shown in Figure 6.8.

Category	WACC less than median of sample
Leading climate-change performer	50%
Not leading climate change performer	49%
(chi-test of independence p = 0.91 / 91% probability that variables are not dependent)	
Climate-change risks high (as per definition)	51%
Climate-change risks not high	47%
(chi-test of independence p = 0.70 / 70% probability that variables are not dependent)	

Figure 6.8: Relationship between climate-change performance and WACC

The results indicated that, whether a company is a leading climate-change performer or has identified high climate-change risks, there is a minimal to nil effect on the cost of capital. This appears to indicate that providers of equity or debt capital to companies are not yet factoring in climate-change performance and climate-change risks in determining the returns they require from their invested capital. It is unknown

whether this pattern may be different for certain industries that may be more climate-sensitive.

6.2.9 Relationship between climate-change performance and internal rate of return (IRR)

Question 13: Is there a relationship between climate-change performance and IRR?

The purpose of this question was to determine if there is a relationship between climate-change performance and the achievement of positive IRR. Leading climate-change performers were identified and compared to establish whether they achieved a positive or a negative IRR. IRR was based on historical accounting records for the previous five years as published in 2012. Figure 6.9 shows the results.

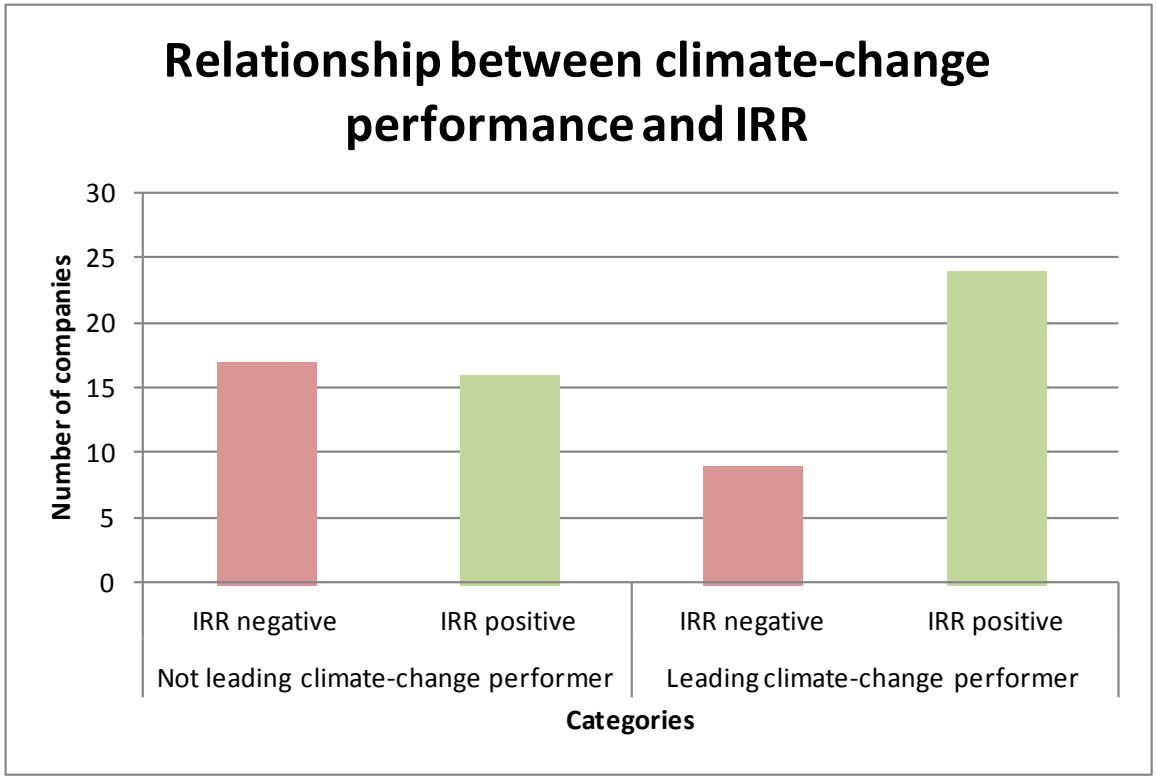

Figure 6.9: Relationship between climate-change performance and IRR

The figure on the previous page demonstrates that 73% of leading climate-change performers had a positive IRR whereas just 48% of those who were not leading climate-change performers had a positive IRR (chi-test of independence p = 0.043/4% probability that there is no dependence). Compared to those that were not leading in climate change, a leading climate-change performer was 1.5 times more likely to be company with a positive IRR. Whilst this is a strongly positive relationship, it should be noted that cause and effect would require further qualitative research to determine which variable occurred first.

6.2.10 Relationship between climate-change performance and market value premium over book value (M/B ratio)

Question 14: Is there a relationship between climate-change performance and the M/B ratio?

The purpose of this question was to determine if increased climate-change performance coincides with higher M/B ratios. The premise was that, as companies invest in sustainability endeavours, the value of their intangible assets (market value premium) increases. This analysis was performed in two ways:

- comparison of leading climate-change performers to instances where M/B ratios were above the sample median (Figure 6.10); and
- comparison of the actual M/B ratios based on climate-change performance (Figure 6.11)

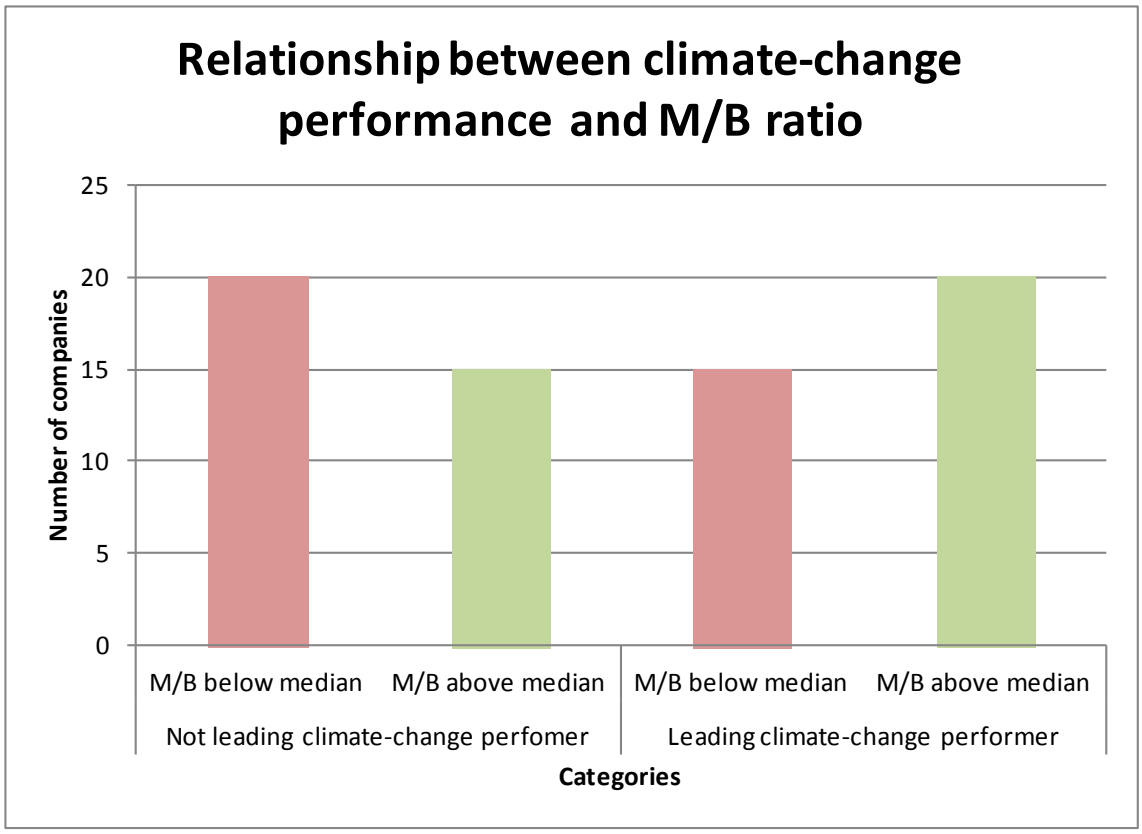

Figure 6.10: Relationship between climate-change performance and M/B

Figure 6.10 demonstrates that 57% of leading climate-change performers had market-to-book values above the median (chi-test of independence p = 0.23/23% probability that there is no dependence between the variables). This compared to 42% for companies that were not leading climate-change performers. Whilst this appears to be a positive correlation, the high chi-test of independence implies that statistical significance cannot be inferred from this analysis alone. Therefore, Figure 6.11 below analyses the M/B ratio further.

