The influence of institutional factors on the environmental strategy of companies in the energy industry

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Abstract

The energy industry is facing serious pressure to reduce carbon dioxide emissions. The purpose of this study was to investigate if there is a statistically significant correlation between certain institutional factors and type of environmental strategy employed by companies in the energy industry. The academic foundation upon which strategy was studied is Institutional Theory.

Institutional theory is embedded in the school of sociology and prescribes that behaviour is a function of social norms and routines. At the organisational level, this translates to a high degree of interdependency between organisations and the environment which they operate in.

The institutional factors selected for analysis in this study were economic growth, gross domestic product per capita, unemployment, poverty, income inequality, human development index, and national competitiveness. The environmental strategy of energy companies was categorised in two broad measures namely; carbon dioxide reduction and carbon independence.

The study has found that there is no significant correlation between any of the institutional factors and combination of carbon reduction and independence strategies. However, an important finding is that the statistical significance of the bi-variate regression analysis increased considerably when national competitiveness was used as an explanatory variable of strategy.

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From this, it is concluded that it is critical to understand which institutional factors are expected to be determinants of strategy in the energy industry. More importantly, it is concluded that as energy is a primary requirement for national competitiveness, strategy in the energy industry is determined by a combination of factors and not just a single variable. This is an important distinction which must be clear in the mind of both policy makers and business leaders in the energy industry especially those who are seeking to expand into new markets.

Keywords: energy strategy, global warming, carbon dioxide, institutional theory

Declaration

I declare that this research project is my own work. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration at the Gordon Institute of Business Science, University of Pretoria. It has not been submitted before for any degree or examination in any other University. I further declare that I have obtained the necessary authorisation and consent to carry out this research.

10 November 2010

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Umesh Ramdhani Date

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Nomenclature

Word/s or symbol	Meaning	Context in which applied
Adjusted R^2	Correlation coefficient adjusted for non-significant terms	Bi-variate and/or multivariate statistical analysis
CO_2	Carbon dioxide	Global warming, Greenhouse gas
Economic growth	Increase in national output in monetary terms	National wealth
Energy industry	Fuels and electricity companies	Environmental strategy
Environmental strategy	The option a company chooses with respect to the means by which it aims to reduce greenhouse gas emissions	Global warming, Strategy
Global warming	Refers to an increase in the average temperature of the earth as a result of greenhouse gas emissions	Global warming
Global 500 companies	500 largest global companies ranked by revenue	Energy industry
Greenhouse gas	Gases in the earths atmosphere with physical properties which result in a high heat trapping tendency of the gas	Global warming
GDP per capita	Gross domestic product per person	National wealth
HDI	Human development index	Standard of living

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Income inequality	The extent to which income is distributed unevenly in an economy. A score of zero refers to total equality while a score of 100 refers to maximal inequality	Socio-economics, Demographics
Poverty	Percentage of population living below poverty line (1 $US/day)	Socio-economics, Demographics
Predicted R^2	Correlation coefficient adjusted for inclusion of new data in the model	Bi-variate and/or multivariate statistical analysis
Renewable energy	Non-carbon based energy technologies such as solar, wind and hydropower	Energy industry
R^2	Correlation coefficient	Bi-variate and/or multivariate statistical analysis
Unemployment	Refers to the share of the labour force that is without work but available for and seeking employment	Socio-economics, Demographics

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Chapter 1

Introduction to the research problem

1.1 Environmental strategy and the energy industry

Companies in the energy industry are facing severe pressure to reduce their carbon dioxide (CO_2) emissions in an effort to curb global warming. The purpose of this study was to better understand the environmental strategy of energy companies in their drive to reduce CO_2 emissions. In order for the value of this work to be realised, it is important that the reader understand the phenomenon of global warming, major contributors to global warming and the impact of global warming on society and business in general. The following sections address this.

1.1.1 Global warming

Global warming can be explained as the average increase in the temperature of the earth as a result of greenhouse gas emissions, one of which is CO_2. The greenhouse gas effect was first postulated in 1896 by Arrhenius who was a famous scientist at the time (Kessel, 2000). Arrhenius's theory was that specific gases in the earths atmosphere permit the transmission of the sun's radiation and without this naturally occurring effect, the average temperature of the earth would have been -18˚C compared to 15˚C at the time. This natural heating effect provided the basis for plant and animal life. However, there is a limit to which this heating effect can sustain life. The planet Venus is an example in this regard, as its average temperature of 430˚C which is largely a result of CO_2 presence, is too high to support life (Kessel, 2000).

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1.1.2 Major sources of CO_2 emissions

Carbon dioxide emissions are normally most evident in processes where large amounts of energy are used (Straelen, Geuzebroek, Goodchild, Protopapas, and Mahoney, 2010). If viewed from a global perspective in 2005, electricity generation lead to the emission of 10539 million tons of CO_2, followed by cement production which was responsible for the emission of 932 million tons of CO_2, and thirdly, the fuel industry whose contribution was a further 798 million tons of CO_2 (Straelen et. al., 2010).

While the production of fuel does not release as much CO_2 as electricity and cement production if viewed from a single point source of emission perspective, there is further release of CO_2 when products from oil refineries such as gasoline and diesel are burnt in internal combustion engines. A previous study has found that CO_2 released from these engines can range anywhere between 150 and 285 grams of CO_2 per kilometre driven depending on the engine efficiency (Vliet, Faaij, and Turkenburg 2009). If this element of CO_2 release is also taken into account, the fuels industry is responsible for nearly 80% of all CO_2 released (Quadrelli and Peterson, 2007), which then provides context for the scrutiny which this industry faces with regard to global warming.

Figure 1 shows the total scope 1 CO_2 emissions for the energy and utilities, industrial, and finance sectors of Global 500 companies, which participated in the 2009 Carbon Disclosure Project (PricewaterhouseCoopers, 2009). Scope 1 emissions refer to direct release of CO_2 from each industry while emissions across the boundary of the value chain to account for activities such as transport

and logistics for example, are ignored. The results show that the energy and utilities industry is responsible for close to 66% of the total scope 1 emissions which further supports the need for a reduction of CO_2 emissions in these industries.

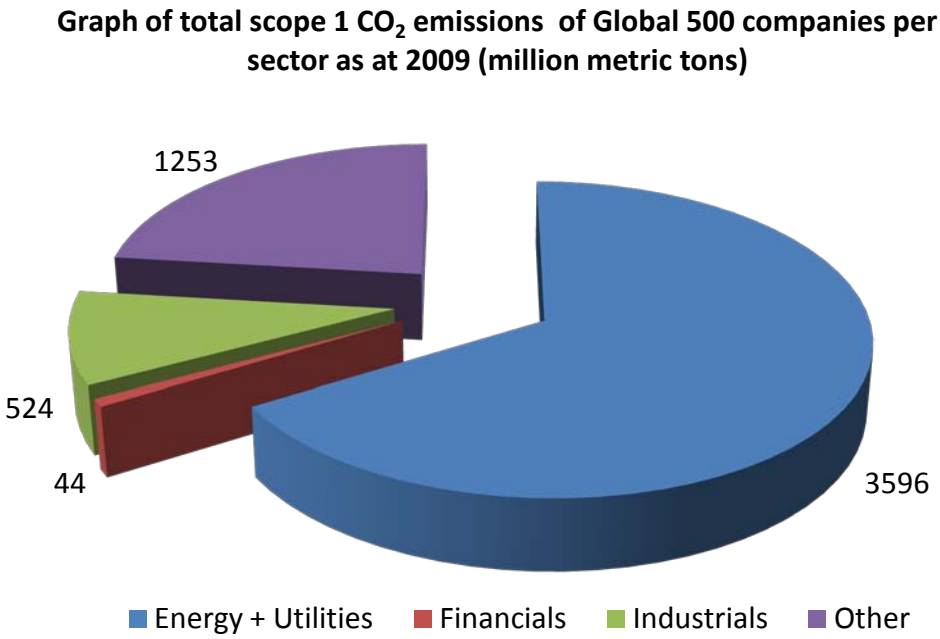

Figure 1: Graph of total scope 1 CO_2 emissions of different sectors of Global 500 companies as at 2009. Data source: PricewaterhouseCoopers (2009), Authors analysis

1.1.3 The relationship between the energy industry and stakeholders

The causal relationship between CO_2 emissions and global warming was introduced in Section 1.1.1. Section 1.1.2 provided evidence that 66% of the total scope 1 CO_2 emissions were from the energy and utilities industry in 2009, while nearly 80% of all CO_2 released is from fuels production and consumption (Quadrelli & Peterson, 2007). It is against this backdrop that the following section discusses the link between the energy industry and stakeholders through the

phenomenon of global warming which the energy industry has been shown to be largely responsible for.

1.1.3.1 The energy industry and society

Global warming will have an undisputed effect on general public health. Yoganathan and Rom (2001) argue that global warming will result in a change in the earth's ecology with particular emphasis on the transmission dynamics within microbes, which are stimulated by CO_2. The consequence of this would be higher rates of infectious disease. Pulmonary infections, cardiovascular diseases, and psychiatric and neurological disorders are all expected to be more prevalent (Yoganathan and Rom, 2001). However, while this work is based on sound theoretical medical knowledge, the authors cite few examples to support their propositions.

Nonetheless, a second and more recent study by Khansis and Nettleman (2005) also presents similar arguments and goes further to describe the likely regional impacts of global warming. The primary risk in Africa is expected to be reduced arable land and an increase in vector and water borne diseases, while the major impact in Europe and North and South America is expected to be reduced air quality and an increase in respiratory diseases (Khansis and Nettleman, 2005).

With public health at risk, global warming will also indirectly influence the economics and competitiveness of nations by means of a less active labour force. Weston (2009) argues that the poor will be the most affected by global

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warming as they will be the least capable of responding to a climate which is expected to foster disease and sickness.

While there is little evidence to conclusively test these propositions, it is needless to say that when viewed against the backdrop of the potentially dire health risks that may prevail and changes in the ecosystem, both of which threaten economic prosperity and thus general living standards; global warming is viewed in a very serious light by the public sector. As a result, the energy industry is facing severe pressure to reduce CO_2 emissions.

1.1.3.2 The energy industry and policy

Energy is a basic requirement for sustaining human life, be it energy used as electricity, burning of wood or coal to generate heat or modern transportation (Kessel, 2000). The consequence of energy utilisation however, is the release of CO_2 (Ang, 2007).

Figure 2 shows the total scope 1 emissions of the different continents based on performance data of the Global 500 companies participating in the 2009 Carbon Disclosure Project (PricewaterhouseCoopers, 2009). While the data only presents scope 1 CO_2 emissions, the striking result is the comparatively low emissions in Africa and South America. With both these regions being home to rapidly developing economies such as Brazil and South Africa, these results will change in due course. Nonetheless, at present, it poses an interesting challenge to policy makers in these regions whose ultimate goal should be upliftment of society. The critical question which then must be answered by these policy

makers is: to what extent can this goal be compromised by the reduction of energy utilisation which is a key requirement for economic growth, while economic growth is often an enabler in addressing societal imbalances in developing economies?

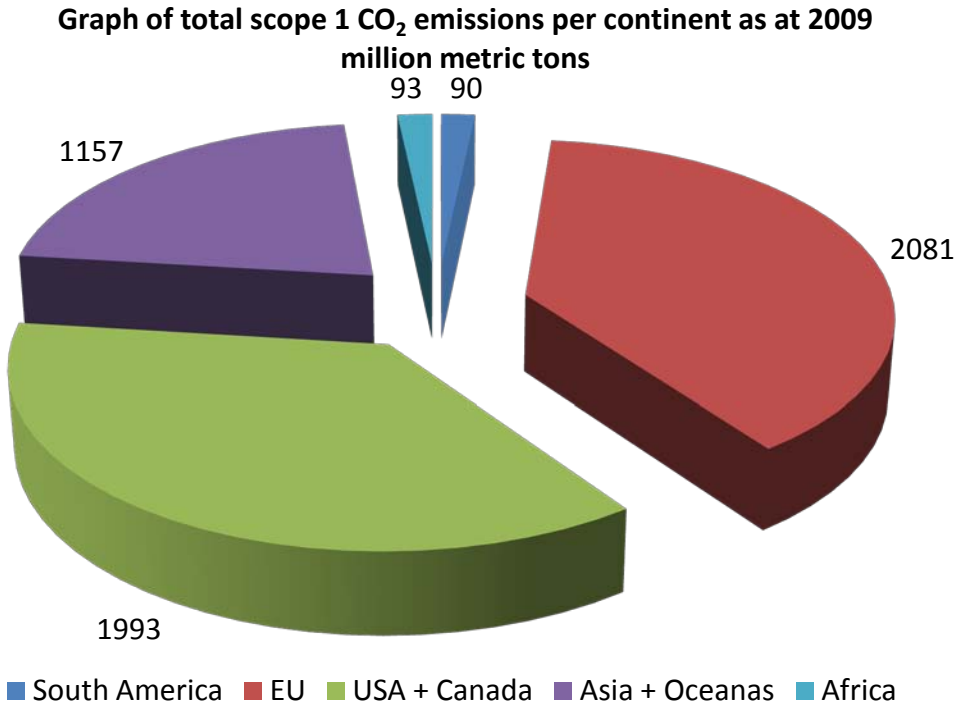

Figure 2: Graph of total scope 1 emissions of different continents as at 2009. Data source: PricewaterhouseCoopers (2009), Authors analysis

1.2 Reduction of CO_2 emissions in the energy industry

As a result of the energy intensity of the fuels and electricity industry and its contribution to CO_2 emissions, the industry is facing severe pressure from governments and society in general to develop cleaner technologies in the long term and reduce CO_2 emissions in the short term. The Kyoto Protocol of 1997 was one of the earliest commitments to a reduction of greenhouse gas emissions

by industry (United Nations, 2008). This convention saw Japan and the European Union agreeing to a reduction of greenhouse gas emissions of 8% and 6% respectively, based on 1990 emission levels, within 10 years (Yoganathan and Rom, 2001; United Nations, 2008). More recently, the Copenhagen summit of December 2009 saw 192 heads of state meet to discuss and agree on an approach to climate change (Giddens, 2010). While the success of the summit has received much criticism (Giddens, 2010 and Michelowa, 2010), it is clear that the drive to reduce CO_2 emissions is gaining momentum.

In response to this drive, many companies have committed significant research to carbon capture and storage technologies, one of which is CO_2 sequestration. Shell has recently opened an 80000m^2 technology centre in Amsterdam where emphasis will be placed on research on CO_2 sequestration (Anonymous, 2009). The government of Norway has also announced the expenditure of 594 million US Dollars to finance a facility that will capture 100 000 tons of CO_2 in 2010, with a view to reach an ultimate capacity of 1.3 million tons of stored CO_2 in 2014 (Anonymous, 2006). However, given the current level of emissions introduced in section 1.1.2, it must be said that significant development must still occur for this technology to be employed on a meaningful scale.

Feasibility studies have shown that the cost of CO_2 capture for existing refineries could range anywhere between 30 and 150 Euros per ton depending on the state at which CO_2 is normally released into the atmosphere, where state refers to temperature, pressure and concentration (Straelen et al. 2010). This clearly highlights that carbon capture is an extremely expensive technology,

notwithstanding any possible legislation which may require companies to continuously maintain the mines at which the captured CO_2 is stored. The implication is that margins for investments in new refineries or new coal fired electricity plants where CO_2 capture is considered becomes smaller, and at the current oil price of close to 85 US Dollars per barrel, some projects may be abandoned.

