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Green Business

High-Tech firms environmental performance and the effect shareholders can have on environmental reformation

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Abstract

As the interest in environmental sustainability continues to grow, a methodology for rating how firms are performing is required. The main challenge encountered is the lack of comparable and credible information.

Given a ranking it is necessary to understand if shareholders can use this information to manipulate firms' actions. The results of the analysis indicated that given the correct number of environmentally conscious investors, companies would have to make the necessary adaptations to their operations.

A salient conclusions which can be made, is that there is not enough information to make an informative decision, but as environmental accounting develops investors will be able to use the information and are likely to support acceptable green firms. If management's mindset continues to be focused on maximizing shareholder value, this will hamper unacceptable firms and force them to reform if they wish to succeed. This is likely to continue until all firms are regarded as acceptable within their industries and no premium exists.

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Foreword

Although this thesis is only a fragment of the industries that need to be evaluated I hope it can be used to give some insights into the complexity of the issues surrounding sustainable environmental development.

I would like to express my gratitude to Professor Arent Greve of the Department of Strategy and Management at the Norwegian School of Economics and Business Administration, for his useful feedback and supervision during the writing of this thesis. In addition, I would like to thank Professor Mario Monzoni of Fundação Getulio Vargas (Sao Paulo, Brazil) for his advice and time.

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Sincerely

Bruce Kerr-Peterson

1. Introduction

1.1 Background

The environmental revolution has been looming for the past couple of decades. During the 1960's and 1970's companies did not acknowledge their impact on the environment, however a number of problems emerged (Hart, 1997). Today many companies have acknowledged their responsibility toward the environment and have made an attempt to "go green".

The challenge facing the World today is to develop a sustainable global economy. This challenge presents numerous threats and opportunities. Currently, the World is on an unsustainable course, meeting our current needs will prevent future generations from meeting theirs (Hart, 1997).

The future drivers of this crisis are to be found in the explosive population growth and rapid economic development in emerging economies (Hart, 1997). These two causes are beyond the control of corporations and fall into the realm of political and social issues. Despite this, corporations are the few entities with the resources, technology, global reach, and motivation required to reach sustainability (Hart, 1997). The degree to which a company is viewed as being a positive or negative participant in solving sustainability issues, will determine their long-term business viability (Bonini et al, 2007).

Executives stress that corporations contribute to the public good in the regular course of business, by creating jobs, making scientific and technological breakthroughs, producing necessary products and services and paying taxes (Bonini et al, 2007). However the aforementioned points, particularly in developed countries, are seen as a minimum contribution that is expected without side effects such as pollution.

Despite the belief that corporations are contributing to the public good, it appears that there is a significant "tactics gap" developing. The tactics gap is occurring because of the difference between the tactics corporations frequently rely on to manage socio-political issues and those that are perceived to be the most effective (Bonini et al, 2007).

The most used tactic is media and public relations that has a primary aim of giving the company a positive image in the eyes of the public (Bonini et al, 2007). This brings into

question how individuals can adequately analyse the environmental performance of companies. The valuation of environmental performance will become a pivotal aspect when determining the intrinsic value of a company in the future.

Prior research has been contradictory on the relationship between financial and environmental performance. The reason for the discrepancy is that complying with environmental regulation is costly and thus might hurt a firm's bottom line. On the other hand, a firm that is efficient at pollution control might also be efficient at production. Among the reasons for the discrepancy in empirical findings is the lack of objective criteria to evaluate environmental performance (Cohen et al, 1997). As environmental reporting develops, it might be possible that investors could have a significant impact on the way companies conduct their environmental operations.

It is clear that respondents perceive that large corporations cause harm to the publics welfare by polluting and damaging the environment. However, determining how much a company pollutes and how to value this company as an individual investor is particularly difficult.

1.2 Objectives and methodology for this study

The goals of this study are to determine means by which individual investors can differentiate between the environmental performance in the High-Tech electronics industry and if shareholders can have an impact on environmental performance of companies. Ultimately, this study will enable us to determine if, given the current environmental reporting standards, individual investors can adequately differentiate between companies and make a profound difference to the environmental performance of companies.

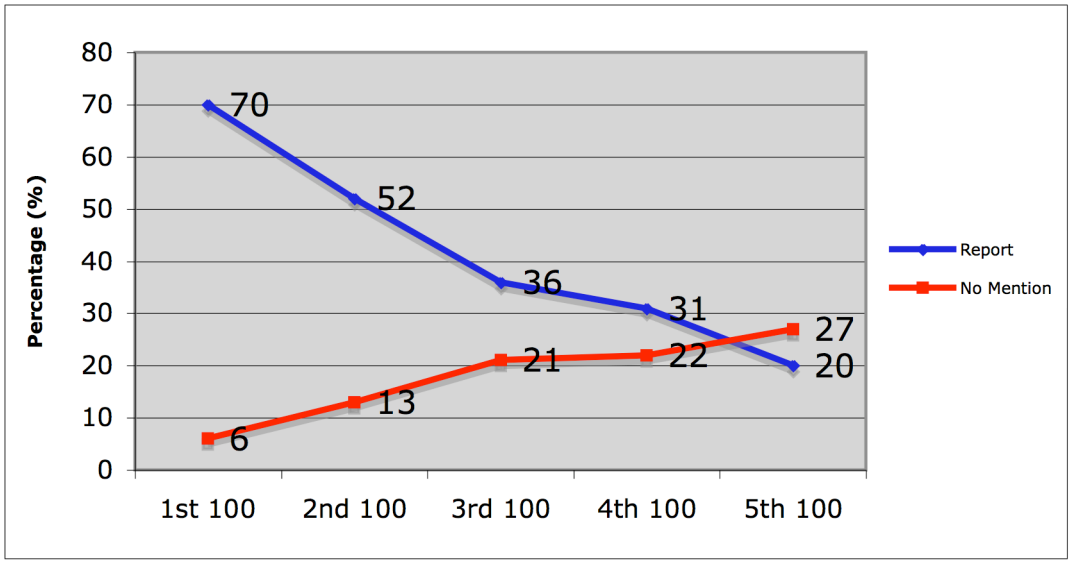
Concrete Objectives:

1. Determine a methodology for comparing High-Tech electronic companies environmental performance as an individual investor

   'Corporate environment reports have quickly become the key channel for companies to communicate their environmental performance and, just as important, have become an effective tool to demonstrate company-wide integrated environmental management systems, corporate responsibility and the implementation of industry voluntary codes of conduct' (UNEP/SustainAbility, 1994).

Despite this enormous growth in environmental reporting, only 209 of the Fortune 500 companies report sustainable activity (Pederson, 2008). A staggering 89 companies do not make any mention of environmental activities. From the graph below it is evident that the higher the company ranking in Fortune 500 (based on revenues), the more likely it is that they report.

Figure 1 Fortune 500 environmental activities reporting



Source: Pederson, 2008

Despite the number of companies that are currently reporting individual investors are faced with numerous challenges when trying to compare environmental performance.

The major challenges are (Gee, 2001):

- Continuity: in that the same methods and metrics are used year after year
- Comparability: to allow for benchmarking and assessing progress
- Credibility: to ensure that the information provides a 'true and fair' picture of the company's environmental performance.

Given these constraints how can individual investors compare the environmental performance of companies?

According to Hadley (1996) ranking systems offer a simple but effective measure of benchmarking companies, both within and across industries. The ranking of companies provides a method for assessing progress over time, and for the provision of favourable treatment. The above sentiment is echoed by Cogan (2006), who advocates that investors should be particularly interested in companies that rank high or low in relation to their industry peers. The ranking methodology has been used by Cogan (2006) in a report, which aims to evaluate industries based on their environmental performance in a number of areas. The results of the analysis have been included in the table below.

Table 1 Average environmental industry scores (closer the industry score, to the maximum score, the better)

Industry	Board	Mgmt.	Disclosure	Emissions	Strategy	Total
Maximum	**12**	**18**	**14**	**24**	**32**	**100**
Chemicals	5.9	9.0	7.7	13.8	15.5	51.9
Electricity	5.5	8.8	8.7	13.7	11.9	48.5
Autos	6.5	9.0	7.9	12.9	11.6	47.9
Equipment	3.0	7.5	5.1	11.2	15.5	42.3
Mining	4.7	8.1	6.2	10.5	12.7	42.2
Forests	4.0	7.8	5.4	9.4	11.0	37.6
Oil & Gas	4.1	6.1	4.9	10.3	9.5	34.8
Coal	1.6	3.6	5.4	5.2	5.6	21.4
Food	1.6	3.2	2.5	5.4	4.9	17.6
Airlines	0.9	3.0	3.7	4.6	4.4	16.6
Average	**5.5**	**8.9**	**8.7**	**13.7**	**11.7**	**48.5**

Source: Cogan, 2006

This report will look at an intra-industry comparison, using salient environmental measures. Thus, information meeting the major challenges, as indicated previously (Gee, 2001), will be taken from the selected High-Tech environmental reports, the information which is common to all of the companies will then be used to present a ranking of the companies, based on their environmental performance.

2. Discuss if shareholders can pressure companies into improving environmental performance.

Gee (2001) advocates that environmental performance reporting and ranking is the link between business and financial sectors. The previous objective aimed to determine how individual investors could use the environmental reporting to develop a meaningful ranking.

The second objective aims to investigate the effect environmentally conscious investors can have on a firm's behaviour. The financial sector wields a significant amount of power, and could play a vital role in ensuring environmental improvement (Gee, 2001).

Due to the lack of data and information on this relatively new topic, a theoretical model will be used as the basis for the analysis. The pertinent results from the abstract model will then be applied to socially responsible indexes, with a focus on the FTSE4GOOD. Changes will be made to the initial parameters established by the authors, based on the findings of the analysis, and the results discussed.

1.3 Outline of thesis

This thesis is comprised of two main sections, each of which aims to address objectives one and two as introduced in 1.2 above. Section one is comprised of chapter four through six, and looks at the possibility of ranking companies based on their environmental performance in the High-Tech industry. Chapter four introduces the idea that there is a divergence between what companies say and what they actually do, and how this may affect the analysis in chapter six. Chapter five forms the foundation of the High-Tech industry, and justifies the need to look at this specific industry. This foundation is then built upon in chapter six, with an attempted ranking of companies based on a number of proxies.

The second section of this thesis builds on the results of the first section. Section two is comprised of chapters seven and eight, and attempts to identify if shareholders can exert pressure on firms, and why firms should act. Chapter seven looks at the specific reasons why corporations need to act. Finally, chapter eight introduces the idea of the financial pressure shareholders can exert on firms, and how this may change their environmental actions.

Chapters nine and ten present a number of conclusions and recommendations, each directed toward the main objectives as highlighted above (section 1.2). An appendix and references follow the final two chapters.

2. What corporations say and what corporations do

It is important to understand if company reports can be used effectively, and if they are meaningful. In order to determine this, it is imperative to discuss if there is continuity between what corporations say and what they do. Through this discussion the main drivers for environmental change can be determined.

In order to divulge if there is a divergence between what corporations say and what they do it is important to understand the underlying assumptions of this question. To answer the previous question it is required that another be asked,

> *'Can business meet new social, environmental, and financial expectations and still win?' (Business Week, 1999)*

If corporations cannot "win" while trying to meet these new expectations then they have the incentive to avoid their responsibilities.

Rugman and Verbeke (1998) constructed a matrix to identify the impact of environmental regulations on the firm and the corresponding managerial perspectives. The four-quadrant matrix and description of the parameters are detailed below.

Figure 2 Impact of environmental regulations on a firm

		IMPACT ON INDUSTRIAL VS. ENVIRONMENTAL PERFORMANCE	
		CONFLICTING	COMPLEMENTARY
TIME HORIZON OF MANAGERIAL RESPONSE	STATIC	1	3
	DYNAMIC	2	4

Source: Rugman and Verbeke, 1998

The horizontal axis presented in the matrix represents the relationship between industrial versus environmental performance. Industrial performance is defined as a measure of traditional goals such as profitability and growth. Environmental performance is a function of emission levels, degree of resource consumption and ecological impact measures. Managers are faced with determining if environmental regulations will conflict with or complement the industrial performance of the company.

The vertical axis represents a time continuum, with a static or dynamic perspective. The dynamic time horizon is a longer-term perspective of environmental decisions. The static view is concerned with the short-term impact of the decision on the company.

Rugman and Verbeke (1998) indicate that quadrant one has been the main area of activity for corporations. The key characteristic of quadrant 1 is that governments impose environmental regulations on corporations, and the corporations merely comply with the regulations. There are no additional benefits for the company and few green competencies can be developed, resulting in minimal investments.

Quadrant two provides a more extreme case of quadrant one. In quadrant two Rugman and Verbeke (1998) believe that firms reject the development of green capabilities in response to environmental regulations. The rationale used for this decision is the focus of companies on minimizing the perceived negative impact of environmental regulations on industrial performance (Rugman and Verbeke, 1998). Firms evidently believe that environmental regulations have a negative correlation to industrial performance.

Quadrants three and four present a more optimist view toward environmental regulation. Quadrant three argues that greening of firms has become inevitable as a result of external forces (Rugman and Verbeke, 1998). However, this greening is complementary to the industrial performance of the firm, and is thus embraced. The fourth quadrant is similar to the third, but the focus is on long-term sustainability and innovation, which takes time to develop (Rugman and Verbeke, 1998).