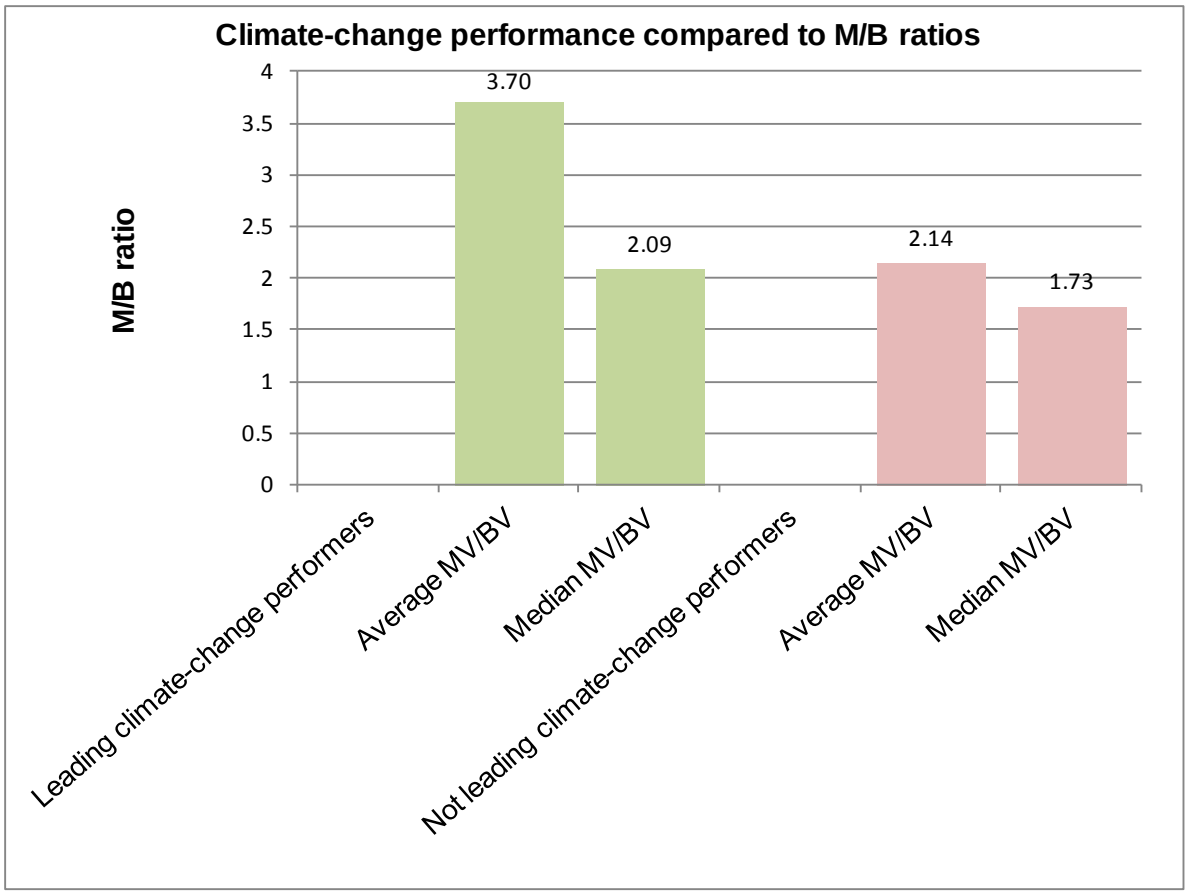

Figure 6.11: Comparison of climate-change performance to M/B ratios

Figure 6.11 shows that the average M/B ratios of leading climate-change performers are 72.8% higher than those of none leading climate-change performers. For the same comparison, median M/B ratios are 20.8% higher. Both average and median statistics are shown in this comparison to illustrate the effect of a positive skew whereby leading climate-change performers tend to have more extreme M/B ratios.

Based on Figures 6.10 and 6.11, it appears that there is a tendency for leading climate-change performers to demonstrate higher M/B ratios. Over time, growth in the M/B ratio of a company creates higher returns for shareholders as the value of their investment increases.

6.2.11 Relationship between climate-change performance and forecasted three-year growth in earnings per share (EPS)

Question 15: Do equity analyst predictions of future EPS show a link to climate-change performance?

This question set out to establish whether the predicted future EPS of companies are likely to increase as climate-change performance increases. Firstly, it determined which companies had between nil and three indicators of climate-change performance. A comparison was then made between the levels of climate-change performance and the extent to which EPS growth is forecast to exceed the median of the 70-company sample. Categorised results are shown in Figure 6.12, and the actual numeric increases are demonstrated in Figure 6.13.