The consequence of this is that companies in the energy industry in particular need to make more informed project decisions related to investments in new capacity to minimise risk from a CO_2 emissions perspective in relation to allowed and acceptable limits.

1.3 Research title

The influence of institutional factors on the environmental strategy of companies in the energy industry.

1.4 Terminology in research title

1.4.1 Environmental strategy

In the context of this study, environmental strategy refers to a company's orientation with respect to the means by which the company chooses to reduce CO_2 emissions in an effort to curb global warming.

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The following dimensions are highlighted as strategic orientations or simply, types of strategies (Weinhofer and Hoffman, 2008) and will be discussed in detail in Chapter 2:

- Carbon compensation: *This refers to the scenario where a company highlights purchasing carbon credits as a focal point of its environmental strategy,*
- Carbon reduction: *This refers to the scenario where a company highlights carbon dioxide emission reduction as a focal point of its environmental strategy,*
- Carbon independence: *This refers to the scenario where a company highlights a focus on renewable energy such as solar, wind and hydro as a focal point of is environmental strategy.*

1.4.2 Institutional factors

The academic foundation for the study is institutional theory. Institutional theory is embedded on the school of sociology and explains behaviour as a function of social norms, rules and routines (Scott, 1983). It is an outward looking theory which at the firm level of analysis, is used as a means to derive strategy or at least evaluate the same where it already exists, in relation to dynamics in the external environment (Oliver, 1991).

Institutional factors on the other hand refer to specific attributes of the external environment which are expected to correlate with strategy.

1.5 Motivation for the Study

1.5.1 Business motivation

The outcome of this study is the provision of data and supporting evidence which is valuable to business leaders in the energy industry who are considering expansion into new and unknown markets. Using this information, such leaders will be better positioned to understand the extent to which certain institutional factors are linked with strategy in the energy industry. This foresight could be used as a bargaining tool for new energy ventures and also drive technology development and marketing efforts.

1.5.2 Academic motivation

This study adds to a body of knowledge on the degree to which institutional theory can be used to rationalise strategy of companies in the energy industry.

1.6 Summary

Global warming which is largely a result of CO_2 emissions has both direct and indirect impacts on the general health and well being of society. The energy industry which is made up of the fuels and electricity generation sectors are the two largest contributors to CO_2 emissions and as such is facing pressure from governments and society to decrease these emissions. As a result, investment in new facilities for production of fuels and electricity require foresight on possible future demands and the extent thereof on energy companies to reduce their CO_2 footprint. This is required to ensure that technology development in the energy sector is aligned with expectations of government and consumers. The purpose

of this study was to investigate the influence of institutional factors on the environmental strategy of companies in the energy industry.

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Chapter 2

Literature review

2.1 Introduction

The literature review is presented in three sections and will address the following dimensions specifically;

a) Institutional theory,

b) The impact of business context in shaping environmental strategy and,

c) Environmental strategy of companies in the energy industry

Section 2.2 introduces institutional theory which forms the academic foundation of this study. Section 2.3 discusses institutional theory in more detail to illustrate factors which have been found or are expected to influence the environmental strategy or environmental pro-activity of companies in the energy industry in general. Section 2.4 introduces the various types of strategies which energy companies have been found to employ in their drive to reduce CO_2 emissions.

2.2 Institutional theory

Institutional theory is embedded on the school of sociology and explains behaviour as a function of social norms, rules and routines (Scott, 1983). It is an outward looking theory which at the firm level of analysis, is used as a means to derive strategy (Oliver, 1991).

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If viewed in the context of organisational behaviour, institutional theory prescribes that organisational choice is constrained by external pressures which influence strategy. In order to survive and to seek stability, organisations respond to these external pressures and demands (Oliver, 1991) and in doing so, organizations tend to become predictable to some extent. This is supported by work of Kostova, Roth and Dacin (2008) where the concept of institutionalism presents the argument that organisational survival is determined by alignment with the external environment.

While institutional theory has been studied extensively, there are many challenges as to its applicability in modern business. Westney and Zaheer (2001) argue that one specific limitation of institutional theory is in the application of the same to multinationals which differentiate not only in “degree” but also in “kind”. Kostova et. al. (2008) built on this point by arguing that as multinational organisations have complex internal structures with language barriers, inter-unit power struggles and conflicts of interests to mention a few; this introduces an additional degree of complexity which is difficult to dimension using institutional theory. This is an interesting point in the context of the present study as most energy companies operate in many regions and may therefore be categorised as having the multinational characteristics as discussed by Kostova et. al. (2008).

It is also fair to point out though that there is also compelling evidence in favour of institutional theory at a national level. Bockem and Tuschke (2010) have studied foreign direct investment in Germany using classical economic theory as well as institutional theory. For the economic approach, the willingness of a firm

to enter foreign markets was studied as a function of return on investment while for the institutional approach, the attractiveness of the labour market and product market were used as explanatory variables. The study has found that the likelihood of a firm to enter a foreign market is highly dependent on both the economic and institutional factors. Furthermore, the investment decision was also influenced by prior decisions made by similar companies wishing to enter the same market. This is consistent with the argument of Scott (1983) where norms and practices are introduced as explanatory variables of organisational behaviour but more importantly, the study of Bockem and Tuschke (2010) concluded that both economic theory and institutional theory complement each other in strategy design.

In summary, institutional theory prescribes that organisations create structures and derive their strategy to build legitimacy with important stakeholders. The extent to which institutional theory is applicable in modern business is questionable. Within the context of institutional theory, there are clear cases where specific factors correlate well with strategy but there are also valid arguments as to why the principle will not hold in certain cases. It is also very important to point out that there is great complexity in determining factors in the business environment which are actual constraints or determinants of strategy (Scott, 1983).

2.3 The influence of business context in shaping environmental strategy

Section 2.2 introduced institutional theory. The purpose of section 2.3 is to discuss specific factors which have been found to, or are expected to influence strategy of companies, from an institutional theory perspective. These are referred to as institutional factors in the rest of this study.

2.3.1 The influence of national wealth on strategy

There is great complexity in understanding the factors contributing to and constraints controlling economic growth and while there is no consolidated viewpoint on this matter, it is clear that for an economy to grow, energy needs to be consumed and the consumption of energy will lead to an increase in CO_2 emissions. This was shown in the work of Ang (2007), Yoo (2006), and Mahadevan and Asafu-Adjaye (2007).

Chang, Fang and Wen (2001) have also studied energy consumption, unemployment and economic output in Taiwan for the period 1982 to 1992. The authors concluded that increased energy consumption has lead to increased economic activity or gross domestic product. More importantly, the authors claim that the policy implication of this finding is that energy conservation will constrain economic growth in Taiwan. The finding introduces many challenges in derivation of environmental strategy of energy companies as a decision needs to be taken together with government regarding whether pollution control or economic activity should take precedence over the other.

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A further complication is that the relationship between type of energy strategy and economic activity is location or region specific. To build on this point, it has been shown that nuclear energy consumption, which in essence is a carbon independence technology based on the work of Weinhofer and Hoffman (2008), will have a statistically significant positive impact on India's economic activity (Wolde-Rufael, 2010). The same was found to be true for Switzerland, France, Pakistan and Korea, while no such relationship was found for Argentina and Germany (Yoo and Ku, 2009). Based on these works, one can argue that economic growth may be an influencer of environmental strategy and thus drive technology development. However, it is still unclear as to the extent to and scenarios for which economic growth will actually influence strategy.

Some researchers have taken a fundamental economic approach to evaluate the impact of climate change and economic growth. Work of Fankhauser and Tol (2005) shows that from an economic standpoint, developed countries are less vulnerable to climate change. This is based on the assumption that savings behaviour of individuals changes to accommodate the effect of climate change. While there is reason to question the validity of the assumptions used in the model such as the inherent assumption that the developing world be subject to the same policy for climate change as the developed world, the paper draws attention to the following interesting point. The direct impact of climate change on an economy by means of reduced economic output, as a result of having to align with policy related to greenhouse gas emissions, is not the only way in which global warming affects the welfare of generations to come. The propensity of people to save with an expected reduction in GDP per capita also makes future

investment more expensive. Some critics may argue that this conclusion is future oriented and as there is no counter factual, the validity of such statements can never be tested. Nonetheless, it is powerful insight from an economic perspective.

In summary, the debate of energy consumption, energy strategy and economic growth leads to the following conundrum: How do energy companies respond to pressure to reduce CO_2 emissions, with knowledge that energy is required for economic output and thus growth? Furthermore, does a relationship exist between choice of environmental strategy and economic growth or national wealth in general?

2.3.2 The influence of stakeholder context on strategy

It can be argued that the economic state of a nation sets the scene for investment be it in the energy industry or otherwise. The way in which companies compete however will largely be determined by the business landscape. The purpose of this section is to better understand the relationship between the stakeholders in the business landscape and corporate strategy.

2.3.2.1 The mindset shift from shareholders to stakeholders

The use of the term stakeholders as opposed to shareholders in any business offers a challenging shift in mindset within leadership in deriving strategy. By using the term shareholders, one can argue that focus would solely be on the bottom line of the business, or simply profit. The use of the term stakeholders however, requires business leaders to assess, understand and align strategy

with the views of all participants in a company's value chain be it suppliers or customers (primary or secondary).

To build on this notion, Buysse and Verbeke (2003) studied the role of stakeholder involvement in 197 high polluting companies in Belgium. The results of this study have shown that more pro-active environmental strategies are noticed with a broader coverage of stakeholders. More importantly however, the research supported the general view that environmental leadership is strongly associated with meeting the expectations of stakeholders other than government. While there are limitations to this finding in the sense that it was region specific and the study focussed only on larger companies that contributed heavily to solid waste and water pollution, the critical conclusion is that effective environmental management requires identification of stakeholders and alignment of strategy with their expectations.

2.3.2.2 The need for alignment of business with the environment

Kolk and Tulder (2010) argue that 'the modern era of globalisation' requires companies to find their own balance with regard to profit seeking and human development. In essence, the authors argue that the international business landscape has changed and with this change comes complexity with regard to politics, ethics, legislation, and socio-economics while still trying to satisfy shareholders who are almost always interested in a return on equity.

To expand further on this point, an increase in global competition also requires companies to be geared to operate in business environments which may be

different to their present operation. As a result, companies will have to adopt a more regional approach to align their strategy with that of different government policies and consumer expectations (Boisot, 1990). Edoho (2008) iterates this point by arguing that corporate social responsibility (CSI) must be a focal point of the operations of trans-national corporations in developing countries.

The importance of CSI is evident in the Niger Delta region where militant groups often compromise operations largely as a result of poor responses of oil firms to local community demands (Edoho, 2008; Ibitoye and Akimbani, 1999; Ite, 2005). It would have indeed been interesting to know how different the dynamics would have been in the Niger Delta had the energy companies played a more crucial role in general improvement of living standards of the communities which they operate in. Nonetheless the central argument which is taken from this work is that business cannot succeed in a society which fails. This is also consistent with the view of Kolk and Tulder (2010).

While CSI is one viewpoint which contextualises the argument or necessity for a regional strategy, this can also be reasoned from an economic viewpoint. Through the analysis of the worlds 500 largest firms by revenue, it has been shown that most firms are home region oriented, where “home region orientation” makes reference to the fact that more than 50% of the sales of the respective company is in the home region of operation (Rugman and Verbeke, 2008). Based on this, the authors argue that as the assets and sales are usually concentrated in a specific geographic space, a unified global approach can not

be directly applied. This implication is that companies need to understand the regions which they operate in and align thereto.

To build further on this point; through the analysis of the responses of Shell, British Petroleum, Texaco and Exxon Mobil, all of which are leading petroleum refining companies, it is argued that the different levels of acceptance of the Kyoto Protocol by the respective companies as of 2001 is largely a result of the different economies the companies operate in (Kolk and Levy, 2001). This also provides rudimentary evidence to support the argument of a regionalised approach to environmental strategy.

2.3.2.3 A deeper assessment of the forces which shape strategy

While the argument of a regionalised approach to environmental strategy resonates through the work of many researchers as presented in this document, one needs to take a deeper view to understand the underlying forces which this argument is built on.

Gerpott and Mahmudova (2009) studied the willingness of consumers to pay a mark-up for green electricity in Germany in an attempt to unravel attitudinal, perceptual and socio demographic characteristics of the electricity industry. The authors found that while the price tolerance for green electricity was influenced primarily by environmental issues; perceptions about current electricity suppliers, and perceptions about the evaluation of green energy by an individuals social reference groups, were the second and third most important factors which influenced price tolerance for green electricity. In support of this work, Ozaki

(2009) found that in the UK, consumers who are sympathetic to environmental issues do not necessarily adopt green electricity. Here too, the authors found that this is most likely due a lack of strong social norms related to environmental awareness. The work of Gerpott and Mahmudova (2009) and Ozaki (2009) does present an interesting lens through which one realises the need to understand societal forces which could ultimately shape environmental strategy in the energy industry.

Societal norms and perceptions undoubtedly influence consumers' willingness to pay for cleaner or renewable energy. However, one could also study this from a financial perspective. Scarpa and Willis (2010) showed that while renewable energy adoption is significantly valued by many households in the UK, the value is not as significantly large as it needs to be for them to pay more for this clean or renewable energy.

While it is not the purpose of this study to deepen the understanding of consumer behaviour as such, the findings are highly relevant as it highlights the effect of social behaviour, which is closely linked to socio-economics, on corporate strategy in the energy industry. This is consistent with the central view of institutional theory as discussed by Scott (1983).

2.3.2.4 The influence of consumers on environmental pro-activity

A study by Haddock-Fraser and Tourelle (2009) which examined the extent to which end consumers influence corporate response to environmental challenges is a good example which embodies the work of Gerpott and Mahmudova (2009)

and Ozaki (2009). Through the analysis of environmental disclosures of UK FTSE 100 companies, the authors found that companies which are 'close to consumers' are more likely to engage in environmental activities for which there is often no financial benefit. This shows the direct causality between consumer behaviour which is influenced by their context, and corporate response.

2.3.2.5 The influence of energy policy on environmental strategy

One cannot ignore the fact that policy is possibly one of the most important influencers of environmental strategy. This can be drawn from the works of Weinhofer and Hoffmann (2008); Jeswani, Wehrmeyer and Mulugetta (2008); Gonzalez-Benito and Gonzalez-Benito (2006); and Boisot (1990). However, more compelling evidence of the impact of national policies on corporate strategies of companies comes from the work of Engau and Hoffmann (2009). A questionnaire followed by in-depth interviews with executives in the utilities, industrial goods, basic materials, chemicals, transportation, and oil industries was used to understand the impact of policy uncertainty on corporate strategy. From this study, Engau and Hoffmann (2009) concluded that the higher the uncertainty perceived by firms with regard to policy and regulation, the greater the extent to which they collaborate in the policy making process and prepare for a variety of possible policy scenarios.

This is an important finding which also encompasses Porter's view on the necessity of business and government alignment in policy making from a national competitiveness viewpoint (Porter, 2008). It also reinforces that while this study investigates the impact of stakeholders and economics on corporate strategy,

one cannot ignore the impact of policy derivation which in some cases may be the governing force from a strategy viewpoint.