The four-quadrant matrix provides an interesting framework to understand how firms interact and respond to environmental regulation. The difficulty is distinguishing between firms, which believe that industrial and environmental performance conflict and those that believe they are complementary goals. In the following chapters an attempt will be made to categorise firms into one of the four quadrants. The foundation of the aforementioned

analysis is the environmental regulations imposed by the governments. These environmental regulations will be discussed in the following chapter.

This matrix will be used at a later stage (Section 4.5) to understand the main drivers of action for companies within the High-Tech industry. With a better understanding of these drivers, it will be possible to make more concrete recommendations, facilitating long-term change.

3. The High-Tech industry

Recently, a lot of attention has been placed on the environmental performance of High-Tech companies. Many of these companies are coming under scrutiny for their poor environmental performance. ABC News (2008) published an article in which they highlighted that many High-Tech companies use significant public relations and marketing efforts to promote their environmental consciousness, but are ultimately green hypocrites.

Many of these High-Tech firms still produce toxic products, even though they claim to have reduced their "e-waste" (ABC News, 2008). In these cases High-Tech firms are not living up to their PR and marketing pledges, which consumers buy into.

> *"Being green is more than a press release," says Zeina Al-Hajj, Complaint Coordinator for Greenpeace International. "You need to do more than just promote the concept of combating climate change--you need to actually do it as a company." (ABC News, 2008)*

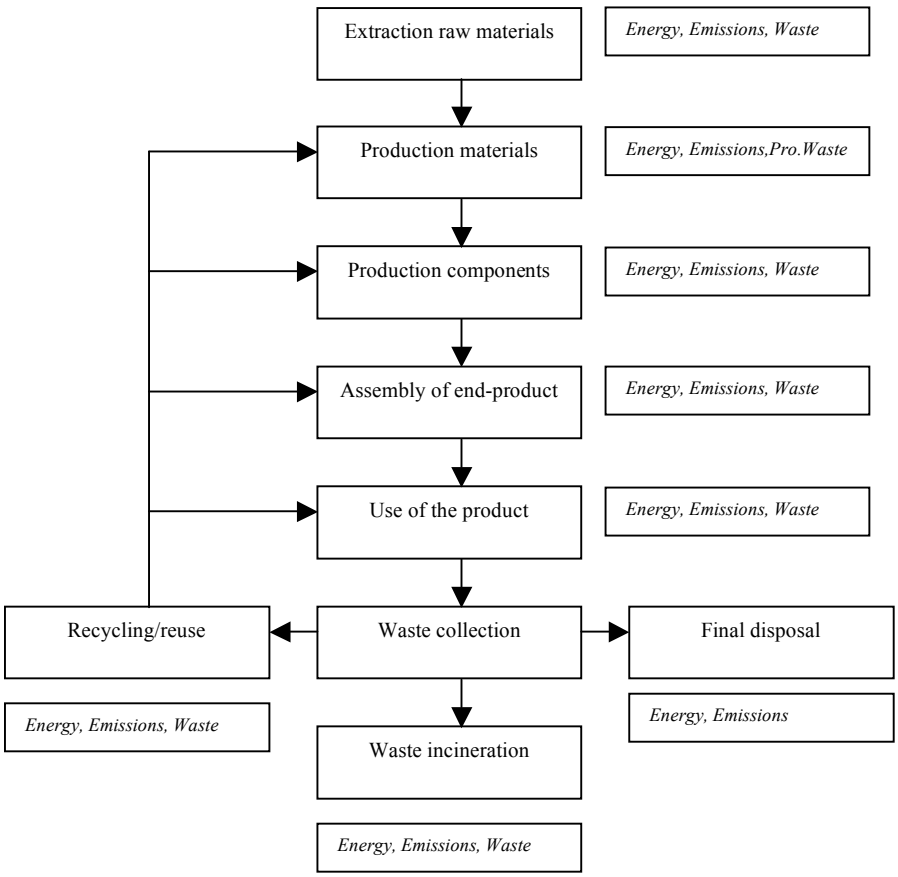
Environmental considerations in production and product development are becoming increasingly important in the consumer electronic industry. The reason for this is government regulation and consumer pressure for green products. To understand the full impact of the High-Tech industry on the environment, the basic life cycle needs to be reviewed.

3.1 High-Tech industry's impact on the environment

The reason for focusing on the High-Tech industry is because of the growing impact this sector is likely to have on the environment in the future. Kleijn (1999) presents a basic overview of the life cycle stages of electronic consumer goods, and the main environmental aspects at each stage. As the diagram indicates, at each stage there is some form of emissions and waste in the production of electronic consumer goods.

The main life cycle stages described in the diagram will be briefly discussed, developing an overview of the economic impact of electronic consumer goods.

Figure 3 Life cycle stages of electronic consumer goods



Source: Kleijn, 1999

Extraction of raw materials: The extraction of resources is dependent on the mining industry. This specific industry is concerned with moving large amounts of land in order to discover useful ore. Through this process large amounts of energy are used and waste is generated. The key extracts are metal ores, other ores, and fossil fuels.

Production materials: This life cycle stage is primarily focused on the chemical and metallurgical industries. These are energy intensive industries, and responsible for the production of polymers and purification of ores. The processes used in the production of polymers and purification of ores results in the emission of large amounts of bulk gasses.

Production of components: This phase is the primary concern of the electronic industry, as it is here that the electronic components will be made. This phase makes use of numerous chemicals and additives, which generate both emissions and waste. The non-electrical components required by the firms will be made in separate factories, which are also detrimental to the environment.

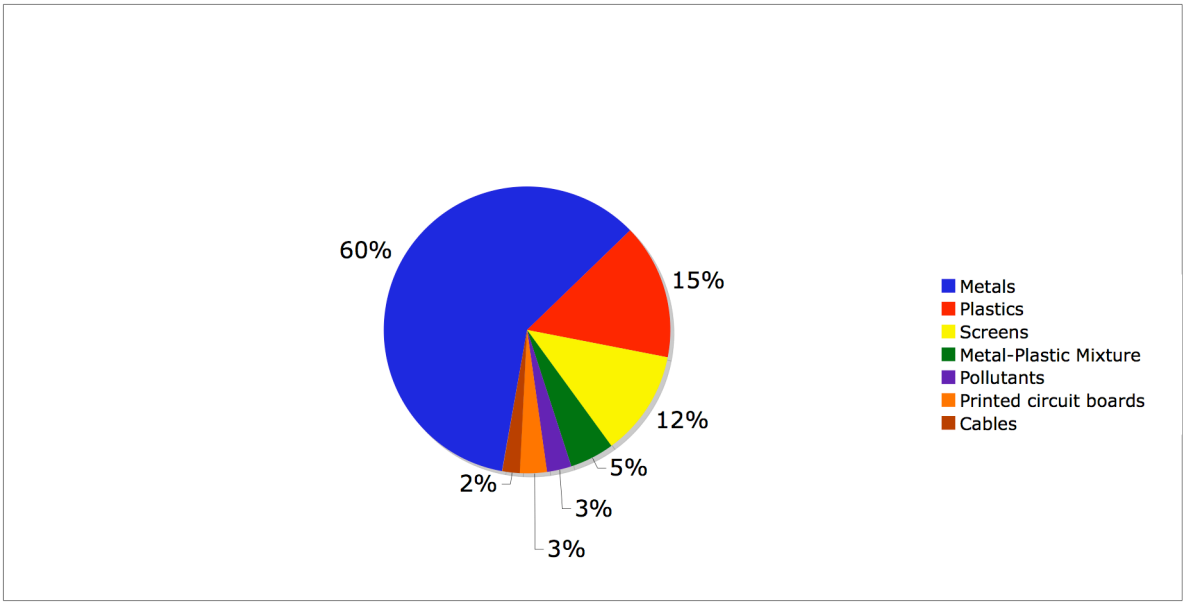
Assembly of the end product: This step is the least environmentally hazard out of the life cycle. It requires little energy and practically no emissions to construct the products.

Use of the product: The use of the product will require electricity, which results in power grid emissions and waste production. However, these outputs are negligible and do not drastically impact the environment.

Waste collection: The final stage of the life cycle is a can be very hazardous to the environment. If electronic consumer goods are incinerated they will produce both emissions and waste. The plastics will be degraded into CO_2, H_2O and other gases depending on their composition via incineration. This process can lead to the emission of toxic compounds such as dioxins.

Through the life cycle there are many additives and parts that form electronic consumer products. The composition of electronic waste is thus fairly diverse. The largest contributor is metals (60%), followed by plastics (15%) and screens (12%). It is the combination of these products that is causing such detrimental effects to the environment (Bodeen, 2007).

Figure 4 Composition of electronic waste



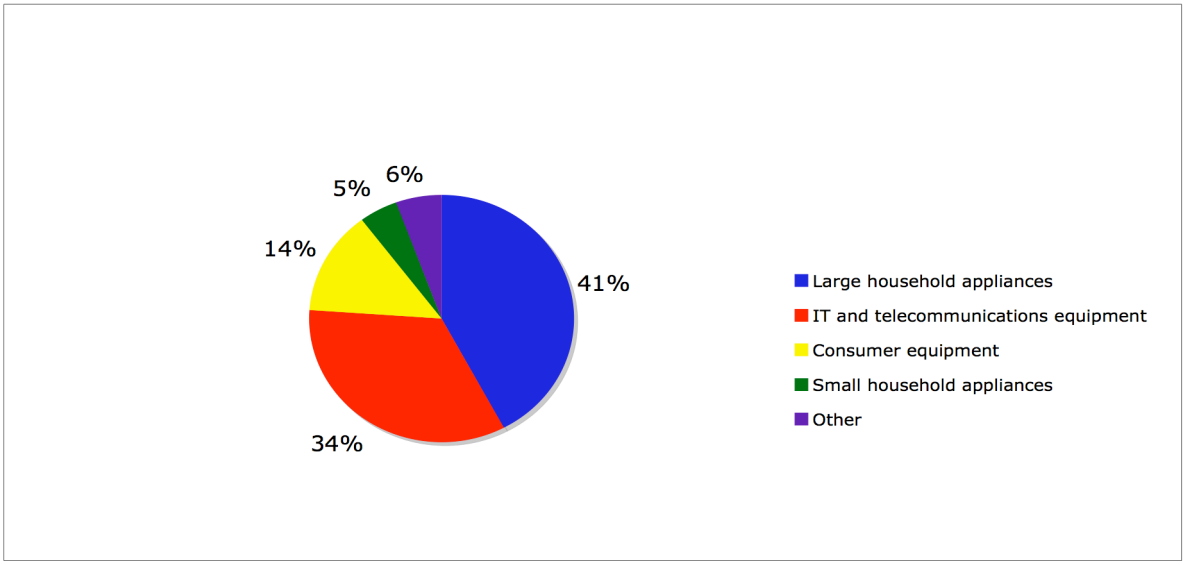
Source: Bodeen, 2007

Through this brief analysis of the electronic goods life cycle it is possible to see how many steps negatively impact the environment. It is because of this large impact on the environment that the spotlight has been turned on electronic producing companies.

A study conducted by the United Nations provides evidence about the incredibly resource-inefficiency of electronics. The study estimated that a 24-kilogram desktop computer and monitor take 10 times its weight in fossil fuels to make (Oliver, 2007). In addition to the fossil fuels, 1500 kg of water and 22 kg of chemicals are required (Oliver, 2007). It is estimated that mobile phones require 2kg worth of materials such as nickel, plastics, lead, lithium, tin and mercury (Oliver, 2007).

A major concern for the environment is the growth of e-waste in the developing world, which is expected to triple in the next 5 years (Oliver, 2007). Currently, it is estimated that 5% of the worlds waste is e-waste, which equates to 50 million tons (Oliver, 2007). European e-waste levels are expected to grow at 3-5% (Oliver, 2007). The reason for the growing e-waste is the rapid turnover rate of consumer electronics. The hardware is still adequate but the software is changing rapidly. The greatest contributor to electronic waste are large household appliances (41%), followed closely by IT and telecommunications equipment (34%).

Figure 5 Origin of electronic waste



Source: Bodeen, 2007

It is clear the High-Tech industry is having a large effect on environmental sustainability. In response to this numerous laws and regulations have been introduced for the High-Tech industry in order to curb the current issues. The applicable environmental regulations will be discussed below. The above discussion justifies the need to better understand the key drivers of change in the High-Tech industry, and the possible ways to effect companies actions.

The life cycle of electronics goods is fairly extensive and covers a number of industries. In order to make the best use of publicly available information, which is relevant to High-Tech companies, focus will be placed on the last four steps in the life cycle. Focusing on "Production of components", "Assembly of the end-product", "Use of the end-product", and "Waste collection", will enable a better intra-industry comparison of companies. The most prevalent legislation used in this sector is highlighted below.