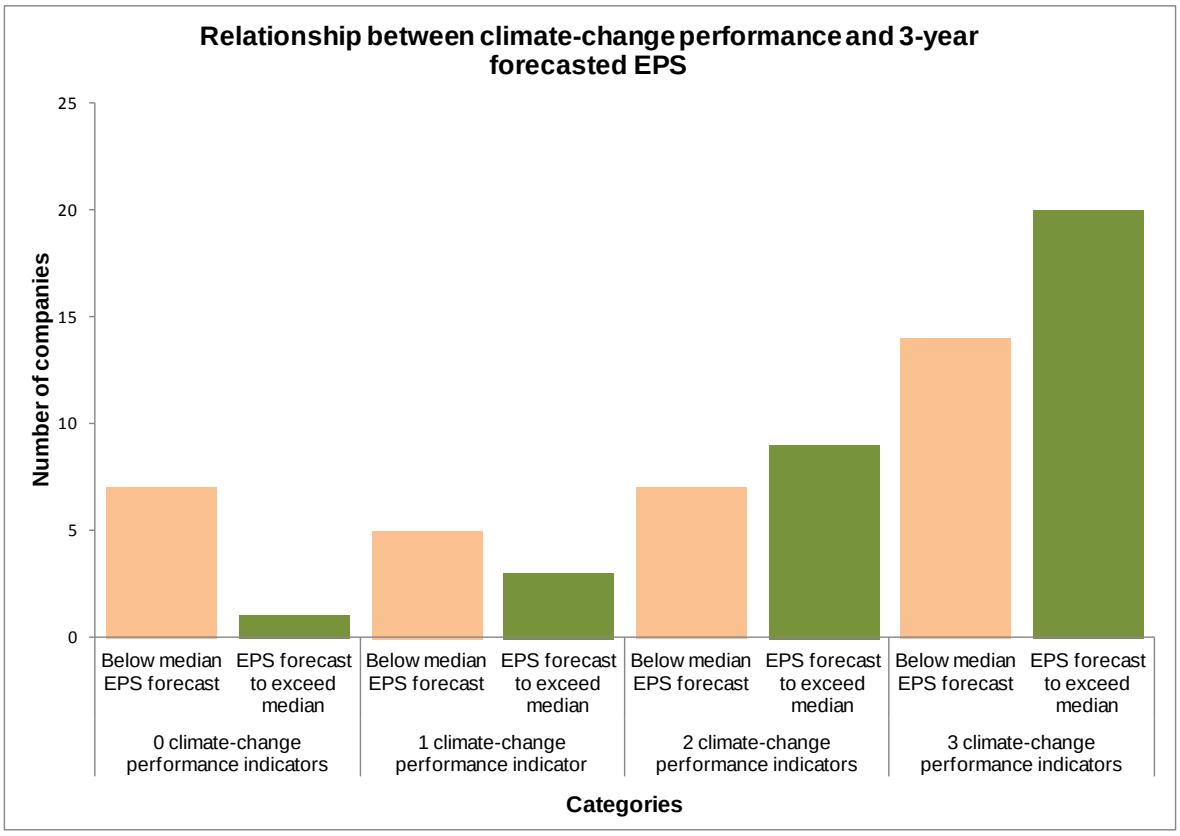

Figure 6.12: Relationship between climate-change performance and forecasted EPS

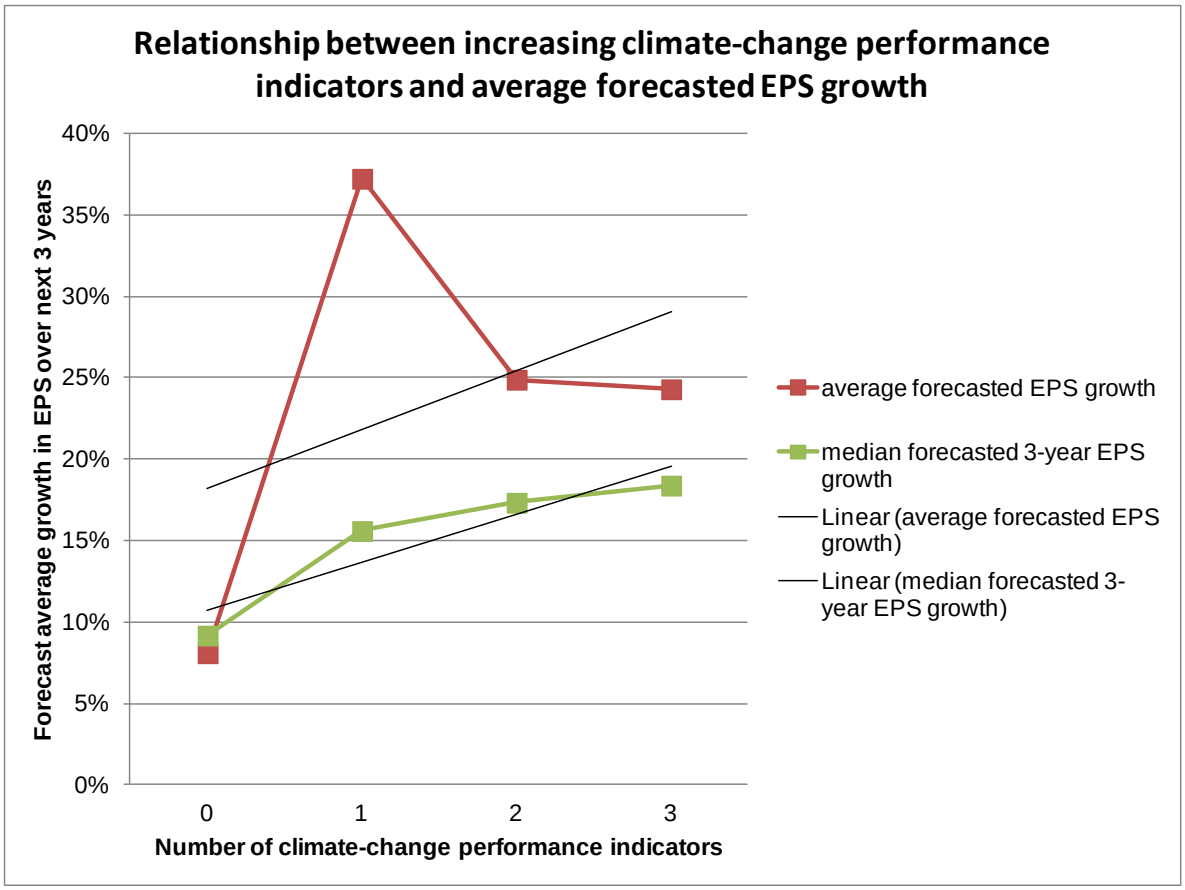

Figure 6.13: Average forecasted EPS growth and climate-change performance

Figure 6.12 indicates that 12.5% of companies with zero climate-change performance indicators are expected to exceed the forecasted median 3-year EPS growth. Thirty-eight per cent of companies with one climate-change performance indicator are forecast to exceed the median 3-year EPS growth. These percentages increase to 56% and 59% respectively as companies demonstrate two to three climate-change performance indicators (chi-test of independence p = 0.097/9.7% probability that there is no dependence between the variables). The results are statistically significant and show a strong correlation between climate-change performance and EPS growth.

Figure 6.13 confirms the pattern and demonstrates that the more climate-change performance indicators companies have, the greater the forecasted EPS growth. Both the average EPS growth and the median EPS growth are illustrated and they show the same positive linear pattern. The average EPS growth line is not as smooth as the median EPS growth line due to outliers that create a skew.

6.2.12 Relationship between high climate-change opportunities and the beta coefficient

Question 16: Is there a correlation between companies that have indicated high climate-change opportunities and the beta coefficient?

The purpose of this question was to determine if the beta coefficient (an indication of non-diversifiable risk) is more favourable for companies that have indicated high climate-change opportunities than those that have low climate-change opportunities. The premise for this was that, as companies detect more opportunities, their risks are mitigated to the extent that their performance volatility decreases. Firstly, companies with high opportunities were determined as those whose climate-change opportunities had at least a medium impact and a more likely than not likelihood as well as a time frame of less than five years. This was compared to companies whose beta coefficient had improved (decreased) between the years 2010 and 2012. The results are shown in Figure 6.14 below.

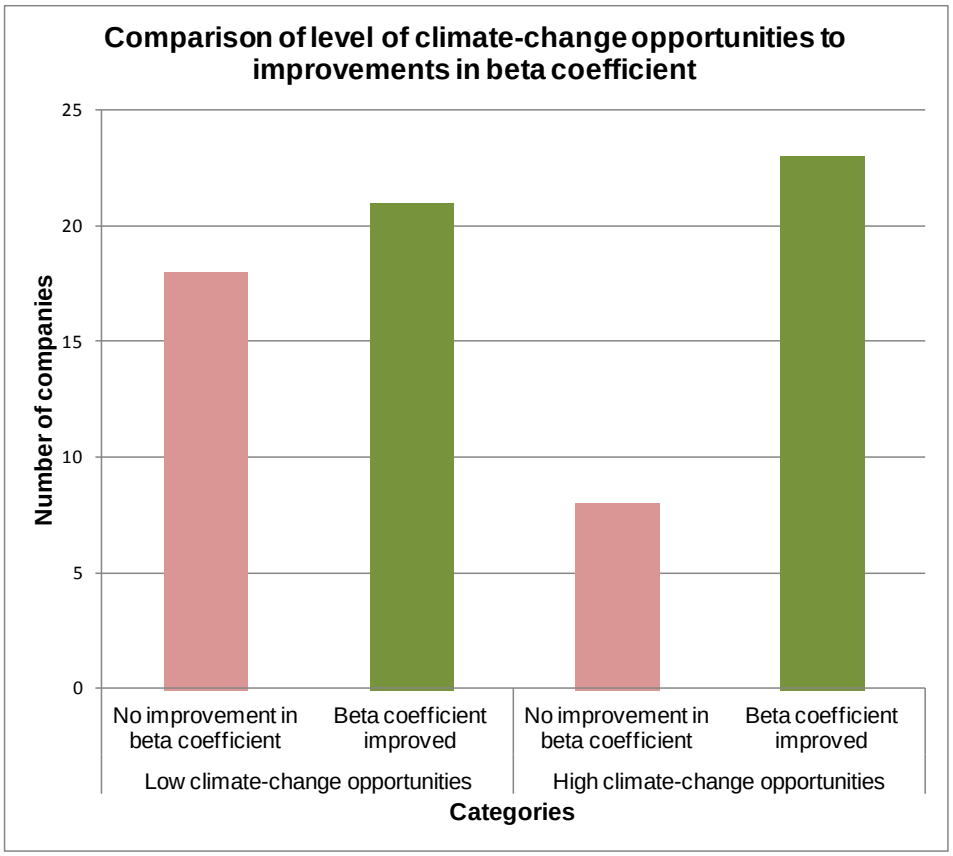

Figure 6.14: Relationship between climate-change opportunities and the beta coefficient

Of the companies, 74% that indicated high climate-change opportunities demonstrated an improvement in the beta coefficient whilst companies with low climate-change opportunities had a 51% improvement (chi-test of independence p = 0.047/4.7% probability that there is no dependence between the variables). It was not possible to assess from this study whether opportunities identified had actually been tapped into. There however appeared to be a positive and statistically significant relationship between the level of climate-change opportunities and improvements in the beta coefficient.

6.2.13 Relationship between climate-change performance and the price/earnings to growth analyst consensus ratio (PEG ratio)

Question 17: Is there a relationship between climate change performance and the PEG ratio?