2.3.2.6 Summary

In closing, Kemmler and Spreng (2007) argue that due to the fact that human activity and most corporate sustainability challenges are closely related to energy use, sustainable development can often be tracked using the energy system. The authors present an interesting argument, which is echoed by Ite (2005), in the sense that while developed countries focus on the environment and ecosystem from a sustainability viewpoint, poverty and equity are equally important for developing countries. This supports the choice of metrics for the present study which will be introduced in Chapter 3.

2.3.3 The influence of the energy industry on national competitiveness

Section 2.3.1 presented the argument that energy is required for economic growth. From this viewpoint, it is commonly assumed that energy security in terms of oil and gas reserves for example, is an important determinant of economic prosperity. However, this may be a misconception and the following sections present arguments in favour, and in defence of this notion.

2.3.3.1 Energy availability and competitiveness

A study by Papyrakis and Gerlagh (2007) which was specific to the United States of America showed that natural resource abundance decreases investment, schooling, and R&D expenditure all of which are associated with

competitiveness. This effect was termed the 'natural resource curse'. Furthermore corruption was found to increase in states that were resource rich.

Early work of Sachs and Warner (2001) also presented strong evidence of the 'natural resource curse'. Figure 3 shows the real GDP growth per capita for the period 1970 – 1989 as a function of the percentage of the natural resource exports of a number of countries. From this data, one can certainly argue that a negative correlation exists implying that countries which have larger amounts of resources are less competitive. However, it is also fair to say that there is significant scatter particularly for countries with a low percentage of exports of natural resources which suggests secondary effects. On the other hand, the number of countries with a high percentage of exports is considerably fewer which may have distorted the ability of the researcher to qualify such secondary effects.

2.3.3.2 Institutional factors and national competitiveness

Brunnsschweiler (2008) also argued that the natural resource curse does not factor account what was termed institutional quality in evaluating whether a negative correlation exists between economic growth or competitiveness and resource availability. Institutional quality in this context draws on the work of Papyrakis and Gerlagh (2004) who argue that the simplest measure of institutional quality is corruption.

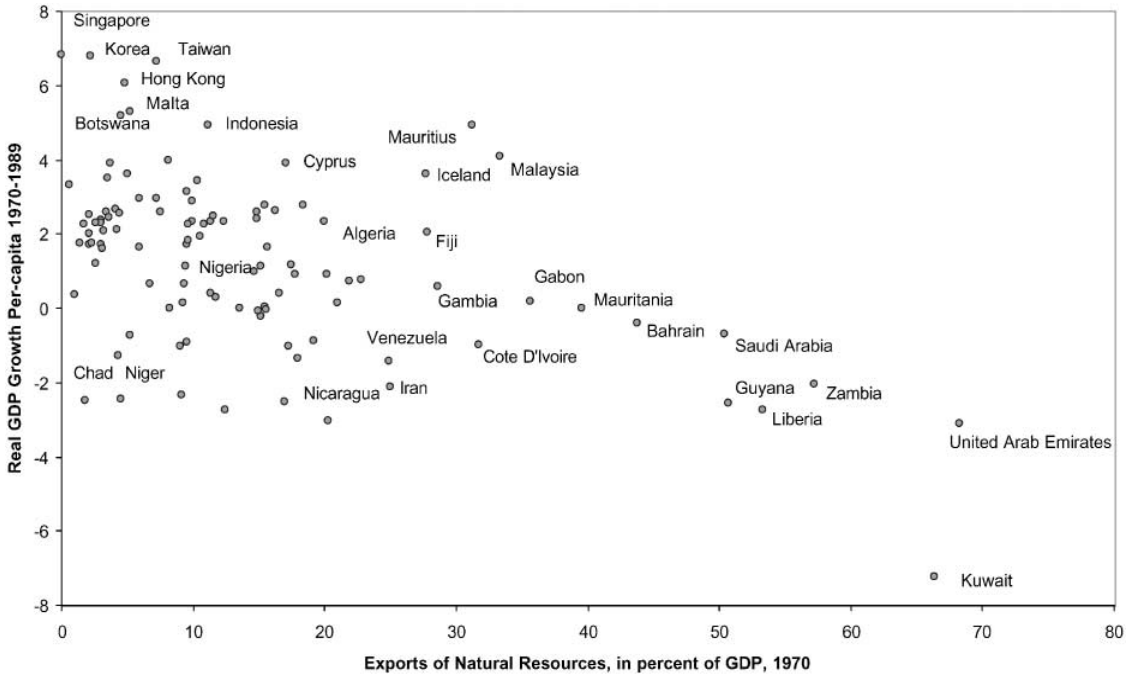

Figure 3: Economic growth and natural resource abundance. Source: Sachs and Warner (2001)

Contrary to Sachs and Warner (2001) and Papyrakis and Gerlagh (2007), Brunnsschweiler (2008) showed that there is no evidence to suggest that competitiveness will be stifled if natural resources are abundant and institutional quality measured by corruption is taken into account. More importantly however, this study showed that there are secondary factors which must be taken into account in the drive for the economic prosperity. This can be measured as corruption but possibly also other factors which characterise standards of living as discussed by Ite (2005).

2.3.3.3 The cost of various energy options

Figure 4 present the results of a study by Baptiste and Ducroux (2003) and illustrate the trade-off between CO_2 emissions and energy cost in financial terms. It can be seen that the cost of energy could almost double by means of employing CO_2 reduction technologies such as CO_2 sequestration. This

increased energy cost would undoubtedly compromise the competitiveness of economies.

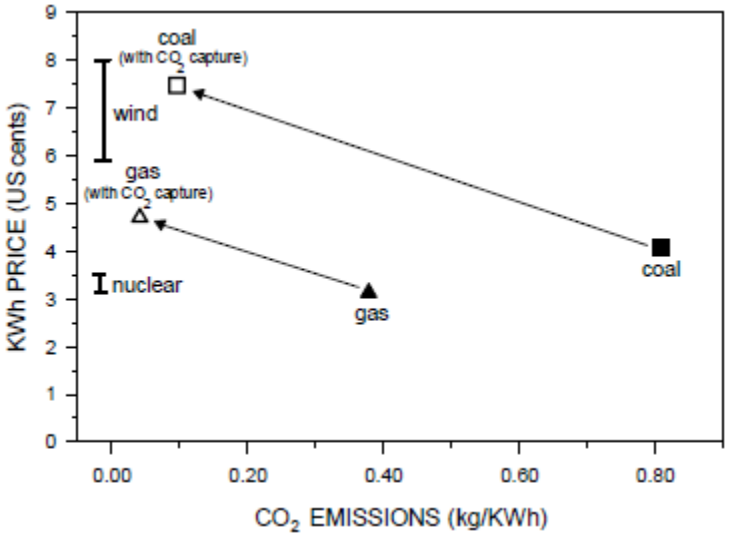

Figure 4: Comparison of kWh price of non fossil or 'renewable' energies (wind, nuclear) and fossil energies (coal and gas) with and without CO_2 capture and sequestration. Source: Baptiste and Ducroux (2003)

2.3.3.4 Summary

It is concluded that for an economy to grow, energy needs to be consumed. Various studies have shown that the type of energy employed could promote or stifle economic growth. In economic terms, it is likely that a shift to renewable energy which is more expensive will result in a reduction in national savings which would make the cost of capital for future investment more expensive. This complicates decision making at a policy level where economic growth is almost always the primary goal. The specific challenge facing policy makers relating to the type of energy strategy employed must be viewed against the backdrop of

the cost differentials between the technologies in relation to economic growth which is often a requirement for improvement of social welfare.

In addition, stakeholders can have a significant influence on corporate strategy. It is also important to point out that while purchasing power and price elasticity are important factors which influence stakeholders' perspectives on energy choices, there are deeper forces embedded within social norms which could ultimately shape consumers' decisions to pay a premium for cleaner energy technologies. It is important that energy companies realize this.

It was also shown from a competitiveness viewpoint that the notion of energy availability being a sole determinant of national competitiveness is flawed. There are specific institutional factors which ultimately form the basis for national competitiveness. However there is great complexity in understanding which the constraining factors are.

2.4 Environmental strategy of companies in the energy industry

2.4.1 What is environmental strategy?

Saeverud and Skjaerseth (2007) present that the strategy of a company is revealed through its goals and objectives in relation to dynamics of the environment which it operates in and alignment of resources within the company to achieve those goals. In the context of the present study, environmental strategy refers to the goals and means a company utilises to respond to the continuous drive to reduce CO_2 emissions.

2.4.2 Determinants of environmental strategy

Through Saeverud and Skjaerseth's (2007) analysis of three major petroleum companies, it was found that environmental strategy cannot be determined solely by region of operation or market conditions. To that end, differences in leadership were argued as the reason for the differences in the environmental strategy of Shell and British Petroleum, both of which are European companies and operate in similar markets.

Paulraj (2009) also studied the motivations which influenced environmental strategy for industries in the United States ranging from food and apparel to petroleum and manufacturing. The three general motivations which formed the framework for the study was: a) legislation, b) competitiveness, and c) ethics. It was found that these external factors had a significant influence on strategy design in each industry. However, like the findings of Saeverud and Skjaerseth (2007) who concluded that leadership had a large part to play in strategy design and execution, Paulraj (2009) also concluded that more insight is needed into each industry and the dynamics therein to conclusively understand the factors influencing a company's environmental strategy.

In general though, any company can be categorised as being pro-active or reactive to demands of all stakeholders irrespective of where they lie in the value chain. The same is true for a company's response to environmental demands.

Gonzalez-Benito and Gonzalez-Benito (2006) presented a literature review to identify the determinant factors of environmental pro-activity. While no primary or

secondary research was conducted, the author's presented a framework to assess environmental pro-activity based on their literature review. The framework presents that; (a) planning and organisation practises, (b) communicational practises, (c) operational practises, (d) the natural environment, and (e) the socio-economic environment, are all determinants of environmental pro-activity. Determinants (a) and (b) were also argued to have a direct impact on the socio-economic environment. This is an important framework in the context of the present study where the inverse causality between socio-economics and planning and organisation, and communication practices is proposed. In other words, in the work of Gonzalez-Benito and Gonzalez-Benito (2006), the planning and organisational practices which are manifested as strategic orientation is expected to have a direct impact on the socio-economic environment and not vice versa.

2.4.3 Types of strategies

Weinhofer and Hoffmann (2008) built on the work of Gonzalez-Benito and Gonzalez-Benito (2006) and developed a framework that categorised a company's CO_2 strategy into three dimensions as shown in Figure 5 namely; CO_2 reduction, CO_2 compensation and carbon independence.

CO_2 compensation refers to a company's decision to purchase carbon credits or investment in CO_2 emission offsetting technologies. It can be expected that this is the cheapest response and arguably would be the case in companies that are taking a short term approach to environmental management.

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CO_2 reduction on the other hand focuses on efficiency improvements and the development of new technologies that are still carbon based but have a lower CO_2 footprint. This requires a significant amount of investment in research and development and would most likely be prevalent in companies where large fixed capital investments are required and therefore risk with regard to technology misalignment with the external environment must be minimised.

Carbon independence refers to the strategic orientation whereby the energy industry itself is in the process of being redefined to some extent at least. Examples of this may include hydrogen powered vehicles, solar power and hydroelectric power to mention a few.

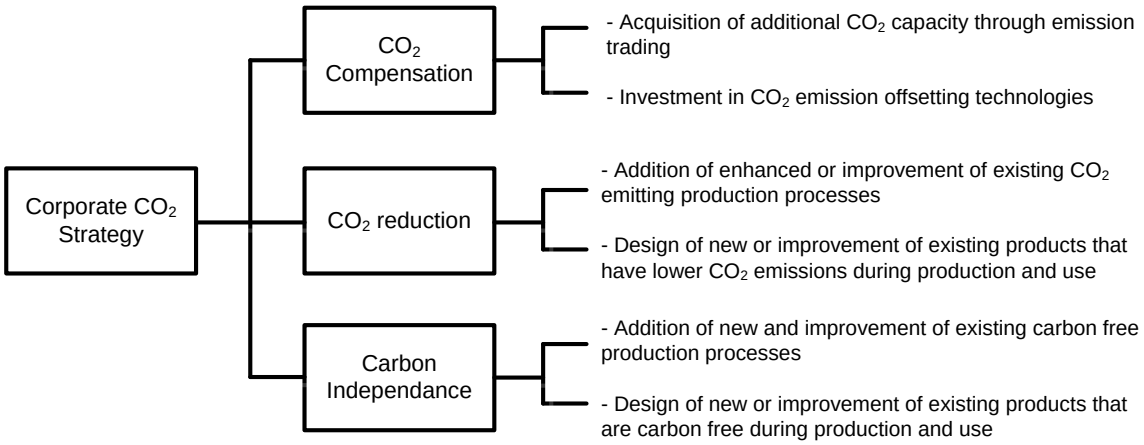

Figure 5: Proposed energy strategy framework. Source: Weinhofer and Hoffman (2008)

2.4.4 Strategy and perceptions of major energy companies

A recent study by Chang and Yong (2007) which analysed the perspectives of the major oil firms (Exxon Mobil, BP, Shell, and Total) on the point of energy technology development presented an interesting finding. The authors

characterised the companies' response in terms of 3-A's which were intended to dimension the following:

a) Availability of resources, denoted by AV,

b) Applicability of technology, denoted by AP, and

c) Acceptability by society, denoted by AC

For AV, the authors used proved hydrocarbon reserves and actual exploration and production expenditure to gauge the companies' commitment to remain fossil fuel based. For AP, the authors used relative expenditure on R&D on new energy products which are in production such as wind, water and solar energy and for AC; the authors used expenditure on social development as an indicator. The authors' inclusion of CSI expenditure to dimension the companies' perspective on the energy landscape is questionable. In addition one can argue that the attribute of firm structure and rivalry, and related and supporting industries, as defined by Porter (2008) in the cluster approach to analyses, would have provided more insight into the dynamics of the industry, Nonetheless, the result of the study by Chang and Yong (2007) which is shown in Figure 6 produces some important evidence of the fact that BP and Shell in particular take a multifaceted approach in their energy portfolio. They are followed by Total which seems to be driven more by applicability of technology. Lastly, Exxon's perspective on the energy landscape seems to be highly based on fossil fuel which lends one to question the sustainability of the business, on a very high level at least.