3.2 Environmental regulation for the High-Tech industry

As a result of the impact the High-Tech industry is having on the environment, a number of regulations have been introduced, the most salient of which will be discussed in this section. Global efforts to implement standards and regulations to encourage "green technology" have increased throughout the years. Amongst these include the Ecolabeling, the European

Union's (EU) Restriction of Hazardous Substances (RoHS) directive, the EU Waste Electrical and Electronic Equipment (WEEE) directive and the EU Registration, Evaluation, Authorization and Restriction of Chemicals (Reach) program. Additionally, in the US, there are 26 states that established recycling programs for retired computers and other electronic equipment.

3.2.1 Ecolabeling

An ecolabel is a logo that identifies a product or company that has met an environmentally preferable standard. There are varying standards with different qualifications and controls behind each label. There are hundreds of labels globally that range from food products, retail goods, clothing, electronics, and forest products (Ecolabel, 2008). The primary concern of this paper is the ecolabels given to consumer electronics.

The International Standards Organization (ISO) identifies three types of ecolabels.

- Seal of approval: If a product meets the standard, it receives the label
- General claim: Adding a generic green term to the product name like “organic” or “biodegradable”
- Graded: Like “grade A beef” or “a four star hotel” graded labels provide relative indicators of quality that allow the consumer to select between different grades

Although many labels exist in the consumer electronics industry, few have the "traction" and global presence of Energy Star.

Energy Star, a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy that began in 1992, and implemented a labelling program to signify energy efficiency on computer monitors and equipment (Energy Star, 2008). Throughout the following years, this was expanded to include other office equipment, consumer electronics and appliances. The Energy Star certification signifies that a product meets specific standards of efficiency and low energy use. On average, Energy Star products save 20%-30% on energy consumption (Energy Star, 2008).

The Energy Star program has been expanded to Australia, Canada, Japan, New Zealand, Taiwan and the European Union. However, many European-targeted products are labelled

using a different standard known as the TCO Certification; a combined energy usage and ergonomics rating from the Swedish Confederation of Professional Employees (TCO) instead of Energy Star (Ecolabel, 2008).

3.2.2 Restriction of Hazardous Substances (RoHS)

Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC is a directive of the European Parliament and Council, banning from the EU market, electrical and electronic equipment (including but not limited to electrical and electronic tools, consumer goods, household appliances), containing more than set levels of specific substances (such as lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls, and polybrominated diphenyl ethers) (RoHS, 2003). The RoHS directive was coupled with the WEEE directive when they were enacted.

China RoHS refers to the "Management Methods for Controlling Pollution Caused by Electronic Information Products Regulation" directive published by China's Ministry of Information Industry (MII) on March 1, 2006. It is similar to EU RoHS but it has a wider scope and different requirements; China RoHS law affects the entire supply chain (RoHS, 2003).

Korea RoHS or "The Act for Resource Recycling of Electrical/Electronic Products and Automobiles" (RoHS, 2003) is a RoHS/WEEE -like legislation enacted on March 30, 2006. The scope is very broad and includes aspects of EU RoHS, WEEE, and End of Life Vehicles (ELV). The act covers all electrical and electronic products, as well as automobiles. (Design Chain Associates, 2008)

3.2.3 Waste Electrical and Electronic Equipment Directive (WEEE)

The Waste Electrical and Electronic Equipment Directive (WEEE Directive) is the European Community directive 2002/96/EC on waste electrical and electronic equipment (WEEE, 2003). Combined with the RoHS Directive 2002/95/EC, the two directives became European Law in February 2003, setting collection, recycling and recovery targets for all types of electrical goods (WEEE, 2003).

The directive places the responsibility for the disposal of waste electrical and electronic equipment on the manufacturers of such equipment; that they should establish an infrastructure for collecting WEEE, in such a way that:

> *"Users of electrical and electronic equipment from private households should have the possibility of returning WEEE at least free of charge" (WEEE, 2003)*

In addition, the companies are compelled to use the collected waste in an ecologically friendly manner, either by ecological disposal or by reuse/refurbishment of the collected WEEE. The directive applies to equipment as defined by a section of the WEEE directive and applies to the following categories of products (WEEE, 2003):

- Large and small household appliances
- IT equipment
- Telecommunications equipment (although infrastructure equipment is exempt in some countries)
- Consumer equipment
- Lighting equipment—including light bulbs
- Electronic and electrical tools
- Toys, leisure, and sports equipment
- Medical devices (currently exempt)
- Monitoring and control instruments (currently exempt)
- Automatic dispensers

3.2.4 Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

REACH is the newest of the EU Regulations and was enacted on the 18th of December 2006. REACH addresses the production and use of chemical substances, and their potential impacts on both human health and the environment. This important and complex legislation is lengthy and took seven years to pass (REACH, 2006). It is the strictest law to date

regulating chemical substances and will impact industries throughout the world (REACH, 2006). REACH entered into force in June 2007, with a phased implementation over the next decade.

When REACH is fully in force, it will require all companies manufacturing or importing chemical substances into the European Union in quantities of one ton or more a year to register these substances with a new European Chemicals Agency in Helsinki, Finland (REACH, 2006). Because REACH applies to some substances that are contained in objects ('articles' in REACH terminology), any company importing goods into Europe could be affected (REACH, 2006).

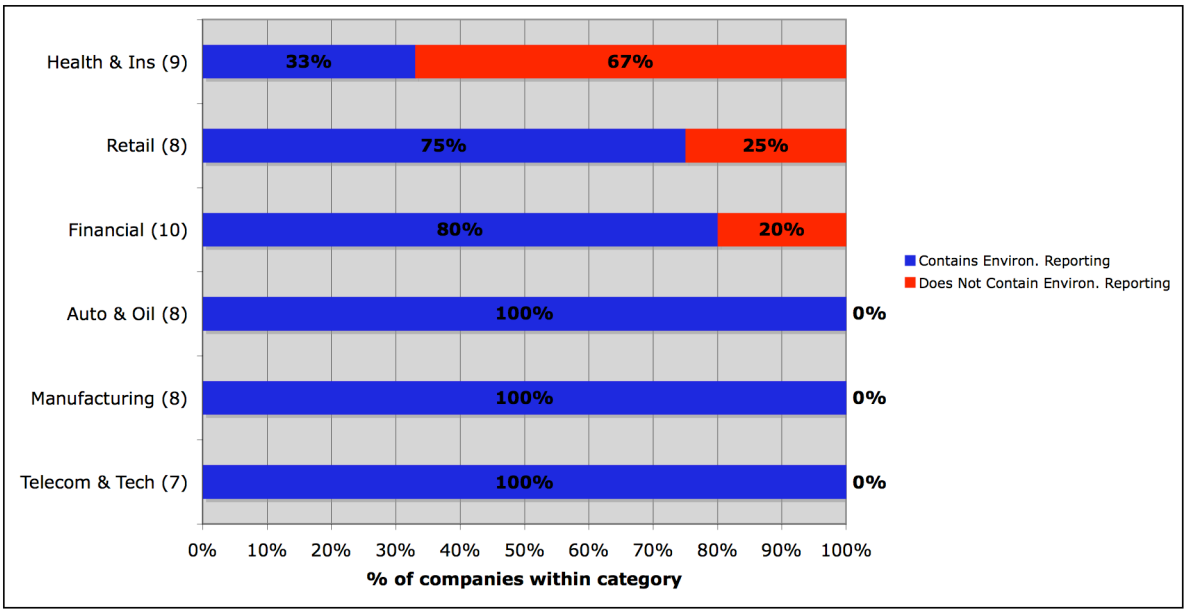
3.2.5 Recycling Programs

Focusing on the US, 26 states have passed recycling legislation that require recycling and restrict use of hazardous materials. However, few states have been as aggressive as California. California SB 20 or the Electronic Waste Recycling Act of 2003 (EWRA) prohibits the sale of electronic devices after January 1, 2007 that are prohibited from being sold under the EU RoHS directive. The scope is narrower, however, as it only covers the four heavy metals restricted by RoHS. EWRA also has a restricted material disclosure requirement.

The key regulations governing the High-Tech industry have been discussed. Rugman and Verbeke (1998) posed the fundamental question, how corporations act on this regulation (Chapter 2). In order to analyse the impact of this regulation on High-Tech companies, use will be made of Hart's matrix. The Hart matrix will form the foundation for the intra-industry comparison of companies.

The High-Tech industry is not notoriously a high polluting sector (Rawlings, 2008). However, because of the numerous regulations a large percentage of these companies issue comprehensive environmental reports. Rawlings et al (2008) conducted a review of the top fifty Fortune 500 companies, the results of the report indicated that 100% of the telecom and technology firms provide environmental reporting.

Figure 6 Saturation of reporting per industry



Source: Rawlings et al, 2008

The high saturation of reporting in the "Telecom and Tech" sector facilitates the intra-industry ranking. Without this information it would be very difficult to compare firms based on their relative environmental performance. Given this level of reporting, the following sections will introduce the information, which can be used to rank companies based on their relative performance.

4. Ranking High-Tech firms based on environmental performance

In order to create shareholder value companies need to focus on multiple dimensions. Likewise, global challenges associated with sustainable development are also multifaceted. However, most managers do not recognise the implications of sustainability on business strategy and the business model, but rather see it as a nuisance Hart and Milstein (2003). The viewpoint leaves companies ill equipped to deal with the challenges and turn them into opportunities. A matrix developed by Hart and Milstein (2003) aims to give direction to companies. The reason for using the Hart matrix is for the clarity and usefulness it provides.

To make use of the matrix ten High-Tech companies were chosen, each of which will be evaluated based on the four quadrants, and compared to the other nine companies. The selection of the companies was based on a number of criteria such as origin, financial size, industry, and listing. The aim was to present a diverse array of companies, in order to determine if any subtle differences exist once the comparative analysis has been completed. The ten companies are presented in the table below.

Table 2: Chosen companies for the analysis

Companies	Origin	Listing (Stock)	Market Cap (bn)	Revenue (bn)
Acer	Taiwan	TSE	$149.09	$19.00
Apple	USA	NASDAQ, LSE	$86.30	$32.48
Dell	USA	NASDAQ,SEHK	$45.09	$61.13
HP	USA	NYSE	$97.13	$113.05
Lenovo	China	SEHK	$20.45	$16.40
LGE	South Korea	KRX, LSE	$10.30	$68.80
Nokia	Finland	OMX, NYSE	$128.00	$64.31
Panasonic	Japan	TYO, NYSE	$34.00	$86.20
Sony Ericsson	Sweden	Joint Venture	-	$16.27
Toshiba	Japan	TYO, LSE	$18.49	$76.68

Source: Company websites, 2008

The chosen companies, although all multinational, have a diverse array of origins. Although the origins are diverse, they have to meet international standards. All of the companies are listed (public), yet they are listed on numerous stock exchanges where investor pressure is

likely to be similar. The two major differences are Lenovo, which has only 50.4% of public shareholders, and Sony Ericsson, which is a joint venture between Sony and Ericsson.

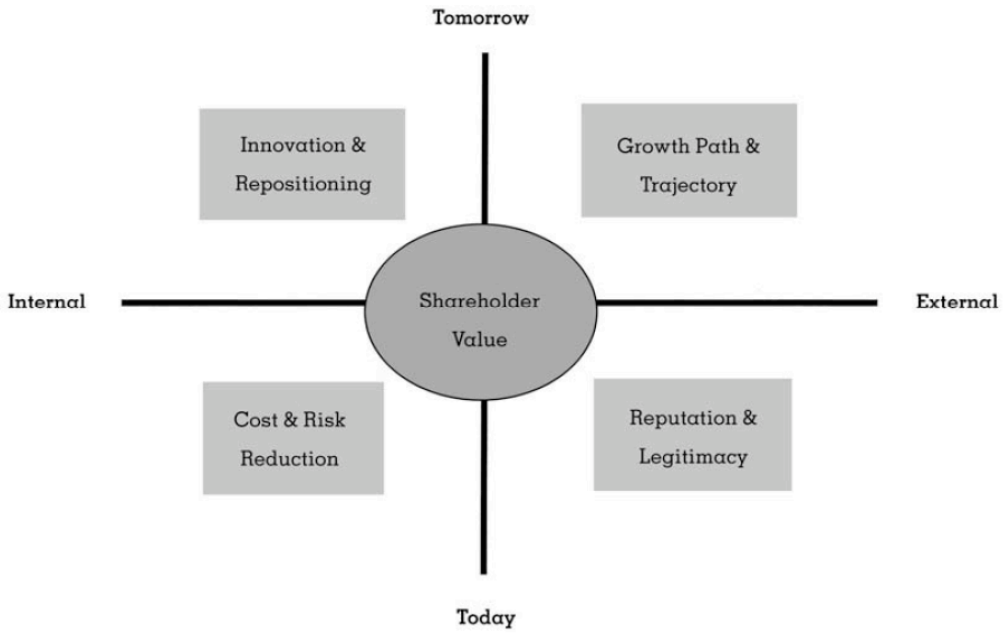
The idea of sustainability has come to represent these rising expectations for social and environmental performance. Global sustainability has been defined as the ability to:

> *"Meet the needs of the present without compromising the ability of future generations to meet their needs" (Hart and Milstein, 2003).*

A sustainable enterprise, therefore, is one that contributes to sustainable development by delivering simultaneous economic, social, and environmental benefits—so called triple bottom line.