The purpose of this question was to determine if PEG ratios (an indicator of a company's potential value) are more or less favourable for companies that have high climate-change performance. As indicated in section 5.6.2.7, companies with PEG ratios between zero and one were expected to provide better growth in returns. For the climate-change variable, companies were categorised between those that were leading climate-change performers and those that were not. In respect of PEG ratios, companies were categorised between those whose PEG ratios were positive and less than one and those whose PEG ratios were greater than one or negative. Figure 6.15 illustrates the results:

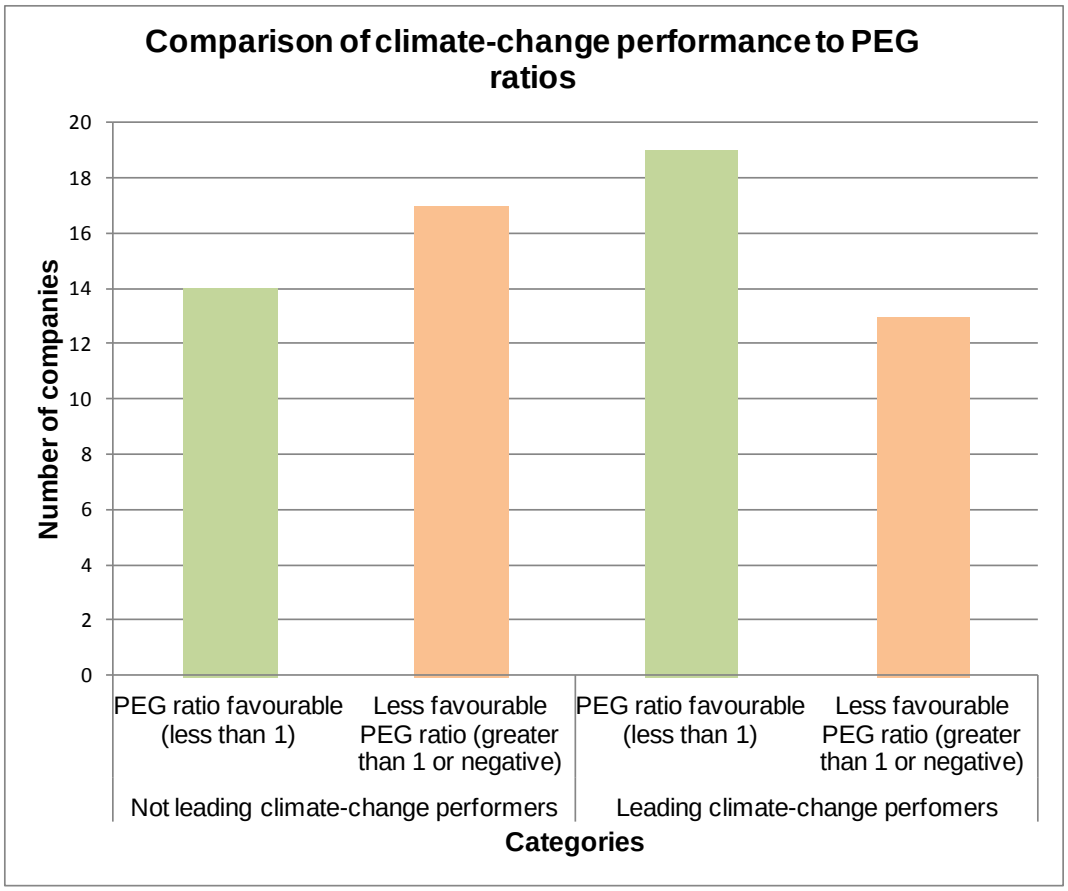

Figure 6.15: Climate-change performance in relation to PEG ratios

The results above show that 59.4% of leading climate-change performers had favourable PEG ratios (between 0 and 1) whilst 45.2% of leading climate-change performers had favourable PEG ratios (chi-test of independence p = 0.259/25.9% probability that there is no dependence between the variables). The statistical chi-test however indicated a low confidence level for this result. Accordingly, it appeared that there is a weak but positive suggestion that leading climate-change performers have more favourable PEG ratios.

6.2.14 Effect of climate-change risks and opportunities on return on equity (ROE)

Question 18: Do climate-change risks and opportunities bear a correlation to ROE?

The purpose of this question was to determine the impact climate risks and opportunities have on ROE. The premise for this was that risk events will negatively affect ROE whilst opportunities realised have a positive effect on ROE. Companies

whose median risks and opportunities were high were identified. These were companies whose median risk or opportunity impact was at least medium, the likelihood was at least more likely than not and time frame was less than five years. This was then compared to the instances where the ROE of the sampled companies was greater than the median of the sample. The analysis is split into Figures 6.16 and 6.17 where risks and opportunities are separately analysed.

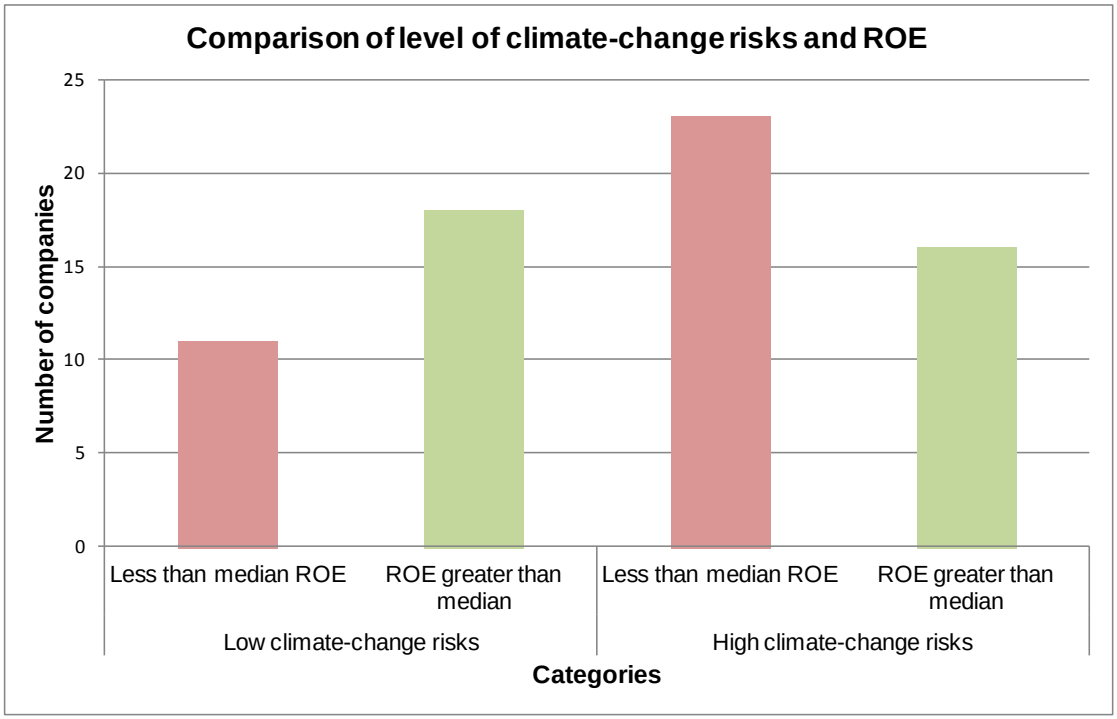

Figure 6.16: Climate-change risks: relationship with ROE

Based on the figure above, it was determined that 58.9% of companies that had high-climate-change risks had a less than median ROE as compared to 37.9% of companies that had low climate-change risks (chi-test of independence p = 0.086/8.6% probability that there is no dependence between the variables). There is therefore a strong suggestion (91% confidence level) that ROE is negatively impacted by high climate-change risks.