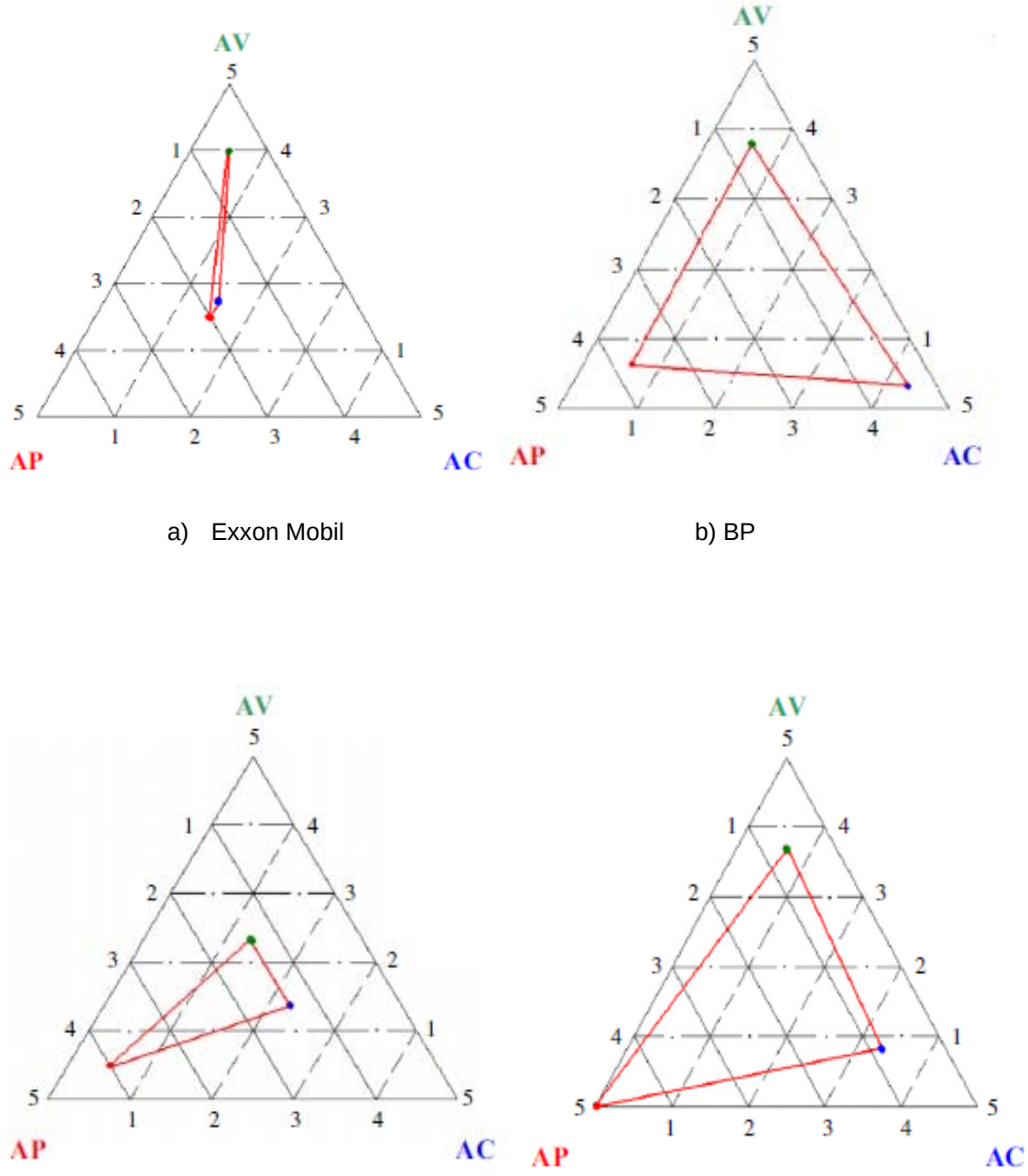

Figure 6: Illustration of major oil companies perspectives on the energy landscape using the 3-A's as at 2006. The company's position in each dimension is indicated by a colour coded dot on iso-lines. Source: Chang and Yong (2007).

The study by Chang and Yong (2007) has shown that there is a growing awareness with regard to the strategy of energy companies and the linkages

thereof, not only with a resource base, but also an element of technology applicability and social awareness. In the context of the present study, technology applicability may be viewed as strategic orientation while social awareness is well aligned with institutional theory.

2.4.5 Regional differences in energy strategy

Weinhofer and Hoffmann (2008) applied the framework shown in Figure 5 in the analysis of the responses of 91 global electricity producers to specific questions in the 2006 Climate Disclosure Project survey. The results showed significant differences in corporate CO_2 strategies for companies in the United States (US), European Union (EU) and Japan. Companies in the EU and Japan adopted an all rounded approach (compensation, reduction and carbon independence) while US electricity companies focused more of their efforts on reduction and compensation. This is an important finding and leads to the question of whether the drive towards a renewable energy economy is actually on the technology development agenda in the US.

Jeswani, Wehrmeyer and Mulugetta (2008) also studied the difference in corporate response of the nine most energy intense industries in Pakistan and the United Kingdom (UK) but adopted a different approach in categorising corporate response. They used ‘indifferent’, ‘beginner’, or ‘active’ as dimensions to categorise corporate response to the continuous drive to reduce CO_2 emissions. While this is also an interesting and valid approach, it provides the *state* of the organisation in responding to the ever growing call for green business. It does not however provide information on the actual direction

different companies are taking in this regard. Nonetheless, the authors have found that responses of companies in the UK could be described as “emerging” or “active”. On the other hand, the response of companies in Pakistan with respect to CO_2 strategy was found to be in the “indifferent” or “beginner” stage. This echoes the early works of Gonzalez-Benito and Gonzalez-Benito (2006) and Boisot (1990) where the need for alignment of corporate environmental strategy to government policy and regional consumer expectations is presented.

2.4.6 Summary

The three general routes which defines a companies strategy with regard to global warming is; a) CO_2 compensation, b) CO_2 reduction, and c) carbon independence. For the purposes of this study, this is referred to as a company’s strategic orientation or type of strategy.

From the observations of previous works which were specific to the energy industry, it is also clear that there are regional differences in terms of the environmental pro-activity of companies. It is also evident that there is a difference in terms of the position which major energy companies have taken with regard to their energy strategy which was dimensioned as a combination of availability of resources, applicability of technology, and acceptability by society.

2.5 Conclusion

The literature review was presented in three broad dimensions which were all intended to develop and understanding of a specific body of knowledge. These dimensions are:

a) the concept of institutional theory as well as its application and limitations in modern business,
b) the influence stakeholders have on shaping strategy of companies as well as specific institutional factors which influence behaviour of firms and consumers alike and,
c) the strategy which energy companies have been found to employ in their drive to reduce greenhouse gas emissions.

Based on the literary review, the following conclusions are drawn.

Institutional theory prescribes that behaviour is strongly influenced by social norms and routines. At a firm level of analysis, strategy is also argued to be strongly influenced by these norms and routines and this calls for alignment of strategy with the dynamics of the environment which a company operates in.

There are examples where institutional theory aligns with economic theory from a strategy perspective but also valid arguments as to why institutional theory can not be assumed to hold for multinationals. In these organisations, the degree of complexity in the organisational design makes it difficult for institutional theory to be directly applied. It is also clear that not all factors in a business environment, or institutional factors to be specific, will influence strategy. It is important but

extremely challenging to evaluate which the constraining factors in the business environment are, from a strategy design perspective.

The complexity as to which institutional factors are constraints complicates decision making at a policy level. This must be viewed against the backdrop of the fact that energy is required for an economy to grow and with energy consumption comes CO_2 emissions. While cleaner technologies are available, these are generally more expensive and the premium will most likely be passed onto consumers. While price is one measure which will influence consumers' decisions to adopt the cleaner technologies, it is also possible that this decision will be influenced heavily by social norms and perceptions about the new and cleaner energy options. One therefore must understand the context which energy companies and all stakeholders find themselves in when deriving strategy.

A further and perhaps more important finding is that resource or energy availability does not necessarily lead to national competitiveness as some may assume. It may be an enabler of competitiveness but must be supported in other dimensions or factors to create a competitive environment.

Lastly, as energy companies try to reduce CO_2 emissions, there are three general strategies which could be adopted. This can be described as CO_2 reduction, CO_2 compensation, and carbon independence. It has also been found that there are specific strategies which are most common in specific nations or regions. It is unclear if these differences align with a specific set of economic

conditions or socio-economic conditions. This needs to be studied further and one way in which this can be done is through institutional theory.

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Chapter 3

Research questions

The purpose of this chapter is to introduce the propositions which were tested in this study. The motivations for the propositions are also discussed.

3.1 Proposition 1: The influence of national wealth on strategy of energy companies

3.1.1 Proposition 1.1

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of economic growth. As economic growth increases, so too does the rate of R-I orientations increase.

3.1.2 Proposition 1.2

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of GDP per capita. As GDP per capita increases, the rate of CO_2 reduction and carbon independence orientations increases.

3.1.3 Motivation for proposition 1

The work of Akinlo (2008), Ang (2007), Yoo (2006), Mahadevan and Asafu-Adjaye (2007) have shown that energy consumption is highly correlated to economic growth. It is expected that rapidly growing economies will adopt the R-I orientation in order to sustain economic growth while at the same time being able

to afford the generally more expensive energy technologies as a result of higher growth rates.

Proposition 1.1 therefore seeks to investigate if there is a direct and statistically significant correlation between the R-I strategy type and economic growth. Proposition 1.2 on the other hand is an attempt to accommodate for the effect of population and the absolute level of economic output by considering GDP per capita instead of a metric such as economic growth where base effects are difficult to dimension.

3.2 Proposition 2: The influence of stakeholder context on strategy of energy companies

3.2.1 Proposition 2.1

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of unemployment. As unemployment decreases, the rate of CO_2 reduction and carbon independence orientations increases.

3.2.2 Proposition 2.2

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of poverty. As poverty decreases, the rate of CO_2 reduction and carbon independence orientations increases.

3.2.3 Proposition 2.3

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of income inequality. As income inequality decreases, the rate of CO_2 reduction and carbon independence orientations increases.

3.2.4 Proposition 2.4

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of the human development index (HDI). As the human development index increases, the rate of CO_2 reduction and carbon independence orientations increases.

3.2.5 Motivation for propositions 2

Proposition 2 is based on the general view that business cannot exist in a society which fails which is the central argument in Kolk and Tulder (2010). This must be understood against the backdrop of the fact that carbon independence technologies are more expensive as discussed earlier.

To be more specific in terms of the literary review, a central argument which has been observed thought the many previous works is that companies need to align their strategy to the region in which they operate (Rugman and Verbeke, 2008). This argument is echoed by studies of Edoho (2008), Ibitoye and Akimbani (1999) and Ite (2005). However, it was duly pointed out that it is not simply about price elasticity of carbon independence technologies. The work of Gerpott and Mahmudova (2009) and Ozaki (2009) have also shown that the underlying forces which shape the behaviour of energy consumers could be societal norms.

Based on this observation which can by and large be described as the influence of stakeholder context on strategy, it is expected that consumers in economies with high levels of unemployment, poverty, income inequality, and a poor HDI rank, will not easily afford to pay or be willing to pay higher prices for energy which is associated with carbon independence technologies.

3.3 Proposition 3: The influence of national competitiveness on strategy of energy companies

3.3.1 Proposition 3.1

A combined CO_2 reduction and carbon independence strategic orientation denoted R-I, is a function of national competitiveness. As national competitiveness increases, the rate of CO_2 reduction and carbon independence orientations increases.

3.3.2 Motivation for proposition 3

Studies have shown that economic output is directly influenced by energy type which influences general production cost and therefore competitiveness (Yoo and Ku, 2009, and Wolde-Rufael, 2010). However, Porter's cluster model for national competitiveness (Porter, 2008) introduces the argument that a number of dimensions influence economic output and therefore national competitiveness, not just a single attribute. These dimensions are categorised as factor conditions, demand conditions, context for firm rivalry and strategy, related and supporting industries, and the role government as shown in Appendix 1 (Porter, 2008. Proposition 3.1 therefore seeks to address if there indeed is a causal relationship between national competitiveness and strategy of energy companies.

Chapter 4

Research methodology

4.1 Data source

Secondary data was used for this study. The responses of companies in the energy industry to the 2009 Climate Disclosure Project (CDP) survey was analysed to determine strategic orientation.

Information on economic growth, GDP per capita, and unemployment was sourced from the World Bank database (World bank, 2010) while country data for income inequality, poverty and human development index was sourced from the CIA world fact book (CIA, 20910). National competitive rankings were obtained from the World Economic Forum (2010).

4.2 Unit of analysis

Only Global 500 companies in the energy industry were considered in this study. The energy industry refers to fuels production companies as well as electricity producers. Analysis was done at a company level to determine the type of energy strategy while institutional factors were assessed at a national level.

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4.3 Method of analysis

4.3.1 Types of Energy Strategies

The strategic orientation of a company was evaluated by analysis of their responses to the 2009 CDP project survey. The strategic orientations which exist are:

a. Carbon dioxide reduction denoted R in the rest of this study
b. Carbon dioxide reduction and carbon independence denoted R-I in the rest of this study

While in theory, Weinhofer and Hoffman (2008) indicated a carbon compensation orientation, it is impractical to assume that energy companies will respond with a compensation strategy in the long run. This orientation was therefore ignored in the analysis.

4.3.2 Evaluation of energy strategies

Companies' responses to the Question 23.8 of the 2009 CDP project (PricewaterhouseCoopers, 2009) was analysed to evaluate if a CO_2 reduction strategy or a combined CO_2 reduction and carbon independence strategy was indicated. The specific question which was raised to companies in this question was: "what activities are you undertaking or planning to undertake to reduce your emissions/energy use?" (PricewaterhouseCoopers, 2009).

Based on the responses of companies to this question, an R or R-I strategy type was deduced. Table 1 shows the keywords which were used to decipher strategy type from the company response. These keywords are consistent with

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technologies which are categorised as independence or renewable technologies (ABS Energy Research, 2010).

Table 1: Keywords associated with CO_2 reduction and carbon independence strategies

CO_2 Reduction	**Carbon independence**
CO_2 reduction	Renewable energy
Carbon dioxide sequestration	Hydropower
Energy integration	Solar energy (photovoltaic and concentrated solar)
	Nuclear energy
	Geothermal energy
	Biofuels
	Ocean energy

Using the keywords shown in Table 1, the percentage of R and R-I strategy types was calculated for each energy company in the Global 500 sample.

4.3.3 Evaluation of institutional factors

Country data for economic growth, GDP per capita, unemployment, poverty, income inequality, HDI and national competitiveness was gathered for the period 2006-2008, where available. Annual averages were used in order to accommodate for upsets which could have distorted performance in any single year. Information for the year 2009 was not used as this was the year when the world began to realise the consequences of the financial meltdown of 2008. This would have distorted country performance data.

It is also pointed out that real economic growth was used in the analysis. This was calculated by stripping out price inflation in the respective year using the following formula:

$$RE_G = \frac{NE_G}{1 + \frac{i}{100}}$$

Where: RE_G – *Real economic growth, %*

NE_G – *Nominal economic growth, %*

i – *Inflation (CPI basis), %*

Information on country information for the period 2006-2008 was also obtained from the World Bank database (World bank, 2010).

4.3.4 Organisation of Data

Once strategy types were calculated as explained in Section 4.3.2 and institutional factors obtained as explained in Section 4.3.3, the data was organised according to percentage strategy types in relation to institutional factors of the home country of the organisation.

4.3.5 Determination of relationships between institutional factors and energy strategy

The R-I strategic orientation was then analysed for a statistically significant association with the various institutional factors using a bi-variate statistical approach. Correlation coefficients from the linear regression were analysed to determine if the independent variables or institutional factors describe the type of

energy strategy observed. The various correlation coefficients and interpretations thereof are shown below.

a. **R^2**: The R^2 value is a measurement of the variation around the mean which can be explained by the model. In simple terms, an R^2 value of 0.7 for example indicates that 70% of the variation in the data can be explained by the model.

b. **Adjusted R^2**: The R^2 value can be artificially inflated if statistically insignificant terms are added to the model as the number of data points is one of the inputs in calculation of R^2. The adjusted R^2 value on the other hand plateaus when insignificant terms are added to the model.

c. **Predicted R^2**: The predicted R^2 is an estimation of the amount of variation in new data which can be explained. For cases where the predicted R^2 is negative, it can be concluded that the model is a poor explanation of observations and the intercept or mean is a better predictor of variation in the data set.