Some managers see this as a moral mandate, and others see it as a legal requirement. Only a few firms have begun to frame sustainability as a business opportunity, offering opportunities for lowering costs and risk, or even growing revenues and market share through innovation, Hart and Milstein (2003). If sustainability is not linked to shareholder value then companies will sacrifice shareholder value for sustainability.

Figure 7 Key dimensions of shareholder value



Source: Hart and Milstein, 2003

The diagram indicates that companies need to manage today's business while simultaneously creating tomorrow's technology and markets. Lower-left quadrant focuses on internal and near term objectives; quarterly earnings, growth and reduction in exposure to liabilities.

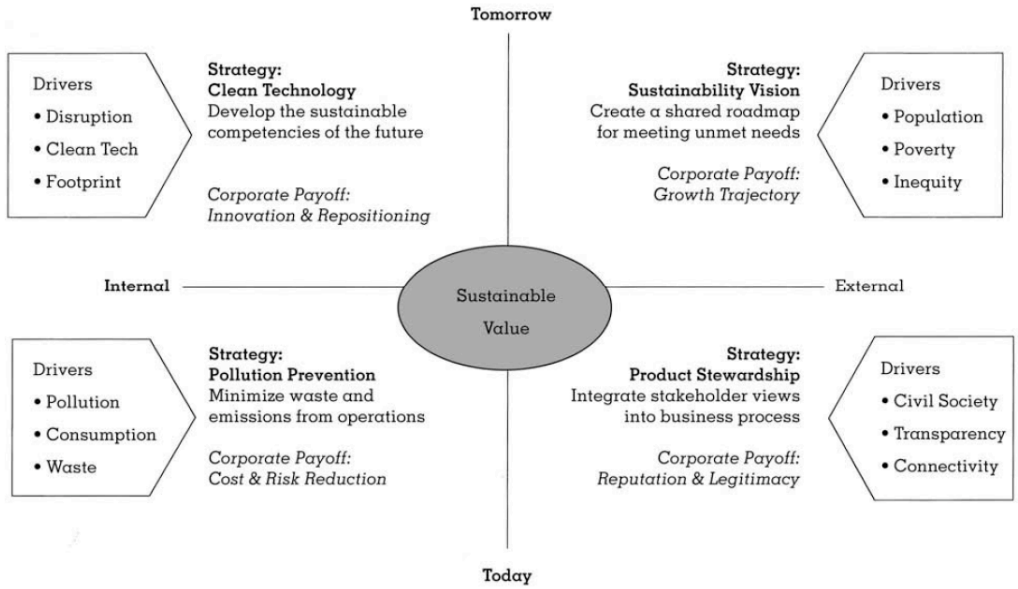
Lower right focuses on near term, but takes into account salient stakeholders external to the firm. It is important to creatively include these stakeholders to ensure the business can run sustainably.

The top left quadrant indicates that companies also need to look into the future and develop products and services of the future. Internally, companies will need to develop skills and technologies, which will allow them to do this.

The upper right quadrant focuses on external dimensions associated with future performance. The growth trajectory provides guidance and direction for new technology and product development.

Firms need to perform well simultaneously in all four quadrants of the model on a continuous basis if they are to maximize shareholder value. Focusing on the short term may generate wealth for a short time but, in the long run, shareholder value will be eroded. Therefore, it is a multidimensional problem. The drivers of sustainability as introduced by Hart and Milstein (2003), have been presented in Figure 8 below.

Figure 8 Sustainable value framework



Source: Hart and Milstein, 2003

The diagram indicates the key drivers that impact each of the dimensions. Over and above this, the required strategies are highlighted and the outcomes alluded to.

In order to apply the sustainability value framework to the four stages of the electronic life cycle ("Production of components", "Assembly of the end-product", "Use of the end-product" and "Waste collection") and present an objective comparison between the ten companies, it is important that some standardised objectives be used where possible. The proxies used to compare the companies have been introduced below and are the ones which best deal with the challenges discussed by Gee (2001), namely continuity, comparability, and credibility (Chapter 1.2).

- Pollution Prevention: Progress towards meeting RoHS requirements, CO2 emissions
- Product stewardship: Progress towards meeting WEEE requirements, recycling rates, percentage of products with Energy Star, Energy Star awards

The problem with the remaining two quadrants is that the proxies do not meet the challenges introduced by Gee (2001). The possible proxies, such as mission statements, company statements, and research and development ideas, may have continuity. However, these proxies often lack both comparability and credibility. These two quadrants will be mentioned, but an analysis cannot take place.

- Clean technology: Products or significant steps towards designing products, which use green energy. Green energy is a term used to describe sources of energy that are considered to be environmentally friendly and non-polluting, such as geothermal, wind and solar power.
- Sustainability Vision: Environmentally driven vision as indicated by the company

4.1 Pollution prevention

The two primary concerns in the High-Tech industry are Polyvinyl Chloride (PVC) and Brominated flame retardants (BFR's). The reason for concern over PVC is due to the production of dioxin as a by-product of vinyl chloride manufacture and from incineration of waste PVC in domestic garbage. The concern over BFR's is due to the harmful effect on

humans, animals and the environment. The table below indicates the current progress that has been made by the chosen companies.

Table 3 Elimination of toxic chemicals

Companies	BFR's	PVC
Acer	Not Eliminated + No Plan	Not Eliminated + No Plan
Apple	Phasing out 2008	Phasing out 2008
Dell	Not Eliminated + No Plan	Not Eliminated + No Plan
HP	Phasing out 2009	Phasing out 2009
Lenovo	Not Eliminated	Not Eliminated
LGE	Phase-out 2010	Phase-out 2010
Nokia	Eliminated	All Products free by 2009
Panasonic	Phase-out 2010	Phase-out 2010
Sony Ericsson	Eliminated	Eliminated
Toshiba	Phasing out 2009	Phasing out 2009

Source: Company websites, 2008

The results vary quite significantly between the companies, from complete elimination to no elimination and no plan for elimination. Sony Ericsson is the clear leader in the elimination of these toxic substances, followed closely by Nokia. Acer and Dell are the two companies, which are lagging significantly in this category.

Another area of interest regarding pollution prevention is that of CO2 emissions, the table presents the information that was available. A number of the companies do not have accurate CO2 accounts, and are unable to publish very specific amounts.

Table 4 Reported carbon dioxide emissions

Companies	CO2 (tons)
Acer	25680
Apple	0
Dell	386363
HP	1643200
Lenovo	73566
LGE	464449
Nokia	235087
Panasonic	398000
Sony Ericsson	243200
Toshiba	351000

Source: Company websites, 2008

It can be seen that Apple does not report any CO2 emissions at the moment. Acer has only reported CO2 emissions within Taiwan, but not for the entire operation. The remainder of the companies have more accurate CO2 figures. The ranking for CO2 is more complicated, as companies are still developing accurate CO2 accounting methodology. As a result, the ranking will be based on the accuracy of the CO2 forecasts based on the published information.

4.2 Product stewardship

There are a number of objective measures that can be used to compare companies in terms of their product stewardship. The first measure is WEEE compliance, which is confirmed by actively collecting electronic waste. The second and more definitive measure is the recycling rate of the companies. This value is more useful than the amounts collected, as it provides a measure of comparison.

Table 5 WEEE achievements to date

Companies	WEEE	Amount Collected (tons)	Recycling Rate
Acer	Yes	875	31.7%
Apple	Yes	9525	9.5%
Dell	Yes	116000	12.4%
HP	Yes	82160	15.0%
Lenovo	Yes	17275	2.2%
LGE	Yes	77684	13.2%
Nokia	Yes	17000	4.0%
Panasonic	Yes	417	6.8%
Sony Ericsson	Yes	56500	7.0%
Toshiba	Yes	88000	12.0%

Source: Company websites, 2008

All of the companies are WEEE compliant, which adds no additional ranking information. Therefore, the primary source of information will be the recycling rate, which varies substantially between the companies. Acer has the highest recycling rate, 31.7%, more than double the second placed HP (15%). The two companies, which are significantly under performing, are Lenovo (2%) and Nokia (4%).

Another objective measure is the Energy Star certification given to companies. The three criteria are the Energy Star certificate, Energy Star awards, and the percentage of products meeting the new Energy Star requirements.

Table 6 Energy Star achievements to date

Companies	Energy Star	Energy Star Awards	Year	% products Energy Star
Acer	Yes			62%
Apple	Yes			100%
Dell	Yes	Special Recognition	2004	57%
HP	Yes	Excellence in Efficient Products	1996, 1997	60%
Lenovo	Yes			100%
LGE	Yes			100%
Nokia	Yes			100%
Panasonic	Yes	Excellence in Efficient Products	1999-2005	100%
Sony Ericsson	Yes	Excellence in Efficient Products	1999	100%
Toshiba	Yes			93%

Source: Company websites, 2008

All of the companies have Energy Star certificates, which adds no additional ranking information. Four of the companies have been given awards in previous years, the most notable of which is Panasonic (received 7 awards). Three companies (Dell, HP, Acer) substantially underperformed the others in terms of meeting the new Energy Star requirement. The remaining seven companies have almost full product Energy Star certification.

4.3 Clean technology

In the case of High-Tech electronics producers, clean technology is seen to make use of green energy. Green energy is a term used to describe sources of energy that are considered to be environmentally friendly and non-polluting, such as geothermal, wind, and solar power. There is only one company, which is meeting this current goal, Nokia.

Nokia has realised the need for renewable energy and clean technology. They have developed a number of chargers, which operate with solar power, cranks or even windmills. This is in an aim to mitigate climate change in the future. Two other companies, LGE and Toshiba have introduced a vague plan, but little has been developed.

LGE does not have any current clean technology. However, they monitor the energy-efficiency of their products, aiming to reduce the emissions. In the long run LGE aims to develop new technology, which works with renewable energy. Toshiba has introduced new life cycle planning into their product developments. This attempts to reduce the environmental impact of their products.

4.4 Sustainable Vision

The sustainable vision is the most subjective aspect of the analysis. Every company has a well-phrased environmental vision, regarding the company and the products. In some cases the vision is supported by a vague roadmap to achieve the goals.

It is apparent from reviewing company reports that the responses are very generic. The reason for this can be attributed to the fact that companies are very proficient at using media and public relations, which has a primary aim of giving the company a positive image in the eyes of the public (Bonini et al, 2007). In this respect it is difficult to present a ranking based on the sustainable vision of the respective companies.

4.5 Ranking the High-Tech companies

In order to present some form of objective ranking, it is only possible to use the information provided by “Pollution Prevention” and “Product Stewardship”, the remaining quadrants are too vague and subjective, thus comments will be reserved until a later stage. The aim of the analysis is to present an intra-industry ranking of High-Tech companies. Thus, the companies are ranked relative to each other based on their performance (1 is the best), as indicated in the tables below. The rankings are not weighted, as each aspect is equally important to the environmental sustainability of the company. The table below contains the relative rankings per aforementioned category, the first three represent “Product Stewardship” and the latter three represent “Pollution Prevention”.

Table 7 Ranking of companies, per category, based on relative performance (1 = best performer)

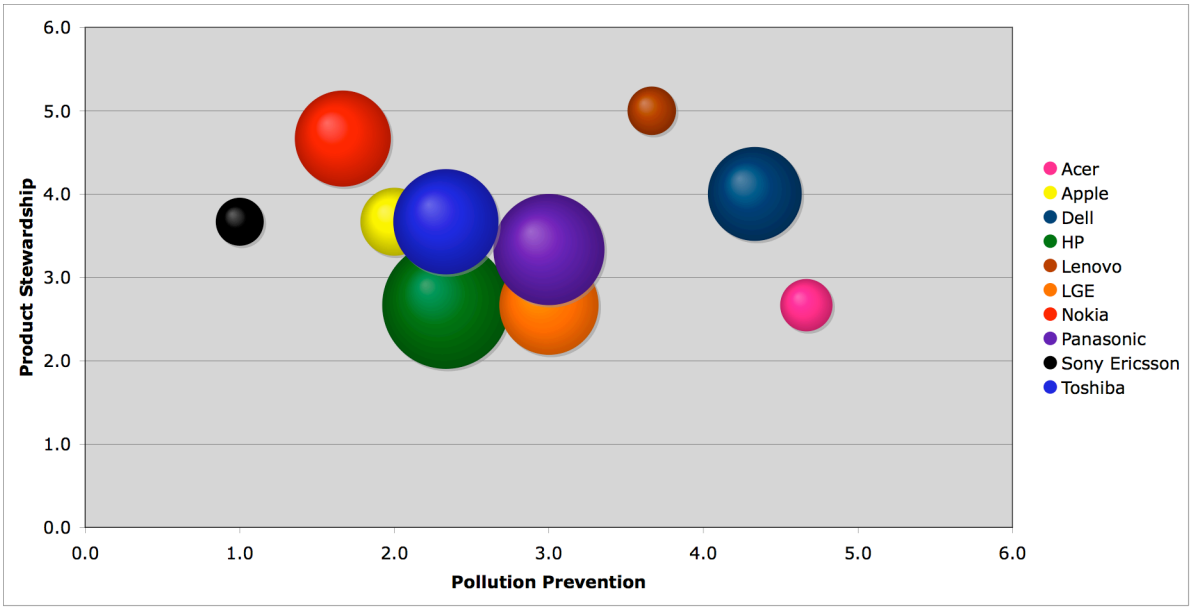
Companies	Energy Star Awards	% product Energy Star	Recycling Rate	CO2 Tons	BFR's	PVC
Acer	4	3	1	2	6	6
Apple	4	1	6	2	2	2
Dell	3	5	4	1	6	6
HP	2	4	2	1	3	3
Lenovo	4	1	10	1	5	5
LGE	4	1	3	1	4	4
Nokia	4	1	9	1	1	3
Panasonic	1	1	8	1	4	4
Sony Ericsson	3	1	7	1	1	1
Toshiba	4	2	5	1	3	3

Source: Rankings based on aforementioned tables

The table presents a rough approximation of rankings, a more accurate approach is not yet possible. The reason for this lack of accuracy is highlighted by Brinkman et al (2008), the authors advocate that companies are unaware of the impact of climate change on their cash flow. The impact of environmental changes on corporate valuation has not been developed, thus it is impossible to compare standardised ratios, as can be done in traditional valuation (Brinkman et al, 2008). Due to this lack of development, it is useful to use a basic ranking, and then compare the results.