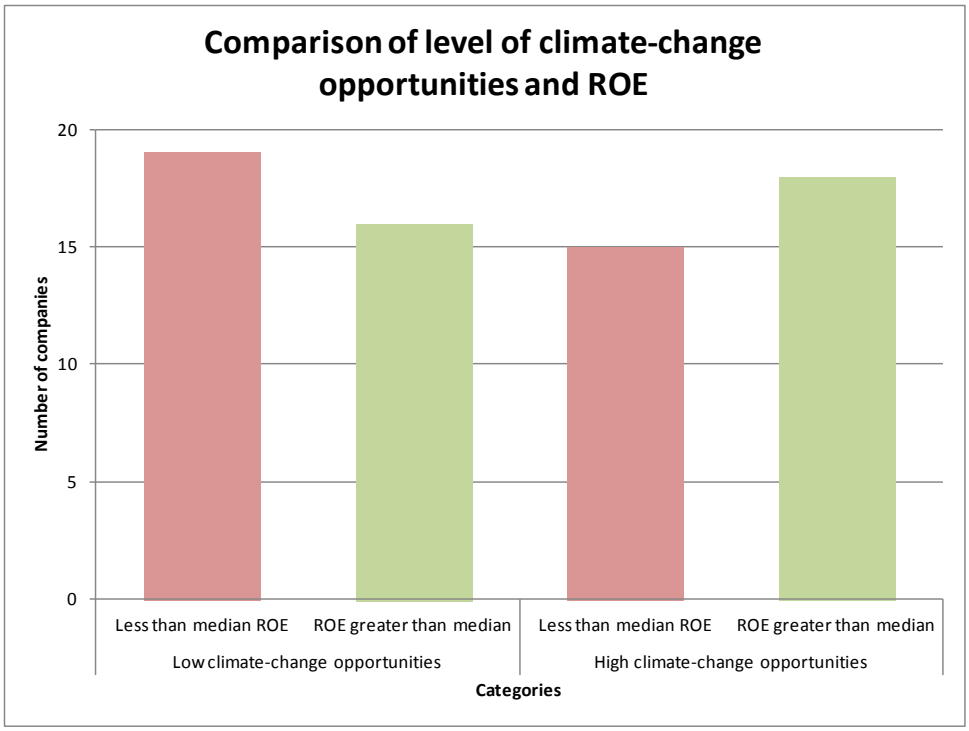

Figure 6.17: Climate-change opportunities: relationship with ROE

The figure above demonstrates that 54.5% of companies that had high climate-change opportunities had an ROE that was above the median as compared to 45.7% of companies that had low climate-change opportunities (chi-test of independence p = 0.466/46.6% probability that there is no dependence between the variables). An analysis of the actual ROE values indicated the following pattern:

	Average ROE	Median ROE			Average decrease / increase	Median decrease / increase
High climate-change risks	16	13	}	ROE decreases as climate-change risk increases	-33%	-31%
Low climate-change risks	23	18	}			
High climate-change opportunities	21	16	}	ROE increases as climate-change opportunities increase	19%	2%
Low climate-change opportunities	17	15	}			

Figure 6.18: Analysis of ROE in relation to climate-change risks and opportunities

Taking the above three figures into account, it appears that the variables are showing a logical pattern in that:

- as climate-change risks increase, ROE is negatively impacted (strong correlation), and

- as climate-change opportunities increase, ROE is positively impacted (weak correlation).

6.3 SUMMARY AND CONCLUSION

The empirical research findings largely confirmed that there is a relationship between climate-change performance and financial performance. The following conclusions have been reached:

- Climate-change risks and opportunities are expected to have a significant impact on business operations, revenue or expenditure. This was demonstrated by 70% and 66% of companies respectively that rated the risk impacts as medium or high.

- A significant 63% of companies believed that climate-change risks and opportunities are likely, very likely or virtually certain.

- Climate-change risks and opportunities are expected by 89% of companies to occur within the next five years with risks expected to precede opportunities.

- A positive correlation was observed between climate-change risks and opportunities.

- Companies that recently improved their climate-change performance were 1.95 times more likely to attract ‘buy’ recommendations from equity analysts. This may indicate greater market expectations of higher returns from implementing climate-change response strategies.

- Decreases in carbon emissions were not found to have a statistically significant impact on analyst ratings. It was observed that climate-change performance does not consistently lead to decreases in emissions and this may be due to acquisitions and organic business growth that make gross carbon emissions a less reliable indicator.

- Leading climate-change performers did not demonstrate different costs of capital, suggesting that providers of equity and debt capital do not yet factor climate-change responsiveness into financing costs.

- Leading climate-change performers were 1.5 times more likely to have had a positive historical IRR.

- For leading climate-change performers, the ratio of market value to book value (M/B ratios) was more likely to be above the median of the market than was noted for companies that were not leading climate-change performers. M/B ratios for these companies were observed to be more than 20% higher than for the rest of the population.

- It was found that there was a positive relationship between companies improving their climate-change performance, and increased EPS for the next three years as forecasted by equity analysts.

- Companies that indicated higher climate-change opportunities reflected improvements in their beta coefficients.

- There was a positive but weak indication that leading climate-change performers have more favourable PEG ratios (a measure of expected growth in returns).

- A strong correlation was found between high climate-change risks and lower return on equity (ROE). A weak correlation was found between high climate-change opportunities and higher ROE.

CHAPTER 7

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

7.1 INTRODUCTION

The objective of this study was to assess whether there is a relationship between climate change and financial performance, as manifested in the mitigation of risks and exploitation of opportunities of selected South African companies. The study sought to establish the extent to which climate-change creates relevant and material risks, returns and opportunities for companies. This objective was addressed, firstly, by a literature review of climate-change risks and opportunities and secondly, through empirical research of the risks and returns of South African companies.

7.2 SUMMARY OF THE RESEARCH

7.2.1 Revisiting the problem statement and hypothesis

The problem statement that this study addressed was:

> The knowledge gap over whether responding to climate change materially affects the risks, returns and opportunities for companies, as ultimately manifested in their financial performance.

The hypothesis formulated was as follows:

> Climate change will have an increasingly material impact on the financial risks, returns and opportunities of leading companies in South Africa. 2 explored whether climate change is a material and relevant risk for companies

7.2.2 Literature review

Chapter 2 explored whether climate change is a material and relevant risk for companies in South Africa. The chapter began by exploring predictions of the impact that is expected to result from climate change. It was demonstrated that as

businesses operate within the ecosystem, they cannot be immune to degradation of ecosystems. Responsible risk management requires that even if climate change was a low likelihood but high impact risk, companies should consider mitigating actions. Chapter 2 further demonstrated that stakeholders of companies will increasingly create pressure for companies to address climate change. Further complicating the risk is that climate change is an ethical dilemma that requires companies to consider principles such as the precautionary, polluter-pays and intergenerational equity principles. These international principles were shown to be reflected in South African legislation and codes of governance. Chapter 2 concluded by indicating that there is a range of three possible company responses to stakeholder concerns about climate change. Most companies are likely to take a middle-of-the-road response of accommodationism where they are sceptical but will make limited changes to their operations.

Chapter 3 analysed the risks that are expected to result from climate change. Fifteen risk categories were identified. These risks arise from external sources and as a result of how companies choose to respond to climate change and from financial exposures. External risks such as physical, market, political, legal and energy risks were demonstrated to have significant impacts on companies. Such impacts include damage to assets, socio-economic challenges, constraints in access to resources required for operation, shifts in consumer behaviour, reduced competitiveness and increases in liabilities. The chapter also demonstrated that companies that respond inappropriately to climate-change risk selecting value-diminishing strategies, impairing their reputation and thus social license to operate, as well as relying on soon-to-be obsolete products. Furthermore, companies face the risks of increasing uncertainty within their supply chains, failure to comply with new regulations and outdated human resource capabilities. Chapter 3 ended with an analysis of financial risks arising from climate change. Those risks included challenges in accessing and using capital optimally, reliance on incomplete information for decision-making, unfavourable changes to asset and liability values. It was also shown that there are direct financial costs that arise from climate change in the form of insurance costs, adaptation costs and the increasing international trend of assigning a cost to carbon emissions.

Chapter 4 provided indications that companies can expect increased returns from adapting to climate change by tapping into new opportunities. Four broad types of opportunities were identified, being opportunities to enhance value creation capabilities, expand revenue sources, improve efficiencies and enhance the competitive advantage of support functions. It was firstly shown that previous research had shown that sustainable companies generate greater value for their shareholders than companies that are not perceived to have embraced sustainability. Companies can create better platforms for creating value by adapting their strategies, tapping into new business models and accessing capital that is attracted to sustainability. Secondly, new revenue sources are becoming available for companies as a result of changing markets, regulatory-driven climate-friendly products, new product offerings and the 'clean technology' sector. Thirdly, literature shows that steps that companies take to reduce carbon emissions have a ripple effect of enhancing efficiencies and thus lowering cost bases of companies. Lastly, Chapter 4 outlined how support functions such as supply chain, human capital and information technology could use climate-change adaptation as a base for recreating themselves into leaner and more responsive functions that enable sustainability across the business.

7.2.3 Empirical research

Chapter 5 outlined the empirical research methodology used to determine the impact climate change has on the risks and returns of companies. The chapter discussed the merits of various research methods and concluded that historical analysis of quantitative secondary data was the most appropriate research method. A population of 70 JSE-listed companies that have all disclosed climate-change data was selected to study. Chapter 5 also described the climate performance and financial performance indicators that were used to investigate whether to accept or reject the core hypothesis of this dissertation.