It is important to point out that it is unrealistic and impractical to expect a correlation coefficient of 1 between any of the explanatory variables introduced in Chapter 3 and type of strategy. However, the important determinant of correlation is the adjusted R-squared value, the predicted R-squared value and the difference between the adjusted R-squared and the predicted R-squared.

For a relationship to be deemed acceptably significant in the context of this study, the following criteria needed to be met:

1. A primary requirement is that the adjusted and predicted R-squared need to be greater than zero (Zikmund, 2003 and Stat-ease, 2010).
2. If the primary requirement is met, the adjusted R-squared and predicted R-squared need to be within an absolute of 0.2 of each other (Zikmund, 2003 and Stat-ease, 2010)

In support of the regression analysis, a one way ANOVA was also used to determine the significance of relationships between strategy and the explanatory variables. The F-statistic which measures the ratio of the explained variance to unexplained variance was calculated. This allowed for calculation of a p-value which needed to be less than the alpha value of 0.05 to conclude with 95% confidence that a statistically significant relationship exits.

4.4 Statistical package used for analysis

Design expert was used for the analysis of the data in this study. Design expert is a statistical software package licensed by Stat-Ease®.

4.5 Risks, assumptions and limitations

The following risks, assumptions and limitations are highlighted:

a. Auspices bias may be have been prevalent in the responses to the 2009 CDP Project. Some respondents may have presented a view which reflects that their organisation is highly proactive in the reduction of CO_2 emissions by virtue of the fact that the interview was conducted by a

reputable body whose mandate is to track company progress with respect to CO_2 management.

b. It was assumed that the respondent's view of the company's CO_2 strategy is a true reflection of the actual strategy. This may not be correct in reality.

c. The sample consisted of the Global 500 companies only. Smaller CO_2 emitters were ignored in the analysis.

d. As secondary data was used, a sample strategy was not developed. As the sample was not drawn on probability, extrapolation from the data to present arguments for companies outside of the Global 500 sample is statistically inappropriate.

e. In some cases, data on poverty and income inequality was not available from the World bank or the CIA world fact book for each year for the period 2006-2008. As a result, instantaneous values were used for the last year available. It was decided not to use data which may have been available from other sources, such as reports published by individual countries, in order to maintain consistency in terms of the data source and the standard validations which would have accompanied it.

f. It is also pointed out that the number of companies within the Global 500 population is smaller for some countries. Therefore the strategy responses for companies in such countries will result in a proportionately higher or lower change per response as percentages are used in the analysis. As a result, the findings of this study will be rendered statistically invalid if the number or distribution of Global 500 companies change. This also supports the earlier argument as to why extrapolation from the data set will be statistically inappropriate. Furthermore, in order to ensure that

responses of companies from a specific country are representative of the entire population of companies in that country, a data set of responses normally in excess of 20 is required to ensure normality (Zikmund, 2003). It is unlikely that there would be more than 20 companies in a country within the Global 500 population.

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Chapter 5

Results

5.1 Proposition 1: The influence of national wealth on strategy of energy companies

5.1.1 Proposition 1.1

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of economic growth. As economic growth increases, so too does the rate of CO_2 reduction and carbon independence orientations increase.

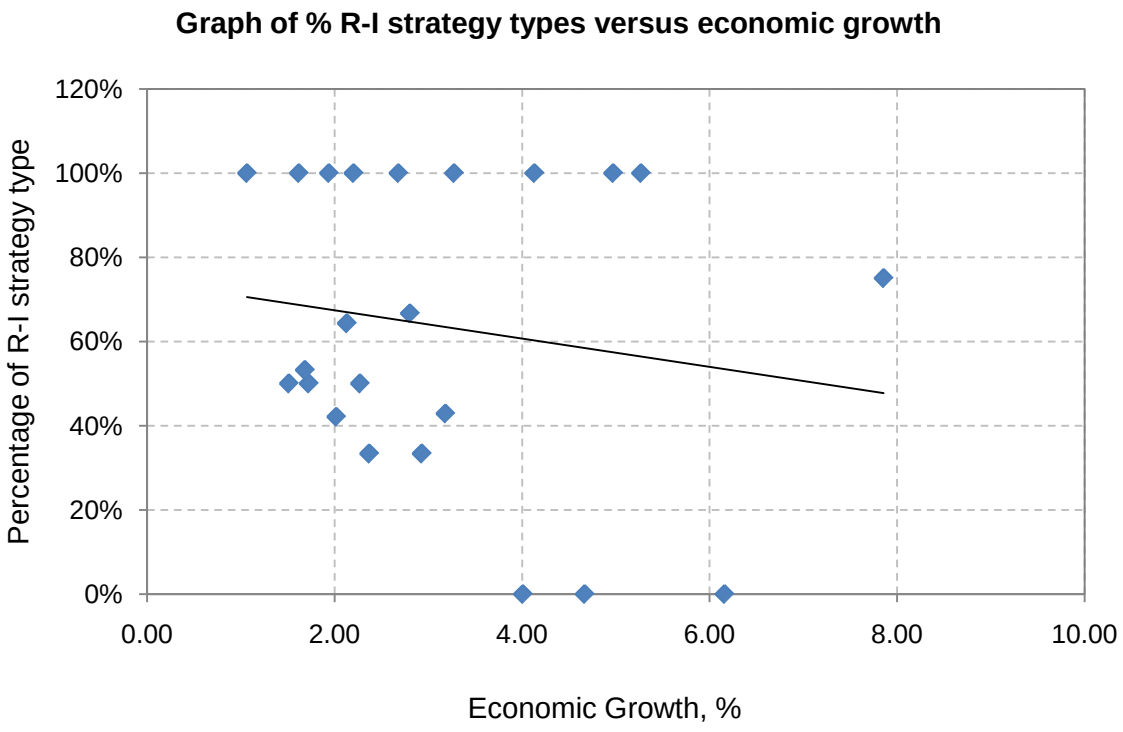

Figure 7: Graph of percentage R-I strategy type versus economic growth in real terms

Figure 7 shows the percentage of R-I strategy type as a function of real economic growth while the results of the regression analysis and the one-way ANOVA are shown in Table 2. The following conclusions can be drawn:

- The R-squared of 0.0257 from the regression analysis shows an extremely poor relationship between economic growth and strategy type.
- The predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than the model from the regression analysis.
- The p-value of 0.4650 is above the 0.05 threshold. This supports the view that economic growth is a poor predictor of strategy type. To be more specific, the p-value indicates that there is a 46.5% chance that the model predictions could be a result of noise.
- Based on there above, there is no conclusive evidence to qualify proposition 1.1.

Table 2: Summary of results for proposition 1.1

Variable	Value
R-squared	0.0257
Adjusted R-squared	-0.0207
Predicted R-squared	-0.2082
ANOVA p-Value	0.4650

5.1.2 Proposition 1.2

A combined CO_2 reduction and carbon independence (R-I) is a function of GDP per capita. As GDP per capita increases, the rate of CO_2 reduction and carbon independence orientations increases.

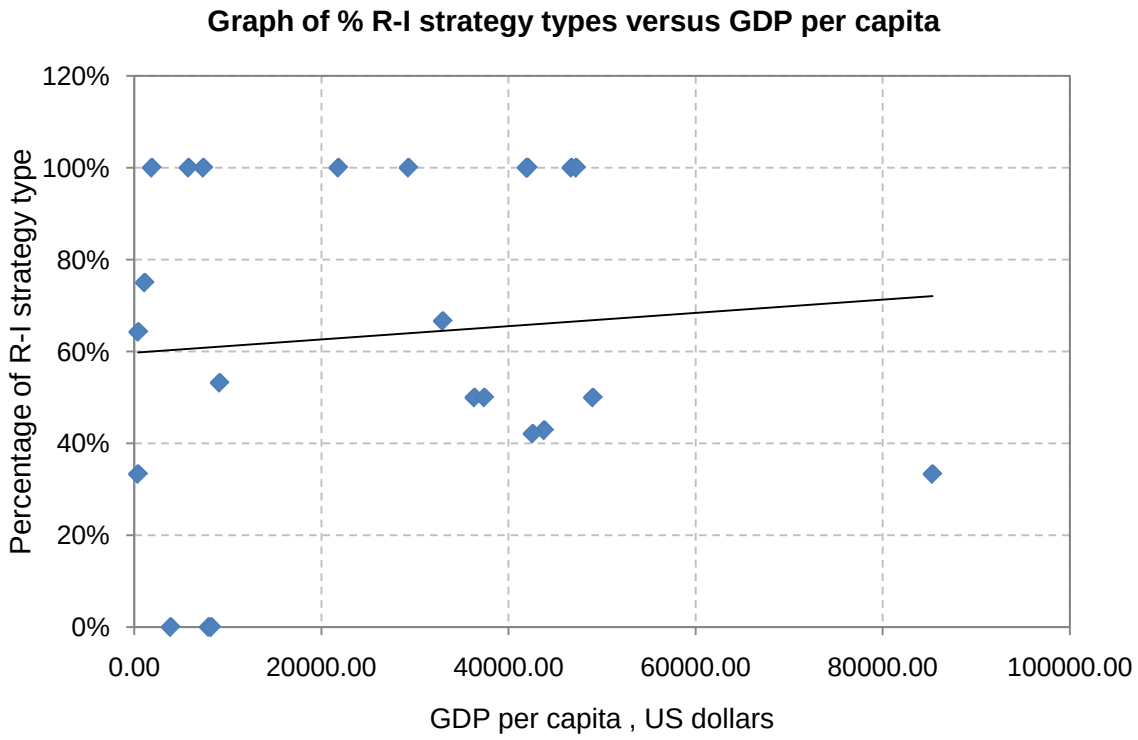

Figure 8: Graph of percentage R-I strategy type versus GDP per capita

Figure 8 shows the percentage of R-I strategy type as a function of GDP per capita while the results of the regression analysis and the one-way ANOVA are shown in Table 3. The following conclusions can be drawn:

- The R-squared of 0.0081 from the regression analysis implies that less than 1% of the variation in the strategy type can be explained by GDP per capita.

- The predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than the model from the regression analysis.
- The p-value of 0.6783 is above the 0.05 threshold and this supports the view that GDP per capita is a poor predictor of strategy type. To be more specific, the p-value indicates that there is a 67.83% chance that the model predictions could be a result of noise.
- Based on there above, there is no conclusive evidence to qualify proposition 1.2.

Table 3: Summary of results for proposition 1.2

Variable	Value
R-squared	0.0084
Adjusted R-squared	-0.0389
Predicted R-squared	-0.2303
ANOVA p-Value	0.6783

5.1.3 Summary

The purpose of proposition 1 was to investigate if there is a statistically significant relationship between institutional factors which may be dimensioned as national wealth, and strategy type. The institutional factors used were economic growth and GDP per capita.

The results show that neither economic growth nor GDP per capita are significant explanatory variables of strategy of energy companies within the

Global 500 sample. Furthermore, there is no evidence to conclusively qualify propositions 1.1 and 1.2.

5.2 Proposition 2: The influence of stakeholder context on strategy of energy companies

5.2.1 Proposition 2.1

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of unemployment. As unemployment decreases, the rate of CO_2 reduction and carbon independence orientations increases.

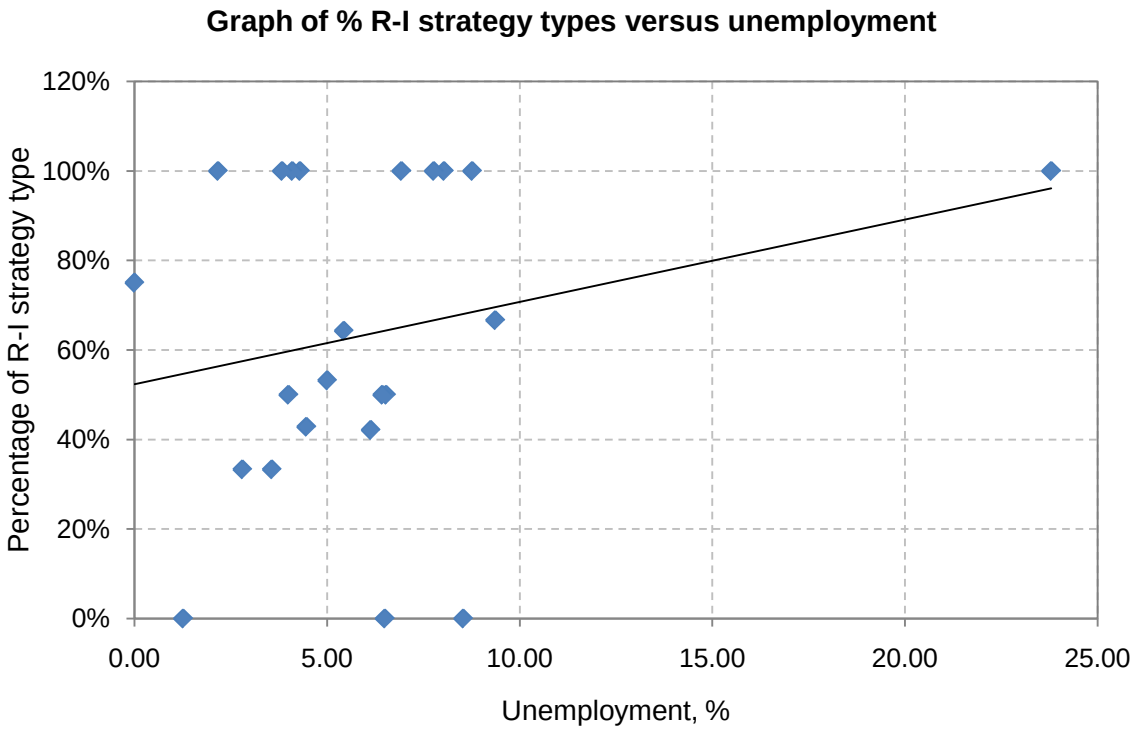

Figure 9: Graph of percentage R-I strategy type versus unemployment

Figure 9 shows the percentage of R-I strategy type as a function of unemployment. The results of the regression analysis and the one-way ANOVA are shown in Table 4. The following conclusions can be drawn:

- The R-squared of 0.0564 from the regression analysis show that roughly 5% of the variation in the strategy type can be explained by GDP per capita. However, it is duly pointed out that the data is skewed by South Africa's unemployment of close to 25% which improved the R-squared value.
- Once again, the predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than the model from the regression analysis.
- The p-value of 0.2752 is also above the 0.05 threshold and from this; one can conclude that unemployment is a poor predictor of strategy type.
- Based on there above, there is no conclusive evidence to qualify proposition 2.1.

Table 4: Summary of results for proposition 2.1

Variable	Value
R-squared	0.0564
Adjusted R-squared	0.0115
Predicted R-squared	-0.0749
ANOVA p-Value	0.2752

5.2.2 Proposition 2.2

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of poverty. As poverty decreases, the rate of CO_2 reduction and carbon independence orientations increases.