Combining the scores and representing them on a two-axis bubble graph, with revenue representing the size of the bubble, it is possible to place each of the ten companies. The x-axis represents “pollution prevention”, Sony Ericsson performs the best in this respect, followed by Nokia. The worst performers are Acer, Dell and Lenovo. The y-axis represents the “product stewardship” quadrant, the best performer is HP, followed by LGE and Acer. The worst “product stewardship” performers are Nokia and Lenovo.

Figure 9 A relative comparison of pollution prevention and product stewardship, with the bubbles representing the size of revenue

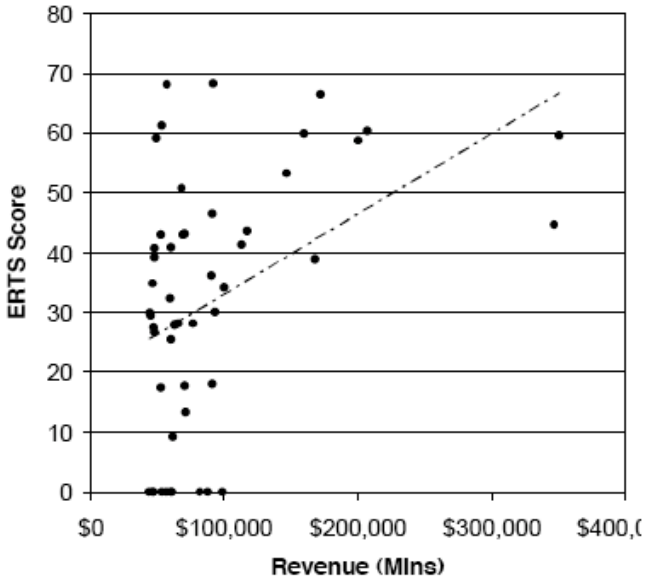


Source: Data taken from Table 3 and Table 7

Revenue appears to play some part in the environmental performance of the firms. The higher the revenue the better the overall performance tends to be. Pederson (2008), described the possibility that the better the ranking of the Fortune 500 company, the better their environmental reporting. The Fortune 500 companies are ranked based on revenue (in dollars) this is the same measure as the relative bubble sizes in Figure 9. The results from the ranking above are coherent with the observations made by Pederson (2008).

Figure 10 below is a regression between revenue of the top fifty Fortune 500 companies and their respective Environmental Reporting Transparency Scores (ERTS). Rawlings et al (2008) statistical model indicates a moderately strong ($r=.42$) and statistically significant ($p<.01$) relationship between revenue and the overall ERTS score. This result indicates that there is some relationship between the two variables.

Figure 10 Revenue versus ERTS score



Source: Rawlings et al, 2008

The reason for this relationship may be due to the enormous amount of pressure these firms are under to perform and ensure they maintain their prominent position within their respective industries. Some of the pressures these firms are exposed to will be discussed in chapter 5 and 6.

The range of the two constructs have been included below, it presents some interesting insights. Companies are performing better, and their performance is more concentrated regarding pollution prevention than they are on product stewardship. The reason for this could be due to the increased legislation surrounding many of the issues in this category.

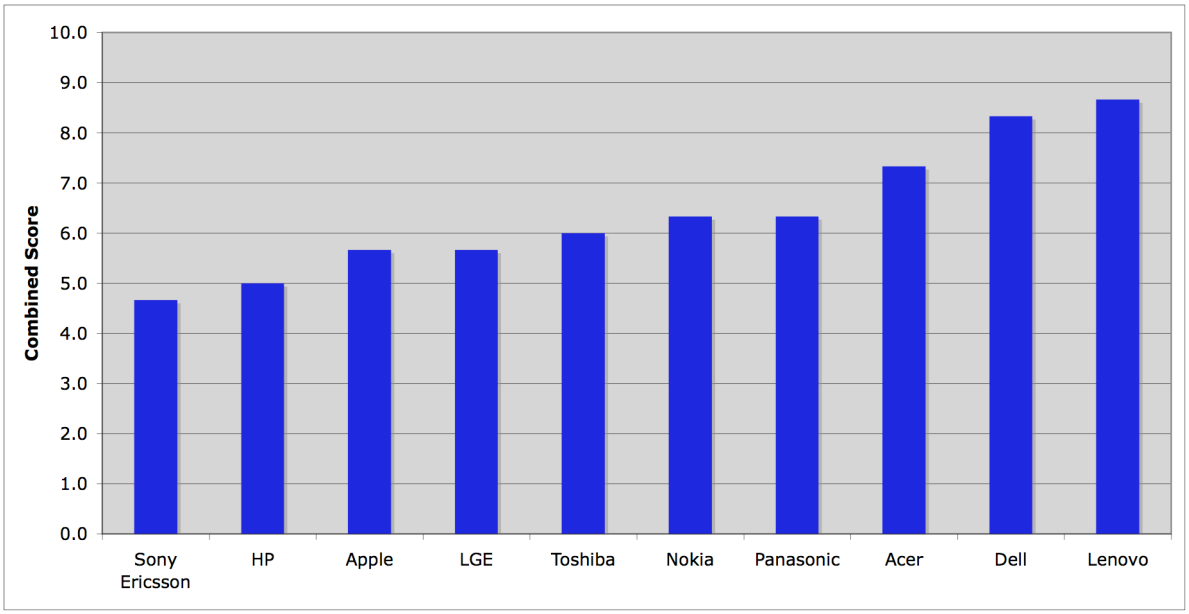
Table 8 Range and average scores for pollution prevention and product stewardship

	Pollution Prevention			Product Stewardship
min	1.0		min	2.7
max	4.7		max	5.0
average	2.8		average	3.6

Source: Data taken from Table 7

The average ranks for pollution prevention is lower than that of product stewardship, indicating that the performance is better. The relative company performance is an interesting measure, as it allows for the under or over performance in certain aspects. However, in order to determine which company is the best to invest in, based on their environmental performance, the holistic score is required. The following bar chart presents the combined pollution prevention and product stewardship scores. The best performing companies based on the aforementioned constructs are Sony Ericsson, HP, and Apple. The worst performers are Acer, Dell and Lenovo.

Figure 11 Combined relative score of pollution prevention and product stewardship (the lower the better)



The most recently announced public company, which is included in the ten companies under analysis, is Lenovo, which has also received the worst ranking. The reason for this may be attributed to the lack of pressure from investors, which will be discussed in the following section.

High-Tech companies are, at a stretch, reaching the required governmental regulations. This places the majority of High-Tech firms in the first quadrant of Rugman and Verbeke's (1998) four-quadrant environmental matrix. The main drivers of environmental performance appear to be governmental regulations and laws, which drive a number of transformations and apply to private and public companies. The question that remains is, despite the

legislative pressure, are there any other reasons companies should tackle environmental challenges?

5. Why corporations need to act

The need for corporations to act is undeniable, whether taken from a negative or positive perspective. From a negative standpoint, if companies do not act they may be faced with impoverished customers, degraded environments, failing political systems and unravelling societies making it difficult for companies to conduct business (Hart, 1997). The alternative viewpoint is equally as convincing, environmental opportunities might be sources for large revenue growth in the future, which corporations cannot afford to ignore (Hart, 1997).

David Bevan a sustainability expert at the University of London believes that in the past *"shareholder interests have dominated how the economy is run, now it is more about being a community player"* (Lia, 2008).

As numerous issues plague the world, companies are being driven towards developing a better understanding of consumers' perceptions and expectations about corporate social responsibility. Without this understanding it is impossible for companies to gain the much needed trust of the public (Bonini et. al, 2007).

Consumers are placing greater emphasis on the expectation that large companies should be responsible for addressing socio-political problems, such as climate change and the affordability of drugs in developing countries. The divergence between what companies are doing and what consumers expect is aptly named the "Trust Gap" (Bonini et. al, 2007). In order for a company to succeed they need to minimise the "Trust Gap", by developing a greater understanding of what consumers expect (Bonini et. al, 2007).

The two fairly consistent trends that emerge across countries are that governments are the most responsible for tackling climate change followed closely by companies, according to consumers. In the case of India and Japan, companies are at least as responsible as governments for tackling climate change.

Table 9 The leading role in climate change

(Values are % of respondents)	USA	China	India	Japan	France	Germany	UK	Aver.
Governments	81	85	61	82	87	83	89	81
Companies (in general)	57	53	57	73	72	77	74	66
Consumers	53	29	42	57	65	67	74	55

Source: adapted from Bonini et. al, 2007

In order to get a rough approximation of the perceived responsibility an average was taken for the four company sectors. It is clear from the averages that 81% of respondents believe that governments are responsible, followed by 66% who think companies are, and lastly 55% felt that consumers are responsible for tackling climate change. This indicates that consumers are wanting companies to play a far more active role in climate change, going beyond their core business in order to do so. Marc Levinson from JP Morgan believes that there is a major risk of being punished by customers (Lia, 2008).

The two most salient measures to combat climate change according to consumers are: increase use of renewable energy and increase use of energy-efficient solutions (Bonini et. al, 2007). It is apparent that consumers have a fairly unanimous view across countries as to how power-generating companies should try and combat climate change. Sceptically it could be said that the corrective measures are directly related to both the industry and climate change, and thus indicate little consumer insight. Thus, it is necessary to look at an indirect industry, namely financial services.

The results of this analysis are also unanimous, financial service companies are responsible for ensuring that the companies and governments they finance act in the best interest of society and the environment. The Asian countries hold financial-service companies far more accountable than the European and US countries. Financial service companies have significant leverage over companies requiring funding, they are able to adjust the cost of capital accordingly. The resultant effect of flexible cost of capital can be seen in the following chapter.

The disparity between the perception of the consumers and executives can be highlighted by the differences in the ranking of issues. Consumers quite convincingly believe that environmental issues will be the most important issue in the next five years (Bonini et. al, 2007). Executives believe environmental issues to be the third most important factor. The executives seem to be more concerned about internal company specific issues, and may not be recognizing the importance of minimizing the trust gap.

It is apparent that High-Tech firms need to quickly adapt to this new approach if they wish to be successful in the future. If High-Tech firms do not adapt then they will be subject to both legal and customer ramifications, both of which will impact the long run sustainability of the company. Brinkman et al (2008), believe that executives are not paying attention to environmental issues for two reasons, firstly because they may not understand and secondly because the consequences are too far away. Brinkman et al (2008) advocate that some sectors will be able to pass short-term pressures onto their customers with little substitution or change in demand. The consumer electronics industry has the potential to provide more efficient products at minimal cost, thus reducing the large impact their consumers have on residential electricity demand (Brinkman et al, 2008).

If High-Tech companies are faced with lawsuits and dissatisfied customers, the company value will be significantly reduced in the long run. This reduction will be emphasised by lower share prices for the respective companies and a higher cost of capital.

6. Pressuring High-Tech Firms

The ten companies reviewed in this study all pride themselves on innovative designs and good performance. However, when it comes to delivering green solutions High-Tech firms are still performing poorly (Morphy, 2007). The reason for the poor performance cannot be attributed to the perception of additional costs. In many cases green practices can drive cost reductions and increase productivity.

Morphy (2007), attributes the poor performance to the inability of current corporate structures to adapt to meet the rigorous demands of this new industry. The green approach requires a complete review of the entire business process from design to supply chain, to operation to disposal (Morphy, 2007). One of the most difficult areas to turn green is the design phase, everything from materials to packaging need to be redesigned in a green friendly way.

Gartner (2008) recently presented a list of immediate, midterm, and long-term green issues that firms in the high tech industry will have to focus on in order to redesign their business processes. The most pertinent of these issues have been listed below.

Immediate Green Issues (next 24 months)

- Integrated energy management
- Use of modelling and monitoring software

The immediate green issues provide the methodology required in order to fully understand the impact the company is having on the environment. Without this understanding further action will not be possible. The midterm green issues provide a more targeted approach to reducing a company's footprint on the environment.