Chapter 6 provided summaries and conclusions on the results of the empirical research. The research demonstrated that climate-change risks and opportunities are expected to have a significant impact on the operations, revenue or expenditure of companies. There is a high likelihood of climate-change risks and opportunities crystallising and this is largely expected to occur within the next five years. The

empirical research found that there are positive correlations between climate-change performance and equity analyst recommendations. It also found that leading climate-change performance is correlated to indicators of return such as higher market-to-book values, positive internal rates of return and forecasted growth in earnings per share. Companies with high climate-change opportunities were observed to improve their beta or non-diversifiable risk. When compared to companies with low climate-change risks, return on equity was observed to be significantly lower for companies that indicated high climate-change risks. Conversely and to a lesser extent, companies with high climate-change opportunities were marginally more likely to have higher return on equity than those with low climate-change opportunities.

7.3 CONCLUSION

The literature review confirmed that climate change is a material risk to companies and their stakeholders. Literature suggests that climate change does and will affect the risks and returns of companies. The literature review indicated that companies are vulnerable to external risks arising from climate change. Furthermore, it was illustrated that inappropriate or inadequate responses to climate change may affect the strategy, reputation, products, supply chain, compliance and human capital aspects of companies. This can culminate in financial risks to companies that will negatively affect capital, financial decision-making, assets and liabilities, and net income. Conversely, the literature review demonstrated that there are material opportunities for companies to enhance their returns and sustainability by successfully adapting to climate change. This will be manifested in enhanced value-creation capabilities, expanded revenue sources, improved efficiencies, reduced costs and increased competitive advantage.

The data from the empirical research addressed the problem statement by demonstrating the positive link between addressing climate change and the financial performance of companies as summarised in section 6.3. A significant proportion of companies asserted that climate-change risks and opportunities were at the very least ‘more than likely’ and that the potential impacts on their business operations, revenue and expenditure are ‘medium’ to ‘high’. The hypothesis that "Climate change will have an increasingly material impact on the financial risks, returns and opportunities of leading companies in South Africa" was positively supported through

examining the relationship between climate-change variables and financial variables. Specifically, the empirical research demonstrated the significant impact and high likelihood of climate change of risks and opportunities in companies within the next five years. Statistically significant correlations were identified between climate-change performance and financial indicators such as internal rate of return, market value to book value, earnings per share, beta coefficients, price/earnings to growth ratios and return on equity. It was also observed that there appears to be a correlation between improving climate-change performance and the recommendations of equity analysts.

7.4 RECOMMENDATIONS

The key recommendations from this research are as follows:

7.4.1 Creation of consistent measures of climate-change performance to enable peer review between companies

The greater part of reporting on the performance of companies is dedicated to financial information. However, if it is accepted that climate-change responses, in addition to other components of sustainability, are a useful indicator of future performance, it is recommended that:

- frameworks be devised to enable sustainability information, such as climate change, to be reported periodically in a manner that facilitates quantitative comparison between different companies;
- models be created for individual companies to measure their sustainability performance, based on predetermined variables that are assigned a statistically appropriate weighting; and
- ranking of climate change or sustainability performance be prepared regularly on all publicly listed and public interest companies.

7.4.2 Tracking of climate-change risks

In view of the fact that climate-change risks are expected to materialise within the next five years, it would be useful for a tracking index or barometer to be created.

This would regularly measure the current levels of climate-change risks based on predefined criteria such as the quantum of extreme events and changes in resource constraints. Such information would assist companies to gauge whether they are responding appropriately to climate-change risks.

7.5 AREAS OF FURTHER RESEARCH

This study was limited to 70 JSE-listed companies. It is firstly suggested that further research be conducted on the remainder of listed companies to assess whether similar correlations exist between climate-change performance and financial performance.

Secondly, the empirical study focused on climate-change performance and not the broader definition of sustainability. Broader sustainability performance would encompass the other parts of environmental sustainability such as water usage and the social aspect of sustainability. A possible hypothesis is that if all aspects of sustainability are considered, the link between sustainability performance and financial performance should show an even stronger correlation.

Thirdly, the population of this study was limited to South African companies. As information collated by the CDP is global, it would be useful for global decision-makers to understand how climate-change impacts differ in various developing and developed countries.

REFERENCE LIST

Albright, S., Winston, W. & Zappe, C. 2004. *Data analysis for managers with Microsoft Excel.* Pacific Grove, CA: Thomson Brooks/Cole.

Armatte, M. 2009. *How climate change became an economic question.* Cournot Centre for Economic Studies Series. Cheltenham: Edward Elgar.

Bartelmus, P. 2003. *Environment, growth and development: The concepts and strategies of sustainability.* New York: Routledge.

Baskin, J. 2006. Value, values and sustainability: Corporate responsibility and emerging markets. Unpublished study.

Benyus, J. 1997. *Biomimicry: Innovation inspired by nature.* London: HarperCollins E-books.

Blignaut, J. & De Wit, M. 2004. *Sustainable options.* Cape Town: UCT Press.

Boardley, S. & Schulze, R.E. 2005. Why adopt a vulnerability approach? In: R.E. Schulze (ed.). *Climate change and water resources in Southern Africa: Studies on scenarios, impacts, vulnerabilities and adaptation*. WRC Report 1430/1/05. Pretoria: Water Research Commission, 359–363.

Brooks, L.J. & Dunn, P. 2010. *Business and professional ethics for directors, executives and accountants.* Mason, OH: South-Western Cengage Learning.

Bryman, A. & Bell, E. 2007. *Business research methods.* Oxford: Oxford University Press.

Burns, M. & Weaver, A. 2008. *Exploring sustainability science: A southern African perspective.* Stellenbosch: Council for Scientific and Industrial Research.

Business & The Environment Programme, University of Cambridge & World Business Council for Sustainable Development. 2009. *Driving success: Human resources and sustainable development.* Cambridge: World Business Council for Sustainable Development.

CDP (Carbon Disclosure Project). 2012. *South African businesses: Shifting the focus to performance.* Johannesburg: National Business Initiative. Available from: https://www.cdproject.net/CDPResults/CDP-South-Africa-Climate-Change-Report-2012.pdf [Accessed: 26 November 2012].

Carbon Trust. 2011. *Green your business for growth: How adopting a green growth strategy can give your organisation a competitive edge.* London: The Carbon Trust.

Ceres. 2009. *Water scarcity and climate change: Growing risks for business and investors.* Oakland, CA: Pacific Institute.

Chevalier, R. 2010. Integrating adaptation into developmental strategies: The Southern African perspective. In: S. Bauer & I. Scholz (eds.). *Adaptation to climate change in southern Africa: New boundaries for development*. London: Earthscan, 191–192.

CPI (University of Cambridge Programme for Industry). 2007. *A business primer: Sustainable consumption and production.* Cambridge: University of Cambridge.

CPI (University of Cambridge Programme for Industry). 2008. *Finding the way: Examples of responsible business.* Cambridge: University of Cambridge.

CPSL (University of Cambridge Programme for Sustainability Leadership). 2009a. *Carbon management: A practical guide for suppliers.* Cambridge: University of Cambridge.

CPSL (University of Cambridge Programme for Sustainability Leadership). 2009b. *Transformational change model: Achieving a low climate risk economy.* Cambridge: University of Cambridge.

Craigie, F., Snijman, P. & Fourie, M. 2009. Dissecting environmental compliance and enforcement. In: A. Paterson & L. Kotze (eds.). *Environmental compliance and enforcement in South Africa: Legal perspectives*. Cape Town: Juta Law, 41–60.

Deegan, C. & Unerman, J. 2011. *Financial accounting theory.* Second European edition. New York: McGraw-Hill Education.

Deloitte. 2007. *The risk intelligent energy company: Weathering the storm of climate change.* New York, USA: Deloitte.

Deloitte. 2008. *The risk intelligent approach to corporate responsibility and sustainability.* New York, USA: Deloitte.

Doyle, T. & McEachern, D. 1999. *Environment and politics.* London: Taylor & Francis Group.

Draper, P. & Mbirimi, I. 2010. *Climate change and trade: The challenges for southern Africa.* Johannesburg: Jacana Media.

Edwards, A. 2005. *The sustainability revolution: Portrait of a paradigm shift.* Gabriola Island, Canada: New Society.

Engardio, P. 2009. *Beyond the green corporation.* Management Journal. Volume 15:170–173.

Epstein, J. 2008. *Making sustainability work: Best practices in managing and measuring corporate social, environmental, and economic impacts.* Sheffield: Greenleaf.

Ernst & Young. 2010a. *Action amid uncertainty: South African business response to climate change.* South Africa: Ernst & Young.

Ernst & Young. 2010b. *Climate change and sustainability – Five highly charged risk areas for internal audit.* South Africa: Ernst & Young.