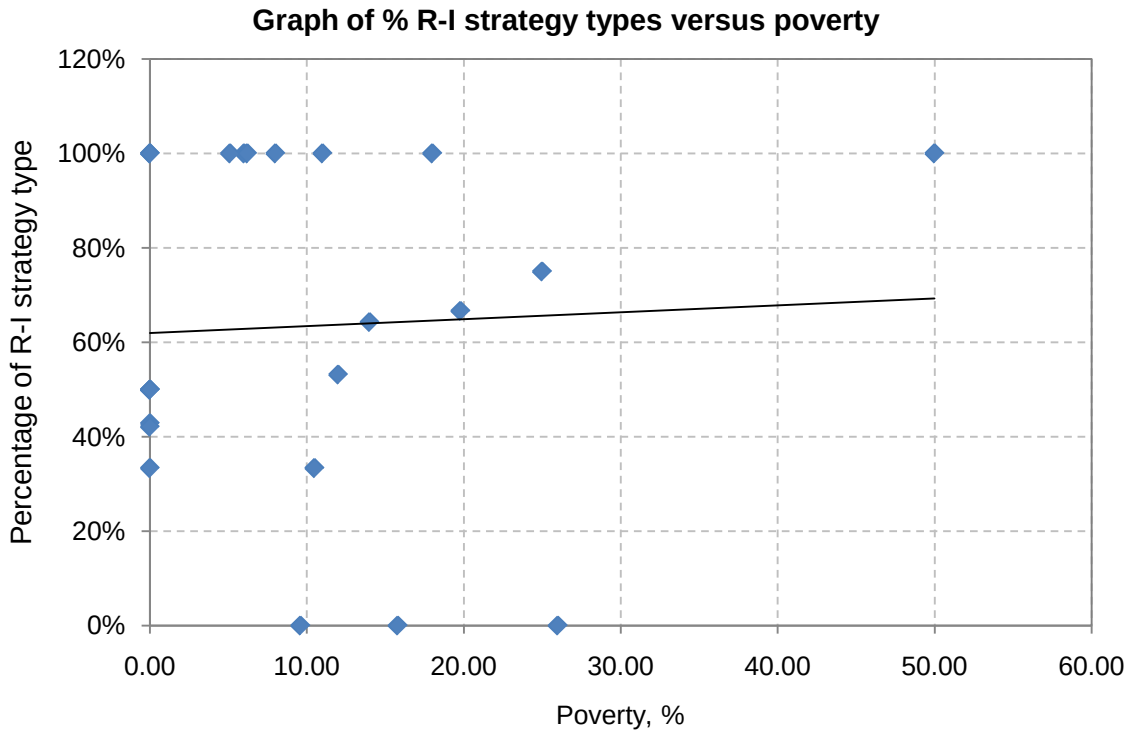

Figure 10: Graph of percentage R-I strategy type versus poverty

Figure 10 shows the percentage of R-I strategy type as a function of poverty while the results of the regression analysis and the one-way ANOVA are shown in Table 5. The following conclusions can be drawn:

- The R-squared of 0.0024 from the regression analysis show that less than 0.5% of the variation in the strategy type can be explained by poverty.

- The predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than the model from the regression analysis.
- There is also an 82.88% chance that the model predictions could be a result of noise.
- Based on there above, there is no conclusive evidence to qualify proposition 2.2.

Table 5: Summary of results for proposition 2.2

Variable	Value
R-squared	0.0024
Adjusted R-squared	-0.0451
Predicted R-squared	-0.2714
ANOVA p-Value	0.8228

5.2.3 Proposition 2.3

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of income inequality. As income inequality decreases, the rate of CO_2 reduction and carbon independence orientations increases.

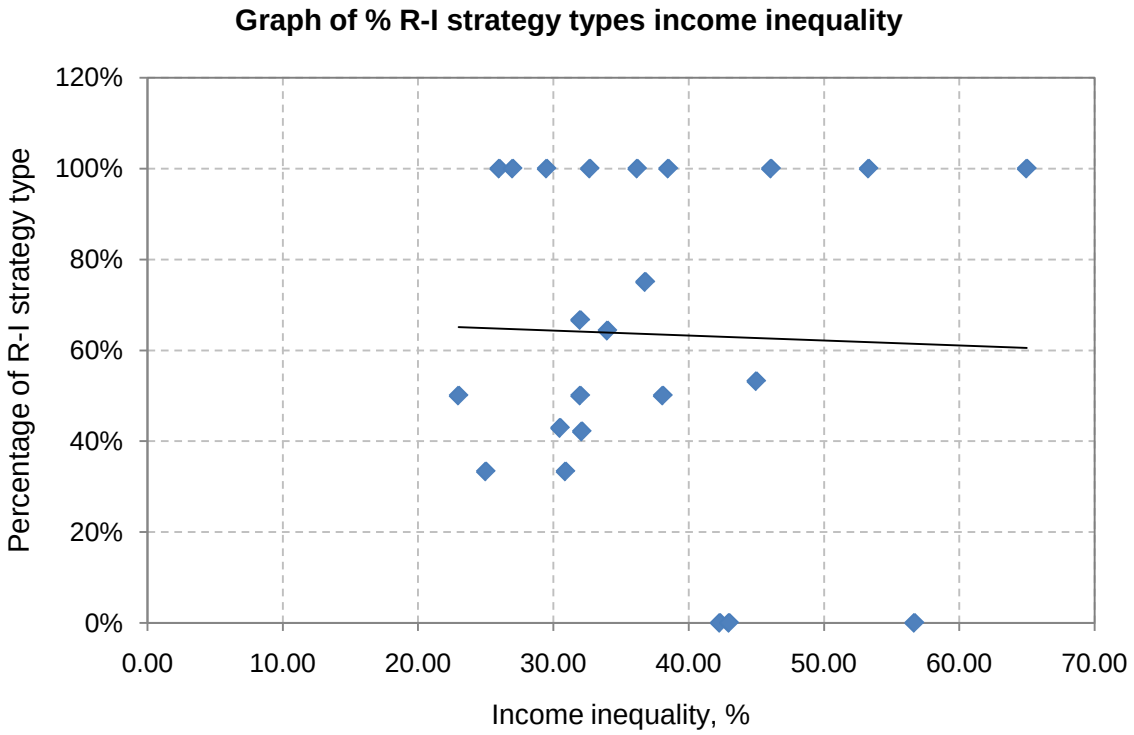

Figure 11: Graph of percentage R-I strategy type versus income inequality

Figure 11 shows the percentage of R-I strategy type as a function of income inequality while the results of the regression analysis and the one-way ANOVA are shown in Table 6. The following conclusions can be drawn:

- The R-squared of 0.0011 from the regression analysis implies that less than 0.5% of the variation in the strategy type can be explained by income inequality.
- The predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than the model from the regression analysis.
- The p-value of 0.8829 is above the 0.05 threshold and this supports the view that income inequality is a poor predictor of strategy type.

- Based on there above, there is no conclusive evidence to qualify proposition 2.3.

Table 6: Summary of results for proposition 2.3

Variable	Value
R-squared	0.0011
Adjusted R-squared	-0.0465
Predicted R-squared	-0.2827
ANOVA p-Value	0.8829

5.2.4 Proposition 2.4

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of the human development index (HDI). As the human development index increases, the rate of CO_2 reduction and carbon independence orientations increases.

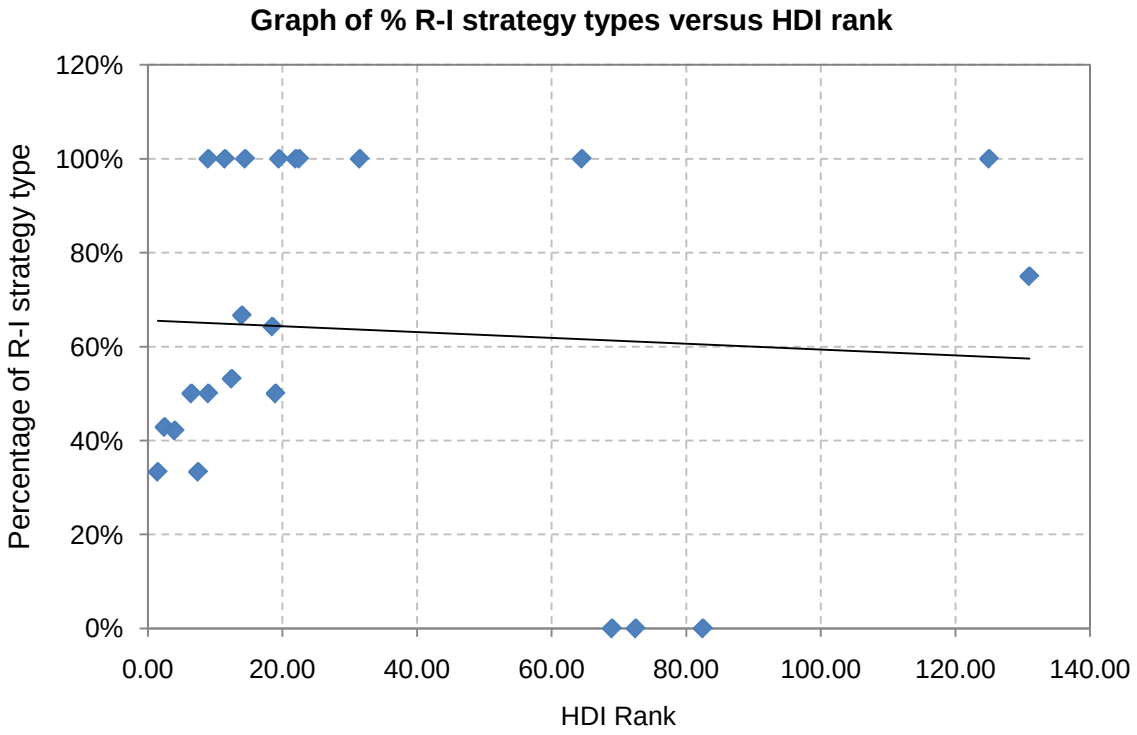

Figure 12: Graph of percentage R-I strategy type versus HDI rank

Figure 12 shows the percentage of R-I strategy type as a function of HDI rank. The results of the regression analysis and the one-way ANOVA are shown in Table 7. The following conclusions can be drawn:

- The R-squared of 0.0045 from the regression analysis implies that less than 0.5% of the variation in the strategy type can be explained by country HDI rank.
- The predicted R-squared is less than zero which implies that the mean is a better overall predictor of strategy type than that from the regression analysis.
- The p-value of 0.755 is above the 0.05 threshold and this supports the view that country HDI rank is a poor predictor of strategy type.
- Based on there above, there is no conclusive evidence to qualify proposition 2.4.

Table 7: Summary of results for proposition 2.4

Variable	Value
R-squared	0.0045
Adjusted R-squared	-0.0429
Predicted R-squared	-0.2376
ANOVA p-Value	0.755

5.2.5 Summary

The purpose of proposition 2 was to investigate if there is a statistically significant and continuous association between stakeholder context and type of energy strategy of the Global 500 energy companies which participated in the 2009 CDP project. Stakeholder context was measured by poverty, unemployment, income inequality and human development index.

The results show that energy strategy can not be explained by poverty, unemployment, income inequality or HDI to a significant degree.

5.2 Proposition 3: The influence of national competitiveness on strategy of energy companies

5.3.1 Proposition 3.1

A combined CO_2 reduction and carbon independence orientation (R-I) is a function of national competitiveness. As national competitiveness increases, the rate CO_2 reduction and carbon independence orientations increases.

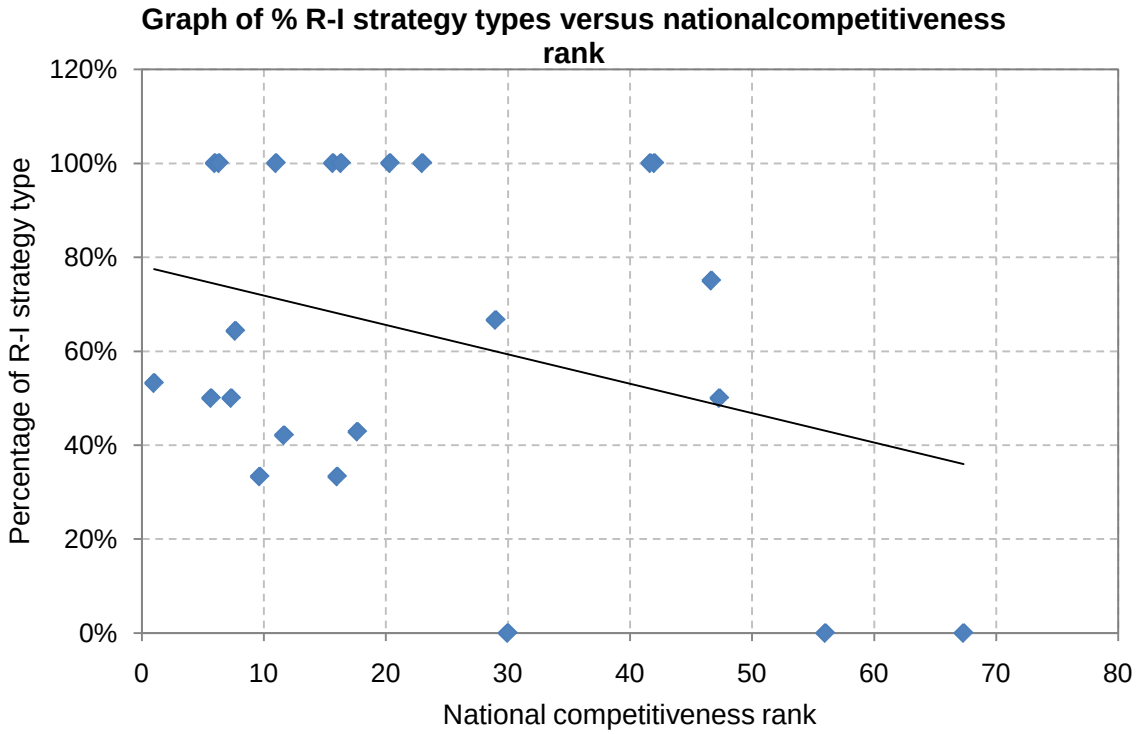

Figure 13: Graph of percentage R-I strategy type versus national competitiveness rank

Figure 13 shows the percentage of R-I strategy type as a function of national competitiveness while the results of the regression analysis and the one-way ANOVA are shown in Table 8. The following conclusions can be drawn:

- The R-squared of 0.105 is a noticeable improvement from the individual factors evaluated in propositions 1 and 2.
- The predicted R-squared is still less than zero, but marginally compared to the results of propositions 1 and 2
- The p-value of 0.13 is still above the 0.05 threshold. While this result suggests that there is a 13% chance that the model variation is a result of noise in the data, it is still a marked improvement over propositions 1 and 2.
- Based on there above, there is no conclusive evidence to qualify proposition 3. However, there is anecdotal evidence to suggest that proposition 1 can not be accepted as the model suggests that the percentage of R-I strategy types decrease with increasing competitiveness.