Midterm Green Issues (2-5 years)

- Green IT procurement
- Green asset life cycle programs
- Environmental labelling

- Changing people's behaviour
- Green accounting: develop a comprehensive green accounting base for the evaluation of the environmental impact of the company's operations.
- Green legislation: During this time, new and stringent legislation will be introduced, companies have to adapt quickly to these new requirements.

Over the next 24-month period companies need to come up with solutions to address the issues mentioned above. The company, which can excel in this area, will mostly likely reap enormous benefits in the long run. In the long-term companies will need to address more challenging issues, which will be based on the foundations established in the earlier years.

Long-Term Green Issues (5-20 years)

- Carbon offsetting and carbon trading
- Alternative energy sources
- Software efficiency
- Green building design
- Green legislation

It is evident from the green issue list that legislation will play a large part in the activities of High-Tech firms. Additionally, there will be a large amount of pressure applied from the investor's side. To reiterate a point made by David Bevan, "shareholder interests have dominated how the economy is run, now it is more about being a community player" (Lia, 2008). Shareholders are likely to value companies on how they interact with the community as a whole.

6.1 Investor Pressure

Heinkel et al (2001), discuss the effect of green investment on corporate behaviour. The results of this paper are pertinent when attempting to evaluate the effect green investors can have on company's attempts to reform their current practices. The fundamental premise presented by the authors is the need for firms to reform in order to increase their share price.

The increase in share price is inversely related to the cost of capital that firms can attain. The derivation of the formula used in the numerical example can be found in the paper, however, the most pertinent result is included below.

Equation 1 Share price of a reformed firm as a function of endogenous variables

$$P_R = \mu_P - \frac{1}{I\tau}\left[N_C\sigma_{CP} + (N - N_C)\sigma_P^2 - KI_n\tau\right].$$

Source: Heinkel et al, 2001

Examining the comparative static's of the share price of a reformed firm (P_R), renders a number of interesting and valuable results when attempting to understand the effect of green investment on corporate behaviour.

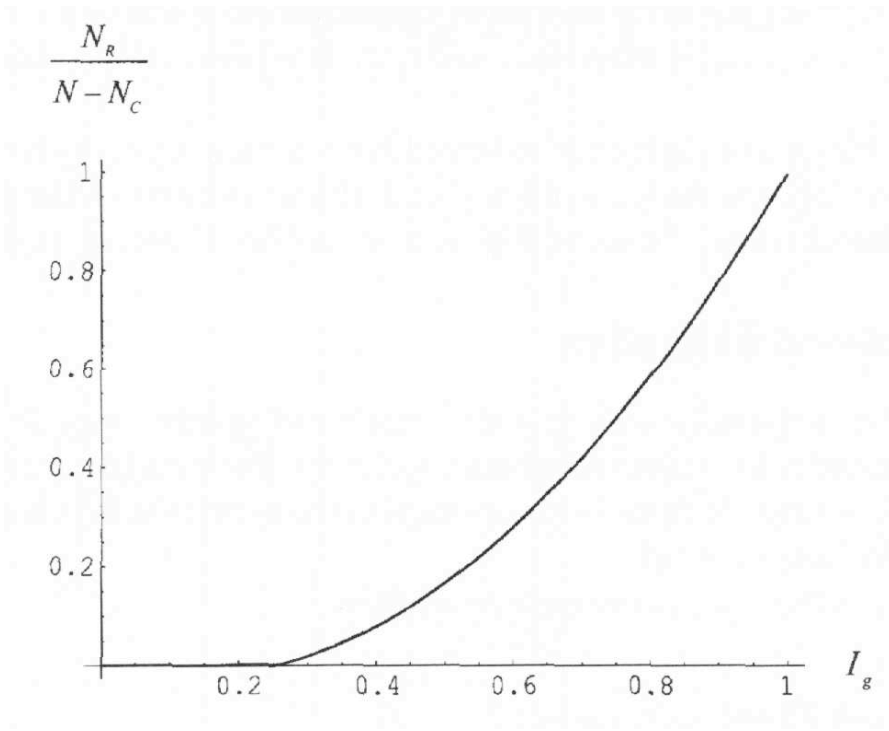
The first result, is the inverse relationship between cost of capital and reforming costs (K). In order to justify high reforming costs, to become a "greener" company, the cost of capital has to be reduced. However, as the number of green investors (I_g) increases the higher the capital costs for reforming firms, this implies that a first mover advantage is present. Given that, investors are either neutral or green ($I = I_n + I_g$), the greater number of green investors (I_g), reduces the number of neutral investors (I_n), and hence a lower price for unacceptable firms. Once an equilibrium point has been reached, the price of the reformed firm will equal the price of the unacceptable firm plus the additional reforming cost (K), therefore a lower unacceptable firm price implies a lower reformed firm price. Finally, the cost of capital is inversely related to the number of risk-tolerant investors.

As discussed in chapter six, Bonini et. al (2007) presented the idea that financial service companies have significant leverage over companies requiring funding, they are able to adjust the cost of capital accordingly. This idea is echoed in the model presented by Heinkel et al (2001), indicating that the reduced share price, will increase the cost of capital for unacceptable firms.

Heinkel et al (2001) propose that there are a critical number of green investors (I_g^*) required in order to induce the first unacceptable firm to reform. This proposition is of particular relevance to the effect that green investing can have on corporate behaviour. A numerical model has been presented in order to provide insights into the magnitude of the endogenous variables.

The first graph represents the number of reformed firms as a percentage of unacceptable firms. This ratio is dependent on the number of green investors in the economy.

Figure 12 The ratio in the base case of reformed firms to originally unacceptable firms as a function of the number of green investors



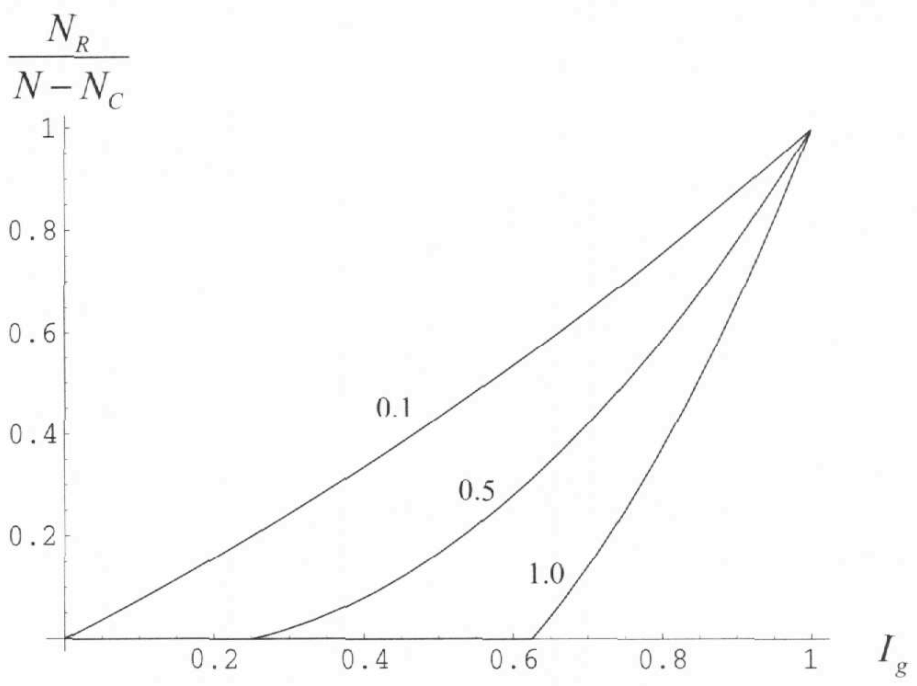
Source: Heinkel et al, 2001

It can be noted that the curve is convex, indicating that the marginal effect of additional green investors on reformed firms is increasing. The increase in green investors results in the reduction of neutral investors, which in turn lowers the price of the unacceptable firm. This lowered price results in a higher cost of capital. Given the parameters of the model, it can be

seen that green investors need to constitute approximately 25% of the investor population in order for the first unacceptable firm to reform (Heinkel et al, 2001).

The following graph indicates the same ratio as before, however the switching costs (K) are varied in order to determine the effect it has on the number of green investors required to induce the first unacceptable firm to reform.

Figure 13 The ratio in the base case of reformed firms to originally unacceptable firms as a function of the number of green investors for three different levels of switching costs



Source: Heinkel et al, 2001

The graph clearly indicates that as the switching costs (defined as K percentage of expected cash flow) increase the percentage of green investors required to induce the unacceptable firms to reform increases. An increase in the switching cost from 1% (K = 0.1) to 10% (K = 1.0) results in the required number of green investors increasing from 25% to greater than 60%.

Heinkel et al (2001) present a theoretically sound model, but it is necessary to relate the findings to actual events. It is clear that the increasing cost of capital is a fundamental driver for reform, this was stated by Bonini et. al (2007). The final area that requires comment is the number of firms attempting to move from unacceptable to reformed due to the number of green investors. In order to analyse this, information will be drawn from socially responsible indexes.

6.2 Socially Responsible Indexes

Due to the recent evolution of green consciousness a few socially responsible indexes (SRI) have come to the fore, which promote responsible investing. The creating of SRI indexes are aimed at helping firms, states, and investors make the most appropriate and sustainable decisions. The SRI indexes have a number of criteria, which need to be met for inclusion, this sets a benchmark and forces companies to improve their practices. There are several criterion that companies must adhere to, namely, economic, environmental and social.

The focus of this paper is on the environmental criterion established by these indexes. Three indices have been mentioned below, however focus will be primarily placed on the FTSE4GOOD, as it is currently the largest SRI index with one of the strongest environmental focus. Briefly, the SRI Index and the DJSI Index will be introduced.

6.2.1 The Johannesburg Stock Exchange SRI Index

The SRI index was launched by the Johannesburg Stock Exchange (JSE) in May 2004 (SRI, 2007). Companies listed on the JSE are automatically valued based on the three pillars of the triple bottom line, namely environmental, social and economic (SRI, 2007). The objectives of the SRI are to provide a tool for the assessment of company policies and practices, against globally aligned and locally relevant CSR standards. The aim of the SRI is the provision of a responsible investment vehicle, which contributes to the responsible business practice in South Africa (SRI, 2007).

The environmental classification of companies is based on a high, medium or low scale. For each sector the direct impacts of routine business relating to climate change, air pollution, water pollution, waste and water consumption are reviewed (SRI, 2007). Each sector is profiled in terms of its impact on the environment. Companies are then reviewed based on

their control and reduction of the negative impact on the environment, and their commitment to promote awareness of its direct and indirect effects. Finally, a commitment needs to be made to risk reduction, reporting and auditing (SRI, 2007).

6.2.2 The DJSI (Dow Jones Sustainability Indexes)

The DJSI was launched in 1999 and is based on cooperation between Dow Jones Indexes, STOXX Limited and SAM (DJSI, 2008). The DJSI portfolio consists of the DJSI World, DJSI STOXX (pan-European and Eurozone) and the DJSI North America. The index tracks the performance of sustainability-driven companies in terms of economic, social and environmental criterion (DJSI, 2008).

6.2.3 FTSE4GOOD

The FTSE4GOOD is a series of indexes, which incorporates financial performance of companies and globally recognised standards of corporate social behaviour. The three main criterions upon which companies are evaluated are efforts towards environmental sustainability, positive relationships with stakeholders, and respect and support for universal human rights (FTSE4GOOD, 2008). The FTSE4GOOD is a brand leader in the financial service industry operating in 77 clients, with offices in the leading financial centres. FTSE4GOOD works with numerous NGO's, governments and trade bodies ensuring they remain the leaders in the field (FTSE4GOOD, 2008).

There are numerous benefits for companies who are included in the index. Namely, cost reduction from eco-efficiencies, attraction and retention of best partners, and the reinforcement of value for shareholders and stakeholders (FTSE4GOOD, 2008). Companies are able to earn substantial profits, due to the sustainability of their business.

The FTSE4GOOD Index aims to provide investors, individual or corporate, with the tools for evaluating and investing in companies with good CSR records. The FTSE4GOOD uses a number of stringent eligibility criteria, which promotes responsible business. The five areas of responsible business are (FTSE4GOOD, 2008):

- Working towards environmental sustainability
- Developing positive relationships with stakeholders

- Upholding and supporting universal human rights
- Ensuring good supply chain labour standards
- Countering bribery

Although there are a number of criteria, a large amount of emphasis is placed on environmental sustainability. The FTSE4GOOD was launched in 2000, in 2001 the governing body enhanced the environmental criteria, this led to the introduction of a new set of criteria in 2002. Finally, in 2006 the FTSE4GOOD climate change advisory committee was introduced (FTSE4GOOD, 2006).

A company needs to meet strict requirements in order for its inclusion into the FTSE4GOOD. The environmental criteria are based on the environmental impact of the companies operations. Company's are classified as high, medium or low based on their impact, the higher the impact the more stringent the inclusion criterion (FTSE4GOOD, 2006). Electronic or electrical equipment companies are placed in the medium impact category. These companies need to meet policy, management and reporting criteria, the key policy indicators have been highlighted below.