Ernst & Young. 2010c. *Defining your strategic response to climate change – "How to convert challenges to opportunities".* South Africa: Ernst & Young.

Ernst & Young. 2010d. *Renewable energy country attractiveness indices*. South Africa: Ernst & Young.

Ernst & Young. 2011e. *Shareholders press boards on social and environmental risks.* South Africa: Ernst & Young.

Ernst & Young. 2010f. *The Ernst & Young business risk report 2010: The top 10 risks for business – A sector wide view of the risks facing businesses across the globe.* South Africa: Ernst & Young.

Esty, D. & Simmons, P. 2011. *The green to gold business playbook: How to implement sustainability practices for bottom-line results in every business function.* Hoboken, NJ: Wiley.

Esty, D.C. & Winston, A.S. 2006. *Green to gold: How smart companies use environmental strategy to innovate, create value, and build competitive advantage.* Yale University Press. Available from: http://www.getabstract.com/en/summary/concepts-and-trends/green-to-gold/7915/ [Accessed: 13 July 2009].

Ferrell, O.C., Fraedrich, L. & Ferrell, L. 2008. *Business ethics: Ethical decision making and cases.* Boston, MA: Houghton Mifflin Company.

Fisk, P. 2010. *People, planet, profit: How to embrace sustainability for innovation and business growth.* London: Kogan Page.

Friedman, M. 1970. The social responsibility of business is to increase its profits*. The New York Times Magazine.* September 1970. Available from: www.umich.edu/~thecore/ doc/Friedman.pdf [Accessed: 19 October 2011].

Friend, G. 2009. *The truth about green business.* Upper Saddle River, NJ: FT Press.

Giamporcaro, S. 2010. *Environmentally responsible investment in South Africa: The state of play.* Cape Town: UCT. Available from: http://www.efdinitiative.org/research/publications/publications-repository/environmentally-responsible-investment-in-south-africa [Accessed: 19 October 2011].

Gilding, P. 2011. *The great disruption: How the climate crisis will change everything (for the better).* New York: Bloomsbury Press.

Gitman, L., Smith, M., Hall, J., Lowies, B., Marx, J., Strydom, B. & Van der Merwe, A. 2010. *Principles of managerial finance: Global and southern African perspectives.* Cape Town: Pearson Education South Africa.

Glautier, M., Underdown, B. & Morris, D. 2011. *Accounting theory and practice.* Essex: Pearson Education.

Hardisty, P. 2010. *Environment and economic sustainability.* Boca Raton, FL: CRC Press.

Hitchcock, D. & Willard, M. 2009. *The business guide to sustainability: Practical strategies and tools for organizations.* London: Earthscan.

Hoffman, A. & Woody, J. 2008. *Climate change: What's your business strategy? Memo to the CEO.* Boston, MA: Harvard Business Press.

Hopwood, A., Unerman, J. & Fries, J. 2010. *Accounting for sustainability: Practical insights.* London: Earthscan.

Horngreen, C., Datar, S. & Foster, G. 2005. *Cost accounting: A managerial emphasis.* Upper Saddle River, NJ: Pearson Education.

Houghton, J. 2009. *Global warming: The complete briefing.* Cambridge: Cambridge University Press.

IFR (Institute for Futures Research). 2006. *Business futures 2006. Chapter 5: The natural/physical environment.* Stellenbosch: Stellenbosch University.

IFC (International Finance Corporation). 2007. *Banking on sustainability: Financing environmental and social opportunities in emerging markets.* Washington, DC.

IIED (International Institute for Environment and Development). 2006. *Africa and climate change.* London.

IOD (Institute of Directors). 2009. *King III report on corporate governance for South Africa.* Johannesburg.

IPCC (Intergovernmental Panel on Climate Change). 2001. *Climate change 2001: Impacts, adaptation, and vulnerability. Summary for policymakers.* Available from: www.ipcc.ch/ipccreports/tar/wg2/pdf/wg2TARspm.pdf [Accessed: 19 October 2011].

IPCC (Intergovernmental Panel on Climate Change). 2007. *Climate change 2007. The fourth assessment report of the Intergovernmental Panel on Climate Change.* Cambridge: Cambridge University Press.

Johnson, G., Scholes, K. & Whittington, R. 2005. *Exploring corporate strategy: Text and cases.* Essex: Pearson Education.

Jolly, A. 2010. *Clean tech, Clean profits: Using effective innovation and sustainable business practices to win in the new low-carbon economy.* London: Kogan Page.

Keller, G. 2005. *Statistics for management and economics.* Seventh edition. Mason, OH: Thomson South-Western.

Kiernan, M. 2009. *Investing in a sustainable world: Why green is the new color of money on Wall Street.* New York: Amacom.

KPMG. 2008. *Climate changes your business: KPMG's review of the business risks and economic impacts at sector level.* Amstelveen, Netherlands: KPMG International.

Kunstler, J. 2005. *The long emergency: Surviving the end of the oil age, climate change, and other converging catastrophes of the twenty-first century.* New York: Grove Press.

Lehmann, K. 2009. Voluntary compliance measures. In: A. Paterson & L. Kotze (eds.). *Environmental compliance and enforcement in South Africa: Legal perspectives*. Cape Town: Juta Law, 269–294.

Llewellyn, J. & Chaix, C. 2007. *The business of climate change.* New York, USA: Lehman Brothers. Available from: http://gei.newscorp.com/resources/files/lehman--thebusinessofclimatechange.pdf [Accessed: 18 October 2012]

Low, P.S. 2006. *Climate change and Africa.* New York: Cambridge University Press.

Lowitt, E. 2011. *The future of value: How sustainability creates value through competitive differentiation.* San Francisco, CA: Jossey-Bass.

MacCracken, M., Moore, F. & Topping, J. 2008. *Sudden and disruptive climate change: Exploring the real risks and how we can avoid them.* London: Earthscan.

McGregor BFA. 2012a. *Understanding broker forecasts and the PEG ratio.* Available from: http://research.mcgregorbfa.com/ManualDownload.aspx?Token=Fecs5%2fhFVWhRZxj6PClCxA%3d%3d [Accessed: 23 November 2012].

McGregor BFA. 2012b. *Understanding the capital asset pricing model.* Available from: http://research.mcgregorbfa.com/ManualDownload.aspx?Token=Fecs5%2fhFVWhRZxj6PClCxA%3d%3d [Accessed: 23 November 2012].

McGregor BFA. 2012c. *Understanding the DuPont model.* Available from: http://research.mcgregorbfa.com/ManualDownload.aspx?Token=Fecs5%2fhFVWhRZxj6PClCxA%3d%3d [Accessed: 23 November 2012].

McGregor BFA. 2012d. *Understanding the internal rate of return model.* Available from: http://research.mcgregorbfa.com/ManualDownload.aspx?Token=Fecs5%2fhFVWhRZxj6PClCxA%3d%3d [Accessed: 23 November 2012].

McGuigan, J., Kretlow, W. & Moyer, R. 2009. *Contemporary corporate finance.* Eleventh edition. Mason, OH: South-Western Cengage Learning.

Mills, E. 2009. *From risk to opportunity: Insurer responses to climate change.* Available from: http://insurance.lbl.gov/opportunities.html [Accessed: 19 October 2012].

Moles, P., Parrino, R. & Kidwell, D. 2011. *Corporate finance.* European edition. West Sussex: Wiley.

Munashinghe, M. & Swart, R. 2005. *Primer on climate change and sustainable development: Facts, policy analysis and applications.* Cambridge: Cambridge University Press.

National Treasury. 2010. Reducing Greenhouse Gas Emissions: The Carbon Tax Option. Discussion paper for public comment. Pretoria: National Treasury. Available from: www.treasury.gov.za/public%20comments/Discussion%20Paper%20Carbon%20Taxes%2081210.pdf [Accessed: 20 February 2013]

Ogilvie, J. 2009. *Financial strategy.* Oxford: CIMA Publishing.

Olson, E. 2010. *Better green business: Handbook for environmentally responsible and profitable business practices.* Upper Saddle River, NJ: Prentice Hall.

Paterson, A. 2009. Incentive based measures. In: A. Paterson & L. Kotze (eds.). *Environmental compliance and enforcement in South Africa: Legal perspectives*. Cape Town: Juta Law, 296–334.

Phyper, J. & MacLean, P. 2009. *Good to green: Managing business risks and opportunities in the age of environmental awareness.* Ontario, Canada: Wiley.