Table 8: Summary of results for proposition 3

Variable	Value
R-squared	0.1058
Adjusted R-squared	0.0632
Predicted R-squared	-0.0970
ANOVA p-Value	0.13

5.4 Conclusion

The results of propositions one to three were presented in Sections 5.1 to 5.3. The results show that strategy type does not correlate well with any of the institutional factors used in this study. This was concluded by analysis of the adjusted R^2 and predicted R^2 correlation coefficients as well as an ANOVA p-value all of which are the result of a bi-variate statistical analysis.

It is however pointed out that a marked improvement was observed in terms of the model fits for strategy type as a function of national competitiveness rank.

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Chapter 6

Discussion

6.1 Introduction

The purpose of this study was to investigate the influence of institutional factors on the environmental strategy of companies in the energy industry. The following attributes were used as explanatory variables within the institutional theory framework:

- economic growth,
- GDP per capita,
- unemployment,
- poverty,
- income inequality,
- human development index, and
- national competitiveness.

The strategy of companies was evaluated based on their responses to the 2009 CDP project (PricewaterhouseCoopers, 2009).

The study has found that there is no statistically significant relationship between the explanatory variables and the environmental strategy of energy companies within the Global 500 sample. However, the association between national competitiveness and environmental strategy showed a marked improvement in terms of the adjusted R^2, predicted R^2 and p-value in relation to the other

explanatory variables albeit the direction of the causality was opposite to that proposed.

The purpose of this chapter is to explain the reasons for the observations both from an academic and practical perspective.

6.2 Proposition 1: The influence of national wealth on strategy of energy companies

There is substantial evidence in literature which supports the argument that energy consumption is highly correlated to economic growth. This include the works of Akinlo (2008), Ang (2007), Yoo (2006), Mahadevan and Asafu-Adjaye (2007). This together with previous studies where the influence of carbon independence technologies on economic growth was studied in specific countries (Yoo and Ku, 2009, and Wolde-Rufael, 2010) has partly formed the basis for proposition one. The results however show that strategy of energy companies does not correlate well with economic growth. This suggests that there are other explanatory variables which are more significant influencers of strategy at a national policy level. The reason for arguing that these factors reside at a national policy level is based on the argument that this is where factors regarding economic growth and national interests are normally decided.

It must be pointed out that this is not the ideal way in which policy should be derived though. According to Porter (2008), government and business need to collaborate to create an environment which allows for development of competitive industries which in this case would refer to the energy industry.

Pearce, De Castro, and Guilllen, (2008) supports this view and also argue that there is a growing need to develop an understanding on the influence of government policy on corporate strategy and vice versa.

It can therefore be concluded that the reason for a poor correlation between energy strategy and national wealth, is partly a result of poor collaboration between government and energy companies. Once again, it must be clear that this statement is made against the backdrop of the argument that energy is required for economic growth, which creates national wealth.

6.3 The influence of stakeholder context on strategy of energy companies

Kolk and Tulder (2010) argued that business can not exit in a society which fails. Rugman and Verbeke (2008) also presented the need for companies to align their strategy with regions which they operate in. Edoho (2008), Ibitoye and Akimbani (1999) and Ite (2005) also argued the very same point through the use of the energy industry in the Niger delta and the importance of corporate social initiatives in this region. While these are compelling arguments, this study has shown poor correlation between any of the explanatory variables in proposition two, and environmental strategy. There could be two reasons for this.

The first reason is that previous works such as that of Buysse and Verbeke (2003) where environmental pro-activity correlated well with stakeholder engagement was highly region specific. It is possible that there influence of

stakeholders in these cases were highly dependent on a specific attribute of corporate and social behaviour which may not exist in other economies.

The second reason is a build on the first reason in accounting for the poor fit. The work of Gerpott and Mahmudova (2009) and Ozaki (2009) have shown that the underlying forces which shape the behaviour of energy consumers could be societal norms. Further support of the impact of typical non measurable factors in economies comes from the work of Fraj-Andres, Martinez, and Matute (2009) where it was also shown that customers concerns about ecological changes as well as management perceptions about change are critical factors which influence a firm's environmental strategy within the Spanish industrial context.

6.4 The influence of national competitiveness on strategy of energy companies

The comparatively better fit between national competitiveness and energy strategy is a good finding and supports the argument that a competitive industry is dependent not on a single attribute in the economy or industry, but on a number of attributes as discussed by Porter (2008). In order to present the argument from an academic perspective, the various works which were influential in the derivation of propositions one to three are dimensioned in the four of Porter's five attributes which define the competitiveness of a nation (Porter, 2008). The fifth dimension, related and supporting industries, was not studied from an academic viewpoint in this work and is therefore ignored. Once again, this analysis is presented with the understanding that energy is one of the primary requirements for economic output and thus national competitiveness.

The results of the analysis are shown in Tables 9-12. The key concept in each reference is shown as well as the impact of the concept on corporate strategy. By dimensioning the theories and studies in this document which were specific to national wealth, stakeholder context, and national competitiveness, in the different attributes of competitiveness; it becomes evident that no single attribute may be used to determine strategy. To illustrate this point, the following specific synergies are highlighted between the different attributes:

a) CFS_1, GE_1 and F_1: Government's role as an enabler of competitiveness must be managed by the constant drive for economic growth to ensure that wealth per capita remains constant or improves. This notion is common among the dimensions of context for firm rivalry and strategy, government, and factor conditions.

b) CFS_2 and GE_2, GE_3: The type and quality of leadership also determines whether business is pro active and willing to engage with government in order to harness synergies and deliver an economic profit to all stakeholders, not just shareholders. This notion is common among the dimensions of context for firm rivalry and strategy, and government.

c) D_1, G_1 and F_2: The paradigm shift from shareholders to stakeholders is crucial irrespective of whether viewed from a demand perspective, a competition enablement perspective, or a factor conditions viewpoint.

d) CFS_5, CFS_6, CFS_7 and D_3, D_4: Socio-economics are integral factors which must be considered in policy design and strategy derivation. One can arrive at this conclusion from a macro-environment perspective or a demand perspective.

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From the above examples of interconnectedness of the various theories when viewed from a competitiveness viewpoint, it logically follows that in derivation of strategy, a company needs to take a holistic view of the macro and micro environment to take a meaningful position which accommodates the dynamics of the environment which it operates in. This argument supports the finding of a marked improvement in the correlation between national competitiveness and energy strategy based on the adjusted R^2, predicted R^2 and ANOVA p-values in comparison to the specific institutional factors. The reason for this is that national competitiveness is evaluated based a range of performance criteria which in theory, is more likely to encompass more aspects in the five attributes of competitiveness, than any single factor would.

The reason for the fit opposite to that proposed could be based on the argument that the basis for countries being more competitive is a result of employing carbon rich energy technologies which are cheaper as shown by Baptiste and Ducroux (2003). This provides a production cost benefit in the short run. This benefit however may be short lived and is highly dependent on national policy which supports Pearce, De Castro, and Guilllen's (2008) view that a deeper understanding of policy and corporate strategy is required.

6.5 Conclusion

The following conclusions can be drawn from this study from an academic perspective:

- There is great complexity in understanding the constraints or determinant factors which influence strategy from an institutional perspective.

- The influence of national policies on energy strategy needs to be more clearly understood. This is important as energy is a requirement for economic growth while national policies are often the most influential in creating an environment geared for economic growth.
- The strategy of energy companies may be influenced more by intangible measures such as social norms and practices, rather than meaningful and absolute measurements which characterise the socio-economics of nations.
- With energy being a requirement for economic growth and a primary requirement for national competitiveness, it is important to understand the influence of various attributes in the business environment in deriving strategy. These are often highly interconnected and cannot exist in isolation.

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Table 9: Summary of literary review dimensioned in attribute *context for firm strategy and rivalry*

Number	Reference	Key concept in reference	Impact on corporate strategy design and policy derivation
CFS 1 a)	Ang (2007)	For an economy to grow, energy needs to be consumed	If the world remains fossil fuel based, there will be a distinct dichotomy between targeting economic growth and emission reduction. This complicates policy derivation where economic growth is an enabler of improvement of living standards and non fossil fuel based technologies are more expensive
CFS 1 b)	Yoo (2006)		
CFS 1 c)	Mahadevan and Asafu-Adjaye (2007)		
CFS 1 d)	Chang, Fan and Wen (2001)		
CFS 2	Brunnsschweiler (2008)	The natural resource curse is an unacceptable explanation for low economic growth in resource rich countries. One needs to factor institutional quality into account.	Institutional factors are integral in the performance of companies and countries
CFS 3 a)	Edoho (2008)	Business cannot exist and thrive where society fails and therefore must play an integral part in upliftment of in order to be sustainable	Corporations must factors into account socio-economics in strategy design. This could be measured by poverty, income inequality, unemployment and HDI.
CFS 3 b)	Boisot (1990)		
CFS 3 c)	Ibitoye and Akimbani (1999)		
CFS 3 d)	Ite (2005)		
CFS 3 e)	Kolk and Tulder (2005)		
CFS 4	Kemmler and Spreng (2007)	Sustainable development can be tracked using the energy system. Sustainable development refers to changes in income inequality, poverty and unemployment	Poverty, income inequality and unemployment are integral factors which must be factored into account in policy and strategy design
CFS 5	Kolk and Levy (2001)	A regionalized approach to strategy is required	The context which the firm operates in is instrumental in strategy derivation
CFS 6	Rugman and Verbeke (2008)	As assets of a company are located in a specific geographic space, a unified global approach to strategy cannot be adopted	
CFS 7	Paulraj (2009)	While legislation is important, one needs to understand the industry dynamics in strategy design	There are other forces other than legislation which must be considered in strategy derivation.

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Table 10: Summary of literary review dimensioned in attribute *demand conditions*

Number	Reference	Key concept in reference	Impact on corporate strategy design and policy derivation
D 1 a)	Buysse and Verbeke (2003)	Higher environmental pro-activity is observed with a broader coverage of stakeholders	The paradigm shift from shareholders to stakeholders is already a reality in developed economies. Stakeholders can have a significant enough influence on companies to warrant a strategy shift.
D 1 b)	Haddock-Fraser and Tourelle (2009)		
D2	Baptiste and Docroux (2003)	The cost of CO_2 storage could double the cost of energy to the end user.	A consumer base that is willing to pay a significant mark-up must exist for a company to shift to cleaner technologies. Once again, this could be determined by levels of poverty and unemployment.
D3 a)	Gerpott and Mahmudova (2009)	Social acceptance and societal norms can have an unprecedented effect the willingness of consumers to pay for cleaner energy	Social norms and practices must be understood in strategy design.
D 3 b)	Ozaki (2009)		
D4	Scarpa and Willis (2010)	The financial impact of more expensive but cleaner energy cannot be ignored.	Poverty and unemployment are likely to be instrumental variables in determining whether governments and companies adopting cleaner but more expensive technologies.

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Table 11: Summary of literary review dimensioned in attribute *factor conditions*

Number	Reference	Key concept in reference	Impact on corporate strategy design and policy derivation
F 1 a)	Sachs and Warner (2001)	Natural resource abundance decreases investment , schooling and R&D output. This compromises economic output and is termed the natural resource curse.	If this were true, foreign direct investment to locations with large amounts of natural resources would decline. In response, governments and local companies would have to redefine their value proposition.
F 1 b)	Papyrakis and Gerlagh (2007)		
F 2	Chang and Yong (2007)	Through the analysis of major oil firms' responses in terms of applicability of technology, acceptability by society and availability of resources; the firm's strategy could be inferred.	An energy resource base is one of the factors strongly considered by corporate in deriving environmental strategy. However, technology availability which is ultimately driven by skill, and social acceptance cannot be ignored in strategy design.

Table 12: Summary of literary review dimensioned in attribute *government and business in policy derivation*

Number	Reference	Key concept in reference	Impact on corporate strategy design and policy derivation
GE 1 a)	Boisot (1990),	Alignment of corporate environmental strategy with government policy and consumer expectations is critical to ensure sustainability of any company.	Environmental strategy cannot be developed in isolation. A multidimensional approach is necessary. A mindset shift from shareholders to stakeholders is also required.
GE 1 b)	Weinhofer and Hoffmann (2008)		
GE 1 c)	Jeswani, Wehrmeyer and Mulugetta (2008)		
GE 1 d)	Gonzalez-Benito and Gonzalez-Benito (2006)		
GE 2	Engau and Hoffmann (2009)	Business is more likely to engage in policy making where the level of uncertainty is greater	Business is only reactive when the causal effect of policy is unknown. This will compromise sustainability in the long run. Strategy design needs to be forward looking and proactive.
GE 3	Paulraj (2009)	Legislation is instrumental in environmental strategy derivation	Business must be involved in policy derivation

Chapter 7

Conclusion

The purpose of this study was to investigate the influence of institutional factors on the environmental strategy of companies in the energy industry. The academic basis for the study was institutional theory which prescribes that the strategy of a company is influenced by factors or dynamics in the business environment. These are referred to as institutional factors.

The institutional factors used in this study were economic growth, GDP per capita, unemployment, poverty, income inequality, HDI, and national competitiveness. These were obtained from the World bank (2010) and the CIA world fact book (CIA, 2010).

Environmental strategy refers to whether an energy company chooses a combined focus on CO_2 reduction and carbon independence as a focal point of its strategy, or whether a CO_2 reduction only strategy is adopted. This was obtained from responses of Global 500 energy companies to the 2009 Carbon Disclosure Project (PricewaterhouseCoopers, 2009).

A bi-variate statistical analysis was performed on the data gathered. Strategy type was regressed against the institutional factors and correlation coefficients were calculated to evaluate the amount of variation in strategy which could be explained by the various institutional factors. This was supported by a one-way ANOVA

analysis where a p-value was calculated from the F-statistic. The alpha value used to evaluate whether a statistically significant correlation exists is 0.05.

The results show that none of the institutional factors are statistically significant explanatory variables of environmental strategy. However, a marked improvement was found in the model fit between strategy and national competitiveness rank, compared to the model fits for each of the other institutional factors. This together with the literary review which has shown that energy use is a primary requirement for national output, and thus national competitiveness, is a rational finding. The reason for the better fit is expected to be a result of the fact that competitiveness is a measure of a number of different factors such as infrastructure, labour market efficiency and innovation, to mention a few.

The following recommendations are made for future work which would improve the body of knowledge with respect to environmental strategy of energy companies:

a) This study was limited to Global 500 companies and therefore the sample was limited. It is suggested that future work expand beyond the sample set used for this study to gather a holistic view with encompasses strategy of smaller energy companies.
b) It is suggested that future work investigate strategy type in relation to various specific points of explanatory variables in the business landscape. An example would be differences in strategy type for economies above and below the mean value of the explanatory variable. This approach could not be adopted in this study due to a limitation of the number of data points available.

c) The influence of policy must be investigated in future work. As the frequency of international conventions where climate change is discussed is increasing, it may be the case that policy will become the determinant of energy strategy, if not already.

d) Most energy companies are multinational. This study focused on strategy type as a function of the home country of energy companies. In reality, company earnings of multinationals are drawn from multiple locations. It is therefore suggested that a weighted average of the institutional factors be used in future work as explanatory variables of strategy. The weighted average could be based on earnings from the different economies.

e) The energy industry is highly capital intensive and once a technology is built, it is sometimes difficult to adapt a technology to make it more environmentally friendly. It is therefore possible that this may be the scenario some energy companies find themselves in and therefore adopting a carbon independence technology orientation for example, would be difficult if not impossible. It is therefore suggested that future work focus only on the orientation or strategy types for new capacity which energy companies are seeking to install.

f) One can not ignore that some energy companies will be highly specific to location. For example, it should be expected that companies in or seeking to enter Brazil, may focus on hydropower as a result of the availability of kinetic energy of water in the Amazon basin. Likewise, a solar based energy strategy would be far more lucrative in Central Africa than in Western Europe. Future work should attempt to de-convolute these location specific factors in the analysis.

g) This study has focused largely on economics and socio-economics as explanatory variables of strategy. It must be pointed out that there are also other dimensions which could be equally, if not more important from a strategy design perspective. One example would be the quality of education at all levels in a country as a determinant of strategy. Education and technical skills are critical requirements for developing carbon independence technologies to a point where it can compete with carbon based technologies from a cost perspective. Further examples of institutional factors in this dimension may also include quality of research and development, patent applications, and alignment of university curricula with specific requirements of the energy industry.

h) A deeper understanding is required in terms of the impact of social behaviour on strategy. While it will most likely be challenging to dimension and quantify, there is a reasonable body of knowledge which leads to the belief that social behaviour could have more of an impact on strategy than any of the institutional factors used in this study.