Indicators (FTSE4GOOD, 2008):

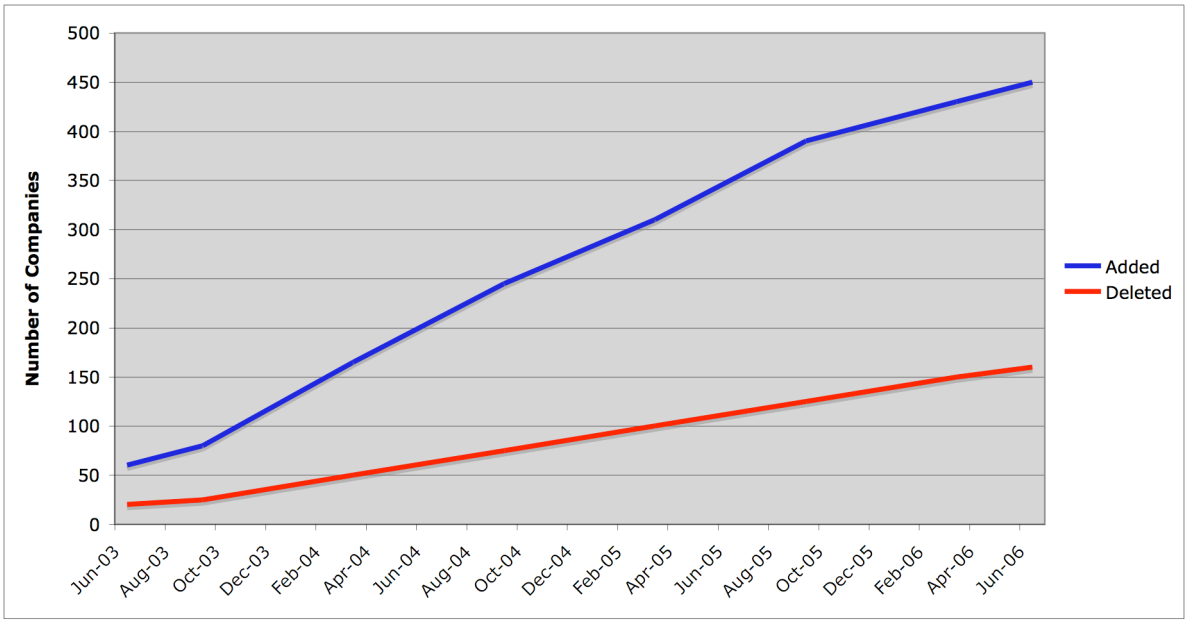
- Policy: Commitment to the use of targets, monitoring and audits, public reporting and globally applicable corporate standards
- Management: Presence of environmental policy, identification of significant impacts, documented objectives and targets in key areas
- Reporting: Text of environmental policy, description of main impacts, quantitative data, performance measured against targets, stakeholder dialogue, and coverage of sustainability issues

The reporting indicators are the key communications with the stakeholders, the timing of the reporting disclosure and the methodology are useful for share price maximisation. Green investors need to be aware of this information, as it will determine what percentage the company forms in the entire investment portfolio.

It is through this form of reporting that individual investors are able to value a company based on their environmental performance. The stringent criterion ensures a greater amount of information flow, which further educates shareholders. As shareholders become more aware of the environmental impact of companies, they are likely to turn from neutral investors to green investors (Heinkel et al, 2001). Fewer neutral investors, results in a lower share price for unacceptable firms, and a higher cost of capital (Heinkel et al, 2001). As a result of this dynamic it is likely that an increasing number of firms are reforming their practices and meeting the criterion outlined by the FTSE4GOOD.

The graph below indicates the number of firms that have met the criterion since 2003 until 2006. Due to the increasingly complex regulations set out by the FTSE4GOOD a number of firms are deleted each period, while additional firms are added. Initially, the rate of addition and deletion are fairly similar, however a divergence begins to appear after September 2003.

Figure 14 The increase in companies in the FTSE4GOOD series since 2001



Source: FTSE4GOOD, 2006

The FTSE4GOOD five-year report indicates that 40% of all eligible companies are able to meet the stringent criteria. As postulated by Heinkel et al (2001), unacceptable firms need to

reform in order to increase their share price in the future. For firms to meet all the criteria specified by the FTSE4GOOD, numerous reforms are required.

Rawlings et al (2008), conducted a review of the top fifty Fortune 500 companies, it has been established that there is a correlation between revenue and ERTS scores (Section 4.5). It is unclear whether higher revenues drive better ERTS scores or if the relationship is in the other direction. Irrespective of this, Rawlings et al (2008) discovered that companies that submit a corporate environmental report to the Global Reporting Initiative (GRI) have significantly higher ERTS scores, non GRI compliant companies have a mean ERTS score of 21 (0 = minimum and 100 = maximum) and GRI compliant companies have a mean ERTS score of 47 ($t=5.503$ and $p<.000$).

The stringent criteria expected by the FTSE4GOOD index require that companies provide comprehensive and informative reports, as highlighted above (FTSE4GOOD, 2008). The GRI reports primary aim is to make sustainable reporting standardised, comparable to financial statements (Global Reporting Initiative, 2008). Although, as highlighted by Rawlings et al (2008) in Figure 6, a large number of High-Tech firms have environmental reports. However, as the table below indicates, only four of the ten companies meet the standards set by the GRI.

Table 10 High-Tech companies using GRI reporting standards

Name Organization	Report Title	OECD/Non-OECD
Dell Inc	Corporate Responsibility Report Fiscal Year 2008	OECD
Hewlett-Packard	2007 Global Citisenship Report	OECD
LG Electronics	2006-2007 Sustainability Report	OECD
Sony Ericsson	2008 CSR Report	OECD

Source: Global Reporting Initiative, 2008

The GRI reporting system does not rank companies based on their performance, it is merely a means of standardising environmental accounting. However, Sony Ericsson, HP, and LGE are in the top four companies in the overall ranking presented in Figure 9, Dell performs less favourable in ninth position. It is possible that the rigid GRI reporting standards forces companies to better their environmental performance, as shortcomings are likely to be

highlighted. Ganzi (2004) emphasises that there are large differences in how much companies disclose about their environmental performance, both among regions and countries and within regions and countries.

6.3 Current Investor Scenario

The focus of this study is to determine the impact green investors have on a firms behaviour, thus holding a number of the original parameters constant, others are varied to make the model representative of the current scenario. The variables, which are kept constant, are included in the table below.

Table 11 Initial parameters included in the Heinkel et. al. model

Description	Symbol	Value
Mean cash flow	$m_p=m_c$	10
Std. Dev. Of cash flow	$s_p=s_c$	10
Covariance of cash flow	s_{cp}	50
Reforming cost	K	0.5
Investors Aggregate Risk Tolerance	t	100
Phi	$f=s^2_p s^2_c - s^2_{cp}$	7500
Total number of firms	$N=N_A+N_R+N_P$	1
Total number of investors	$I=I_g+I_n$	1

Source: Heinkel et al, 2001

Given information from the FTSE4GOOD annual review inferences are made about the number of firms, which are acceptable, reformed and unacceptable. The FTSE4GOOD annual review indicated that of all companies approximately 40% meet the requirements to enter into the index, therefore 60% of firms are considered to be unacceptable. The report went further to indicate that new standards had recently been introduced, and companies

would have to reform and increase their environmental performance to be included. Of the 40% of companies, which met the original standards, only 54% currently reach the new requirements, the remaining 46% are in the process of reforming. Given this information, an approximation of the three classifications of companies used in the Heinkel et al (2001) model can be made.

Table 12 New input variables based on current information from the FTSE4GOOD report

Description	Symbol	Value
Number of acceptable firms	N_A	0.22
Number of reforming firms	N_R	0.18
Number of unacceptable firms	N_U	0.60
Number of firms with clean technology	$N_C=N_A$	0.22
Number of firms with polluting technology	$N_P=N_U+N_R$	0.78

Source: FTSE4GOOD, 2006

The final adjustment to the initial parameters is a current estimation of the number of green investors (I_g). The number of green investors is not easily identifiable, as a result a more useful proxy will be used, namely the current value of assets held in SRI funds, compared with the value of global assets (Social Investment Forum, 2007). The ratio of these two values indicates the power of green investors and will be used as a proxy for the number of green investors as a percentage of the total investing community.

Table 13 New input variables based on current information from the Social Investment Forum

Description	Symbol	1995 Value	2007 Value	12 yr Growth
Total assets held in SRI funds	SRI	$0.639 (trl)	$2.71 (trl)	324%
Total assets held in Global funds	GBL	$7 (trl)	$25.1 (trl)	259%
Green investors (SRI/GBL)	I_g	9%	11%	2%

Source: Social Investment Forum, 2007

In 2007 the Social Investment Forum (2007) estimated that $2.71 trillion was held in SRI funds compared to $25.1 trillion held in global funds, the ratio is 11% and will represent the number of green investors. The variables above will be inputted into the theoretical models developed by Heinkel et al (2001), and the results interpreted, after which comparative statics will be used to vary key inputs.

Equation 2 The resulting equilibrium prices

$$
\begin{aligned}
P_A &= \mu_C - \frac{1}{I\tau}\left[N_C\sigma_C^2 + N_P\sigma_{CP}\right], \\
P_U &= \mu_P - \frac{1}{I\tau}\left[N_C\sigma_{CP} + N_U\sigma_P^2 + N_U\frac{I_g}{I_n}\frac{\phi}{\sigma_C^2} + N_R\frac{\sigma_{CP}^2}{\sigma_C^2}\right], \\
P_R &= \mu_P - \frac{1}{I\tau}\left[N_C\sigma_{CP} + N_U\frac{\sigma_{CP}^2}{\sigma_C^2} + N_R\sigma_P^2 + N_R\frac{I_n}{I_g}\frac{\phi}{\sigma_C^2}\right].
\end{aligned}
$$

Source: Heinkel et al, 2001

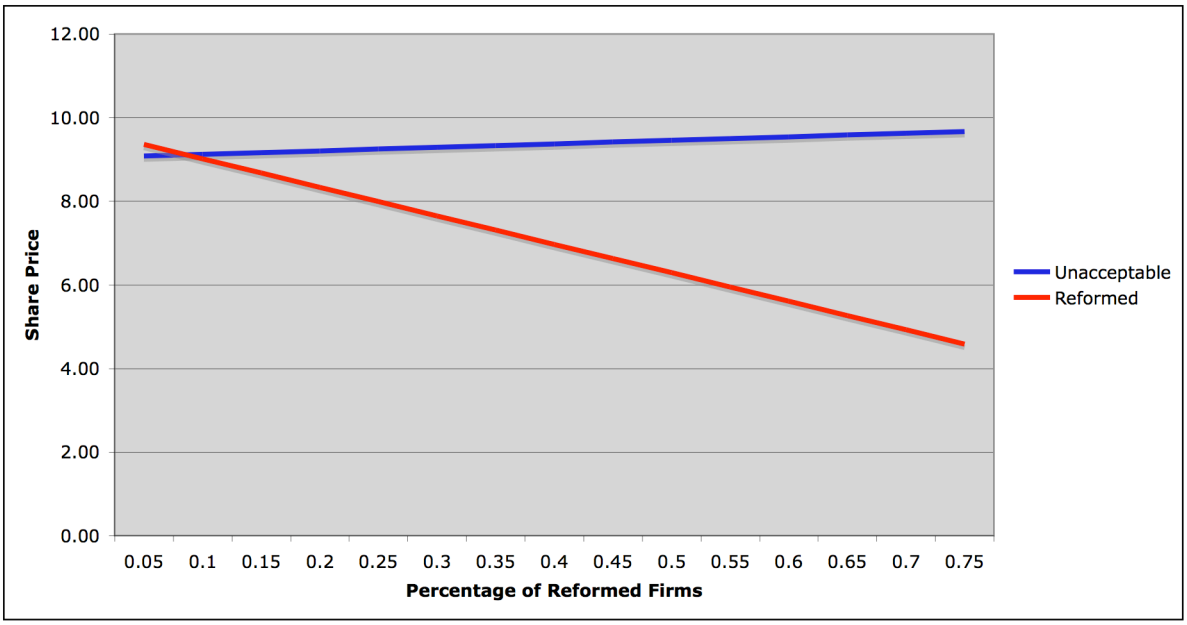
The variables from Table 11, Table 12, and Table 13 are inputted into the three equilibrium price equations (Equation 2), the results of which are detailed in Table 14.

Table 14 Share price of acceptable, unacceptable and reformed firms

Description	Symbol	2007 Value (I_g = 11%)
Share price: acceptable firm	P_A	9.39
Share price: unacceptable firm	P_U	9.19
Share price: reformed firm	P_R	8.44

Given the aforementioned variables it is possible to see that there is a premium for firms, which are already acceptable, as they have incurred all the necessary costs. The acceptable firms share price is not a function of the number of green (I_g) or neutral investors (I_n), and is therefore constant at 9.39. The difference that exists between unacceptable and reformed firms is a function of the number of unacceptable (N_U) and reformed firms (N_R). Thus, holding the number of green investors (I_g=11%) and the number of acceptable firms (N_A=22%) constant, the percentage split between unacceptable and reformed firms can be varied.