Raubenheimer, S. 2011. *Facing climate change: Building South Africa's strategy.* Cape Town: Idasa.

Repko, A. 2012. *Interdisciplinary research process and theory.* Thousand Oaks, CA: Sage.

RSA (Republic of South Africa). 1996. *Constitution of the Republic of South Africa No. 108 of 1996.* Available from: http://www.info.gov.za/gazette/acts [Accessed: 25 January 2011].

RSA (Republic of South Africa). 1998. *National Environmental Management Act No. 107 of 1998.* Available from: http://www.info.gov.za/gazette/acts [Accessed: 25 January 2011].

Salomone, R. 2010. The policy framework. In: A. Jolly (ed.). *Clean tech, Clean profits: Using effective innovation and sustainable business practices to win in the new low-carbon economy*. London: Kogan Page, 57–63.

Schulze, R.E. 2005. Adapting to climate change in the water resources sector in South Africa. In: R.E. Schulze (ed.). *Climate change and water resources in southern Africa: Studies on scenarios, impacts, vulnerabilities and adaptation*. WRC Report 1430/1/05. Pretoria: Water Research Commission, 423–449.

Shaw, W.H. 2011. *Business ethics.* Boston, MA: Wadsworth Cengage Learning.

Soyka, P. 2012. *Creating a sustainable organization: Approaches for enhancing corporate value through sustainability.* Upper Saddle River, NJ: Pearson Education.

Speth, J. 2008. *The bridge at the edge of the world: Capitalism, the environment, and crossing from crisis to sustainability.* New Haven, CT: Yale University Press.

Stern, N. 2006. *Stern review on the economics of climate change.* London: HM Treasury. Available from: webarchive.nationalarchives.gov.uk/+/http:/www.hm-treasury.gov.uk/sternreview_index.htm [Accessed: 18 October 2012].

Stoffberg, H. & Prinsloo, P. 2009. *Climate change: A guide for corporates.* Pretoria: Unisa Press.

Sutcliffe, N. 2010. Intellectual property for clean tech. In: A. Jolly (ed.). *Clean tech, clean profits: Using effective innovation and sustainable business practices to win in the new low-carbon economy*. London: Kogan Page, 74–80.

Taleb, N.N. 2007. *The Black Swan: The impact of the highly improbable.* London: Penguin Books.

Tietenberg, T. 2006. *Environmental and natural resource economics.* Upper Saddle River, NJ: Pearson Education.

TNS Global. 2008. *Our green world: An international survey covering 17 countries into how green we really are.* London: TNS Global. Available from: www.tns-global.es/docs/docs_soluciones_283.pdf [Accessed: 18 October 2012].

Touffut, J. 2009. *Changing climate, changing economy.* Cournot Centre for Economic Studies Series. Cheltenham: Edward Elgar.

Turner, K., O'Riordan, T. & Kemp, R. 1990. *Climate change and risk management.* Proceedings of the Second World Climate Conference, Geneva, November 1990, 397–408.

UNEP (United Nations Environment Programme). 2009. *Catalysing low-carbon growth in developing economies: Public finance mechanisms to scale up private sector investment in climate solutions.* Nairobi: UNEP & Partners.

UNEP (United Nations Environment Programme). 2010. *Are you a green leader? Business and biodiversity: Making the case for a lasting solution.* Cambridge: UNEP World Conservation Monitoring Centre.

UN Global Compact. 2009. *Investor leadership on climate change: An analysis of the investment community's role on climate change, and snapshot of recent investor activity.* New York: UN Global Compact Office. Available from: http://www.unglobalcompact.org/docs/issues_doc/Environment/Investor_Leadership_on_Climate_Change_An_Analysis.pdf [Accessed: 18 October 2012]

United Nations Conference on Environment and Development. 1992. *The Rio Declaration on Environment and Development (1992).* Available from: www.unesco.org/education/information/nfsunesco/pdf/RIO_E.pdf [Accessed: 19 October 2011].

United Nations Programme of Action from Rio. 2002. *Agenda 21.* Available from: www.un.org/esa/dsd/agenda21/res_agenda21_30.shtml [Accessed: 19 October 2011].

Valsamakis, A.C., Vivian, R.W. & Du Toit, G.S. 2005. *Risk management: Managing enterprise risks.* Johannesburg: Heinemann.

Welman, J. & Kruger, S. 1999. *Research methodology for the business and administrative sciences.* Oxford: Oxford University Press.

Werbach, A. 2009. *Strategy for sustainability: A business manifesto.* Boston, MA: Harvard Business School Publishing.

Wheatland, J. 2010. The business model. In: A. Jolly (ed.). *Clean tech, Clean profits: Using effective innovation and sustainable business practices to win in the new low-carbon economy*. London: Kogan Page, 209–213.

White, P. 2010. Proof of market. In: A. Jolly (ed.). *Clean tech, clean profits: Using effective innovation and sustainable business practices to win in the new low-carbon economy*. London: Kogan Page, 214–217.

Wilhelm, K. 2009. *Return on sustainability: How business can increase profitability and address climate change in an uncertain economy.* Indianapolis, IN: Dog Ear Publishing.

Willard, B. 2005. *The next sustainability wave: Building boardroom buy-in.* Gabriola Island, Canada: New Society.

World Resources Institute, United Nations Environment Programme & Oxfam. 2011. *Adapting for a green economy: Companies, communities and climate change.* New York: UN Global Compact Office.

WRI (World Resources Institute). 2005. *Millennium ecosystem assessment: Ecosystems and human well-being: Opportunities and challenges for business and industry.* Washington, DC.

Zikmund, W., Babin, B., Carr, J. & Griffin. M. 2010. *Business research methods.* Ninth edition. Mason, OH: South-Western Cengage Learning.

APPENDIX A

POPULATION OF COMPANIES USED IN THE EMPIRICAL RESEARCH

Number	Company name	Johannesburg Stock Exchange ticker
1	AECI	AFE
2	Absa Group	ASA
3	Adcock Ingram	AIP
4	African Bank Investments	ABL
5	African Rainbow Minerals	ARI
6	Allied Electronics Corporation (Altron)	ATN
7	Anglo American Platinum	AMS
8	AngloGold Ashanti	ANG
9	Arcelor Mittal	ACL
10	Aspen Pharmacare Holdings	APN
11	Aveng	AEG
12	Barloworld	BAW
13	Basil Read	BSR
14	Bidvest Group	BVT
15	Caxton and CTP Publishers and Printers	CAT
16	Clicks Group	CLS
17	Discovery Holdings	DSY
18	Distell Group	DST
19	Emira Property Fund	EMI
20	Evraz Highveld Steel and Vanadium Limited	EHS
21	Exxaro Resources	EXX
22	FirstRand	FSR
23	Gold Fields	GIJ

Number	Company name	Johannesburg Stock Exchange ticker
24	Grindrod	GND
25	Group Five	GRF
26	Growthpoint Properties	GRT
27	Harmony Gold Mining Company	HAR
28	Hosken Consolidated Investments	HCI
29	Hulamin	HLM
30	Illovo Sugar	ILV
31	Impala Platinum Holdings	IMP
32	Imperial Holdings	IPL
33	Investec	INL
34	JSE	JSE
35	Kumba Iron Ore	KIO
36	Lewis Group	LEW
37	Liberty Holdings	LBH
38	Massmart Holdings	MSM
39	Mediclinic International	MDC
40	Mix Telematics	MIX
41	MMI Holdings	MMI
42	Mondi	MNP
43	MTN Group	MTN
44	Murray & Roberts Holdings	MUR
45	Nampak	NPK
46	Nedbank	NED
47	Netcare	NTC
48	Northam Platinum	NHM
49	Oceana	OCE
50	Old Mutual	OML
51	Pick n Pay Holdings	PWK
52	Pretoria Portland Cement	PPC

Number	Company name	Johannesburg Stock Exchange ticker
53	Raubex Group	RBX
54	Remgro	REM
55	Reunert	RLO
56	Royal Bafokeng Platinum	RBP
57	SAB Miller	SAB
58	Sanlam	SLM
59	Santam	SNT
60	Sappi	SAP
61	Sasol	SOL
62	Standard Bank Group	SBK
63	Steinhoff International Holdings	SHF
64	Telkom SA	TKG
65	The Spar Group	SPP
66	Tongaat Hulett	TON
67	Truworths International	TRU
68	Vodacom Group	VOD
69	Wilson Bayle Holmes-Ovcon (WBHO Construction)	WBO
70	Woolworths Holdings	WHL