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9. Appendix

9.1 Appendix 1: Porter's cluster model of national competitiveness

Figure A-1 is a schematic of the different attributes of competitiveness as defined by Porter (2008). From this figure, it can be seen that there are five attributes of competitiveness namely; a) factor conditions, b) context for firm strategy and rivalry, c) demand conditions, d) related and supporting industries and, e) government-business collaboration.

9.1.1 Context for firm strategy and rivalry

Porters description of this attribute is related to governance as it dimensions how companies are created, organised, managed and the extent to which domestic rivalry is fostered (Porter, 2008). In addition, the context is largely influenced by the socio-economics and regulatory systems within which firms must compete.

9.1.2 Demand conditions

Demand conditions can be viewed as the influence that the consumers of the industries product exert on companies within the industry which ultimately informs, shapes or at the extreme, defines a company's strategy.

9.1.3 Factor conditions

Porter characterises factor conditions simply as the factors of production such as skilled labour, energy availability or infrastructure for example (Porter, 2008).

9.1.4 Related and supporting industries

The attribute is intended to dimension and highlight the interactions of stakeholders across the value chain. In other words, for a company to be competitive and sustain its competitive advantage, it needs to ensure that suppliers and buyers are also sustainable. In principle, this can only happen if these related and supporting industries are also competitive.

9.1.5 Government

Porter argues that collaboration between business and government is a pivotal requirement for national competitiveness (Porter, 2008). This collaboration is required to align industrial needs with societal needs to ensure upliftment of the nation as a whole.

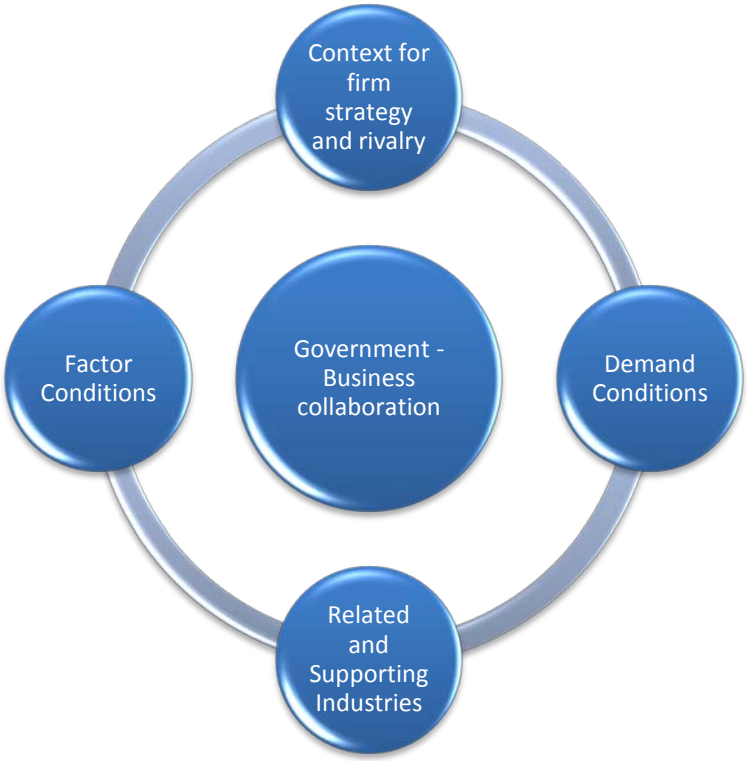

Figure A-1: Porter's cluster model of national competitiveness

Source: Authors adaptation of schematic in Porter (2008)

9.2 Appendix 2: Institutional factors

9.2.1 National wealth

9.2.1.1 Economic growth

Table A2-1: Inflation and nominal economic growth. Data source: World bank (2010)

	Inflation, % (CPI basis)			Economic Growth, % (Nominal)		
	2006	2007	2008	2006	2007	2008
Australia	4.64	4.63	4.41	3.0	3.3	3.7
Austria	1.82	2.13	2.42	3.4	3.1	1.8
Brazil	6.15	3.73	5.87	4.0	5.7	5.1
Canada	2.49	3.07	3.90	3.1	2.7	0.4
Finland	1.34	3.24	2.68	4.9	4.2	0.9
France	2.39	2.50	2.49	2.2	2.3	0.4
Germany	0.52	1.86	1.54	3.0	2.5	1.3
Hong Kong	3.64	7.45	7.20	7.0	6.4	2.4
India	4.97	4.89	6.22	9.7	9.1	6.1
Italy	1.84	2.41	2.84	2.0	1.6	1.0
Japan	-0.90	-0.71	-0.90	2.0	2.4	0.7
Malaysia	3.82	5.20	10.28	5.8	6.3	4.6
Netherlands	1.73	1.51	2.68	3.4	3.5	2.1
New Zealand	3.21	3.77	3.60	1.8	3.1	1.1
Norway	8.52	2.24	9.57	2.3	3.1	2.1
Portugal	2.83	3.05	1.91	1.4	1.9	0.0
Russia	15.51	13.85	19.17	7.7	8.1	5.6
South Africa	7.32	8.99	10.85	5.3	5.1	3.1
Spain	4.04	3.17	3.05	3.9	3.7	1.2
Sweden	1.73	2.99	3.20	4.2	2.6	0.2
Thailand	5.26	3.55	3.84	5.1	4.9	2.5
UK	2.62	2.84	2.30	2.8	3.0	0.7
USA	3.22	2.69	2.15	2.8	2.0	0.4

Table A2-2: Real economic growth. Data source: World bank (2010)

	Economic Growth, % (Real)			
	2006	**2007**	**2008**	**Average**
Australia	2.87	3.15	3.52	3.18
Austria	3.31	3.00	1.72	2.68
Brazil	3.74	5.47	4.79	4.67
Canada	3.03	2.63	0.38	2.02
Finland	4.86	4.07	0.89	3.27
France	2.17	2.27	0.42	1.62
Germany	2.95	2.42	1.25	2.20
Hong Kong	6.77	5.94	2.21	4.97
India	9.21	8.64	5.72	7.86
Italy	2.00	1.53	1.01	1.51
Japan	2.06	2.41	0.71	1.72
Malaysia	5.56	6.03	4.21	5.27
Netherlands	3.32	3.41	2.06	2.93
New Zealand	1.78	2.97	1.06	1.94
Norway	2.10	3.07	1.95	2.37
Portugal	1.33	1.82	0.04	1.06
Russia	6.67	7.11	4.70	6.16
South Africa	4.96	4.68	2.76	4.13
Spain	3.74	3.55	1.12	2.80
Sweden	4.17	2.49	0.15	2.27
Thailand	4.89	4.76	2.37	4.01
UK	2.77	2.94	0.69	2.13
USA	2.69	1.97	0.39	1.68

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9.2.1.2 GDP per capita

Table A2-3: GDP per capita. Data source: World bank (2010)

	GDP per Capita, $US dollars			
	2006	**2007**	**2009**	**Average**
Australia	40660	48499	42279	43813
Austria	44648	49525	46019	46731
Brazil	7185	8536	8114	7945
Canada	43185	45003	39599	42596
Finland	46462	50775	44491	47243
France	40644	44471	41051	42056
Germany	40398	44525	40873	41932
Hong Kong	1731	1919	1960	1870
India	1096	1065	1134	1098
Italy	35641	38385	35084	36370
Japan	34264	38268	39727	37420
Malaysia	7003	8187	6975	7389
Netherlands	364	438	427	410
New Zealand	31853	27045	29000	29299
Norway	82294	94568	79089	85317
Portugal	21037	22955	21414	21802
Russia	7856	9300	7500	8219
South Africa	5933	5666	5798	5799
Spain	32105	35000	31774	32960
Sweden	50558	52884	43654	49032
Thailand	3689	4043	3894	3875
UK	388	456	481	442
USA	7206	9351	10790	9116

9.1.2 Stakeholder context

9.2.2.1 Unemployment

Table A2-4: Unemployment. Data source: World bank (2010)

	Unemployment, %			
	2006	**2007**	**2008**	**Average**
Australia	4.8	4.4	4.2	4.5
Austria	4.7	4.4	3.8	4.3
Brazil	8.4	9.3	7.9	8.5
Canada	6.3	6.0	6.1	6.1
Finland	7.6	6.8	6.4	6.9
France	8.8	7.9	7.4	8.0
Germany	10.2	8.6	7.5	8.8
Hong Kong	4.8	4.0	3.5	4.1
India	0.0	0.0	0.0	0.0
Italy	6.8	6.1	6.7	6.5
Japan	4.1	3.9	4.0	4.0
Malaysia	3.3	3.2	0.0	2.2
Netherlands	4.3	3.6	2.8	3.6
New Zealand	3.8	3.6	4.1	3.8
Norway	3.3	2.5	2.6	2.8
Portugal	7.7	8.0	7.6	7.8
Russia	7.2	6.1	6.2	6.5
South Africa	25.5	23.0	22.9	23.8
Spain	8.5	8.3	11.3	9.4
Sweden	7.0	6.1	6.2	6.4
Thailand	1.2	1.2	1.4	1.3
UK	5.4	5.3	5.6	5.4
USA	4.6	4.6	5.8	5.0

9.2.2.2 Poverty

Table A2-5: Poverty. Data source: CIA (2010)

	Poverty, %	Base year
Australia	0.00	2007
Austria	6.00	2007
Brazil	26.00	2007
Canada	0.00	2007
Finland	0.00	2007
France	6.20	2004
Germany	11.00	2001
Hong Kong	8.00	2006
India	25.00	2007
Italy	0.00	2007
Japan	0.00	2007
Malaysia	5.10	2002
Netherlands	10.50	2005
New Zealand	0.00	2007
Norway	0.00	2007
Portugal	18.00	2007
Russia	15.80	2006
South Africa	50.00	2001
Spain	19.80	2005
Sweden	0.00	2007
Thailand	9.60	2006
UK	14.00	2006
USA	12.00	2004

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9.2.2.3 Income inequality

Table A2-5: Income inequality. Data source: CIA (2010)

	Income inequality, -	Base year
Australia	30.50	2006
Austria	26.00	2006
Brazil	56.70	2005
Canada	32.10	2005
Finland	29.50	2006
France	32.70	2007
Germany	27.00	2006
Hong Kong	53.30	2006
India	36.80	2004
Italy	32.00	2006
Japan	38.10	2002
Malaysia	46.10	2002
Netherlands	30.90	2006
New Zealand	36.20	1997
Norway	25.00	2007
Portugal	38.50	2006
Russia	42.30	2007
South Africa	65.00	2005
Spain	32.00	2005
Sweden	23.00	2005
Thailand	43.00	2006
UK	34.00	2005
USA	45.00	2007

9.2.2.4 Human development index

Table A2-6: Human Development Index. Data source: CIA (2010)

	HDI, -		
	2007	**2008**	**Average**
Australia	3.0	2.0	2.5
Austria	15.0	14.0	14.5
Brazil	70.0	75.0	72.5
Canada	4.0	4.0	4.0
Finland	11.0	12.0	11.5
France	10.0	8.0	9.0
Germany	22.0	22.0	22.0
Hong Kong	21.0	24.0	22.5
India	128.0	134.0	131.0
Italy	20.0	18.0	19.0
Japan	8.0	10.0	9.0
Malaysia	63.0	66.0	64.5
Netherlands	9.0	6.0	7.5
New Zealand	19.0	20.0	19.5
Norway	2.0	1.0	1.5
Portugal	29.0	34.0	31.5
Russia	67.0	71.0	69.0
South Africa	121.0	129.0	125.0
Spain	13.0	15.0	14.0
Sweden	6.0	7.0	6.5
Thailand	78.0	87.0	82.5
UK	16.0	21.0	18.5
USA	12.0	13.0	12.5

9.2.3 National competitiveness

Table A2-7: National competitiveness rank. Data source: World economic forum (2010)

	National Competitiveness, -			
	2006	**2007**	**2009**	**Average**
Australia	16.0	19.0	18.0	17.7
Austria	18.0	15.0	14.0	15.7
Brazil	66.0	72.0	64.0	67.3
Canada	12.0	13.0	10.0	11.7
Finland	6.0	6.0	6.0	6.0
France	15.0	18.0	16.0	16.3
Germany	7.0	5.0	7.0	6.3
Hong Kong	10.0	12.0	11.0	11.0
India	42.0	48.0	50.0	46.7
Italy	47.0	46.0	49.0	47.3
Japan	5.0	8.0	9.0	7.3
Malaysia	19.0	21.0	21.0	20.3
Netherlands	11.0	10.0	8.0	9.7
New Zealand	21.0	24.0	24.0	23.0
Norway	17.0	16.0	15.0	16.0
Portugal	43.0	40.0	43.0	42.0
Russia	59.0	58.0	51.0	56.0
South Africa	36.0	44.0	45.0	41.7
Spain	29.0	29.0	29.0	29.0
Sweden	9.0	4.0	4.0	5.7
Thailand	28.0	28.0	34.0	30.0
UK	2.0	9.0	12.0	7.7
USA	1.0	1.0	1.0	1.0

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9.3 Appendix 2: Strategy type

Table A3-1: Strategy distribution per country. Data source: PricewaterhouseCoopers (2009), Authors analysis

	Number of responses	Reduction Only (R)	Reduction and Carbon Independence (RI)	% R	% R-I
Australia	7	4	3	57%	43%
Austria	3	0	3	0%	100%
Brazil	5	5	0	100%	0%
Canada	19	11	8	58%	42%
Finland	2	0	2	0%	100%
France	4	0	4	0%	100%
Germany	1	0	1	0%	100%
Hong Kong	2	0	2	0%	100%
India	4	1	3	25%	75%
Italy	6	3	3	50%	50%
Japan	8	4	4	50%	50%
Malaysia	1	0	1	0%	100%
Netherlands	3	2	1	67%	33%
New Zealand	1	0	1	0%	100%
Norway	3	2	1	67%	33%
Portugal	1	0	1	0%	100%
Russia	1	1	0	100%	0%
South Africa	1	0	1	0%	100%
Spain	6	2	4	33%	67%
Sweden	2	1	1	50%	50%
Thailand	2	2	0	100%	0%
UK	14	5	9	36%	64%
USA	47	22	25	47%	53%