Figure 15 Share prices of unacceptable and reformed firms as a function of the number of reformed firms (I_g=11%)



Currently, with such a small percentage of green investors (11%), there is little incentive for firms to reform and incur added costs. If there are few reformed firms then the 11% of green investors can make a positive difference to the share price of these companies. The breakeven point on Figure 15 is 8.6% of reformed firms (Share Price = 9.11), therefore there need to be 8.6% or less of reformed firms in order for a premium to exist. As indicated in Table 12 approximately 18% of firms are reforming at present, this is double the breakeven number, and has resulted in a lower share price for these firms.

This trend is apparent in the High-Tech industry, in which firms are adequately meeting their legal obligations, but are not actively reforming their business operations. There appears to be little short-run justification for incurring these extra costs, given the current scenario and focus on maximising shareholder value. The reason for this lack of active reformation could be attributed to the cost of capital received by firms, which determines the feasibility of projects. The current cost of capital is 18.5% for reforming firms and 8.8% for unacceptable firms. This high cost of capital makes the net present value of potential projects relatively low, and hampers the progress towards environmentally sustainable firms.

Figure 16 Cost of capital for unacceptable and reformed firms as a function of the number of green investors

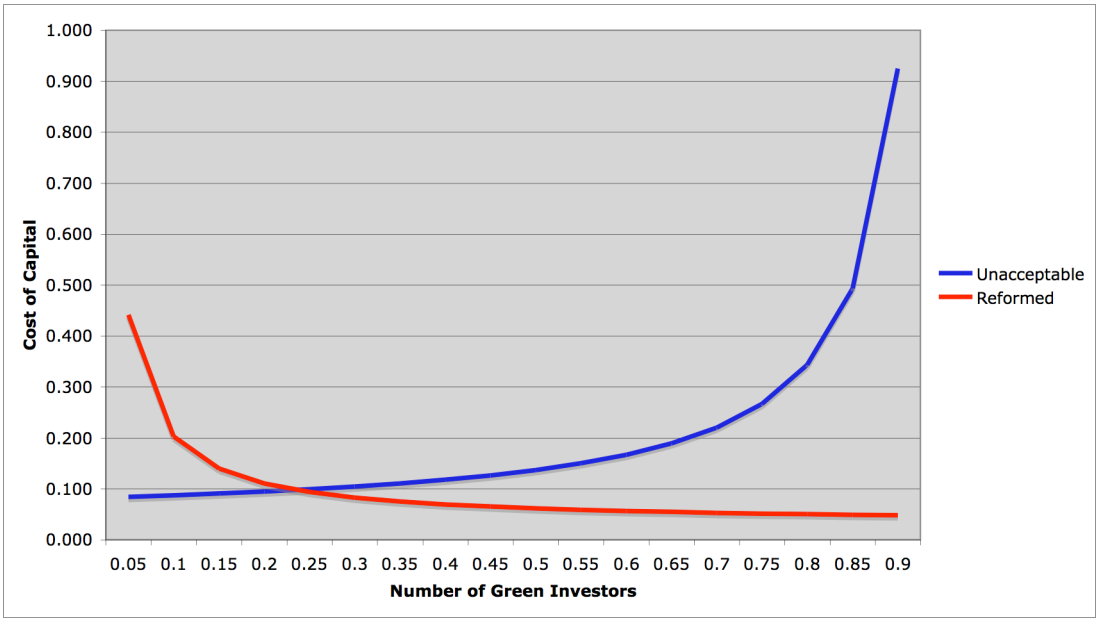


Figure 16 shows, ceteris paribus, the change in the cost of capital that occurs by varying the number of green investors (I_g) for both unacceptable and reformed firms. As the number of

green investors increases the cost of capital for reformed firms reduces, the breakeven point occurs when there are approximately 23% of green investors, resulting in a cost of capital of 9.9%. Therefore, the current level of green investors (11%) is half the required amount to induce firms to reform.

Given the current scenario the minimum number of green investors to encourage reforming is 23%, compared to the current level of 11%. If, holding all else constant, 23% of all investors were green investors what difference would this make to the current situation?

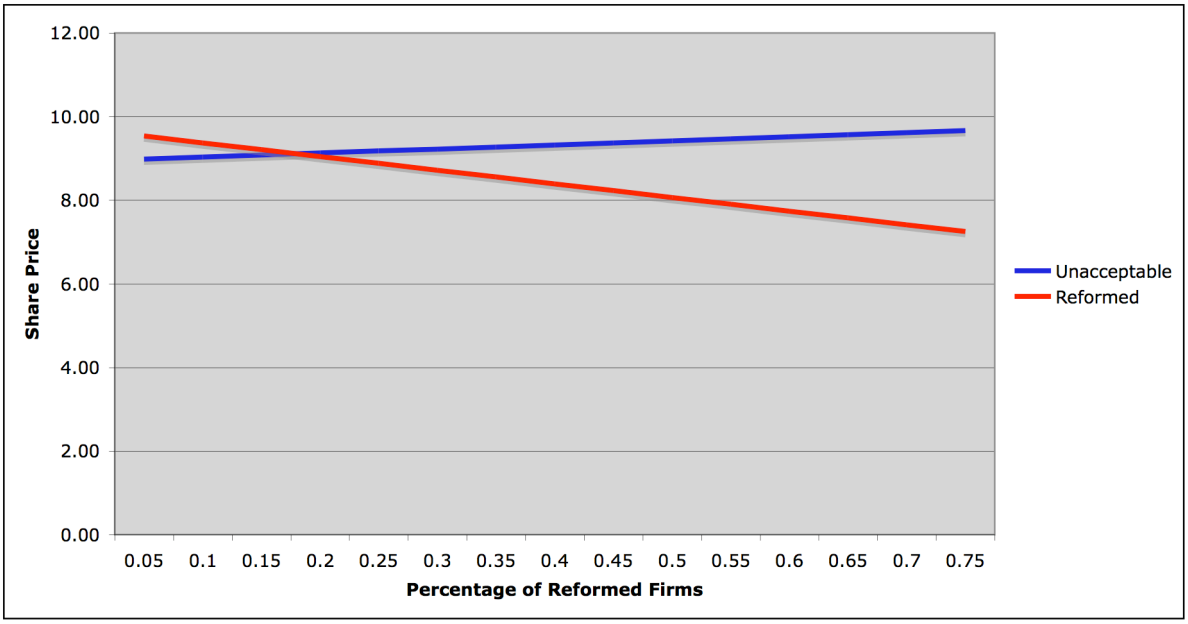
Changing the percentage of green investors from 11% in Table 13 to 23%, while keeping the remaining values in Table 11, Table 12, and Table 13 constant, a new set of comparative statics can be run. The cost of capital for both the reformed firms and unacceptable firms is 9.9%, the other results are included in Table 15.

Table 15 Results from changing the number of green investors from 11% to 23%

Description	$I_g = 11\%$	$I_g = 23\%$
Cost of Capital: Reformed	18.5%	9.9%
Cost of Capital: Unacceptable	8.8%	9.9%
Number of Reformed Firms	8.6%	18.03%
Number of Unacceptable Firms	69.8%	60.4%

From the table above it is evident that the increased number of green investors has resulted in a significantly lower cost of capital for reformed firms (18.5% to 9.9%) and a slightly higher cost of capital for unacceptable firms (8.8% to 9.9%). As indicated in Figure 15, the number of green investors is directly related to the maximum efficient level of reformed firms. Thus, the increase in green investors means that there is a premium for a larger percentage of reformed firms (8.6% to 18.03%). This difference is indicated in the figure below, reformed firms command a higher share price until the number of reformed firms exceeds 18%.

Figure 17 Share prices of unacceptable and reformed firms as a function of the number of reformed firms (Ig=23%)



A comparison of Figure 15 and Figure 17 highlights the difference in the rate of decline of the reformed firm, with I_g=11% the slope is -6.82 and with I_g=23% the slope is -3.26. As the number of green investors tends towards unity the slope tends to zero. It is clear that green investors are likely to have a significant impact on firms' sustainability actions in the future. However, the number of green investors as a percentage of total investors needed to induce change is fairly significant, the optimal amount given the current scenario is 23%.

Table 16 Growth required to attain a green investor population of 23% by 2019

Description	1995 Value (trl)	2007 Value (trl)	2019 Value (trl) forecast	12-yr Growth %
Total assets held in SRI funds	$0.639	$2.71	20.72%	665%
Total assets held in Global funds	$7	$25.1	90.12%	259%
Green investors (SRI/GBL)	9%	11%	23%	

Source: Social Investment Forum, 2007

Table 16 above indicates the required growth in total assets held in SRI funds over the next 12 years in order to have a green investor level of 23%. Holding the growth level over the past 12 years (1995-2007) of global funds constant at 259%, and setting the desired ratio in the year 2019 to 23% results in a 665% growth in total assets held in SRI funds, which is more than double the past 12 year growth of 324% (Social Investment Forum, 2007).

7. Conclusion

The two goals of this study are to determine means by which individual investors can differentiate between producers environmental performance in the High-Tech electronics industry and if shareholders can have an impact on environmental performance of companies. The conclusions that will be made are directly related to the two goals of the study.

7.1 High-Tech Industry

Significant environmental impact by High-Tech industry

The literature and environmental reports indicate that the High-Tech industry is going to have a growing impact on the environment. If action is not taken, the rapidly developing countries are likely to worsen the current problem. Individual investors will become aware of this change and make the necessary adaptations in their portfolios.

Numerous unmonitored life cycles in High-Tech industry

The High-Tech industry has many layers, it is difficult to determine when a company's responsibility begins and ends. However, the entire life cycle needs to be revised in order to develop a sustainable future for the company. The High-Tech sector needs to enforce standards that will filter through to the final product. As an individual investor it is difficult to determine which area to focus on and how to rank the suppliers.

Ranking difficulties

Due to the lack of rigid environmental accounting methods, objective ranking is difficult. Currently, most of the available information is subject to either continuity, comparability or credibility issues.

Environmentally strategic mindset not natural for most executives

Executives seem to have developed a set of competencies for dealing with problems of the past. In order to tackle environmental challenges and turn disaster into opportunity, a

paradigm shift is required. Individual investors do not appear to be focusing enough on the companies executives.

Sustainability requires a multi-faceted approach

In order for companies to develop a sustainable growth plan it is important that both the present and future be taken into consideration. Companies need to look at both internal and external factors when determining how to proceed, investors have to be aware of both the future and present, ensuring they are not myopic in their approach.

High-Tech industry lacks innovative green products

High-Tech companies appear to be more focused on the current, and less so on future possibilities. As a result of this focus, few innovative green products have been developed to date. Investors should be aware of innovative products, which are introduced into the market place, as these have the potential to increase sales revenue.

High-Tech companies have generic sustainability visions

The sustainability visions between companies in the High-Tech industry are very similar, with little differentiation or imagination. The sustainability visions are broad and lack credible plans and direction, thus making it very difficult for investors to differentiate between companies.

High-Tech companies seem to perform better when stringent legislation is imposed

Legislation appears to drive the innovation and environmental consciousness of companies. The current legislation is forcing High-Tech companies to reform their business operations and tackle some of the fundamental environmental issues.

In the High-Tech sector, revenue appears to be related to environmental performance

The larger the revenue of companies the better their overall performance is likely to be. The casual relationship is not easy to identify, given the current amount of information. Therefore, as companies grow financially, they have a greater propensity to develop effective environmental programs. Investors should be aware that environmental programs may be closely linked to revenue, thus reduced revenue is likely to worsen environmental performance.

7.2 External Pressure on Firms

Investor pressure is a reality

Individually investors do not have a large amount of power, yet combined there is the possibility for them to alter the actions of companies. The more environmentally conscious investors, the greater the pressure exerted on companies. It is important that companies acknowledge the power of herd behaviour, and adapted their strategies to make the most of these new opportunities.

Financial institutions and cost of capital

Financial institutions have the power to influence companies operations by adjusting the cost of capital. As green issues become more important, environmentally sustainable projects will be preferred to ordinary projects.

Environmental first mover advantage

As more companies become compliant with green legislation and develop numerous green products, the premium gained from having a few green companies will be lost. Thus, it is likely that there will be a significant first mover advantage, gaining the ultimate premiums granted by green conscious investors.

Sustainability indexes are growing

Sustainability indexes are fairly new to the financial market. Although the environment is not the only rating component, it is a very prominent aspect. Sustainability indexes are an easy way for concerned investors to ensure their wealth is invested in sustainable companies. In order for companies to be included in these indices they must, among other things, meet a number of stringent environmental constraints, among other things.

No concrete casual relationship between environmental impacts and cash flows

Companies have yet to establish how environmental degradation and adaptation is likely to affect their cash flows. If there is no link between the environment and cash flows it is impossible to accurately value the impact of a company. It is important for a company to understand how environmental changes will affect the cash flow, as it is only a matter of time before legislation enforces the financial valuation of environmental impacts.

8. Recommendations

The recommendations aim to address a number of the issues discussed in the conclusions section 7.

8.1 High-Tech Industry

Identify exposure to current regulatory markets

High-Tech firms should continue to adapt their strategies, thus ensuring that they do not falter in meeting the legal requirements applicable to the sector. Corporations must develop a clear understanding of the current legislation and how it affects their business. It is imperative that firms understand how legislation affects their suppliers, as this may alter the products they can use in the upstream processes.

Develop competencies to deal with future regulations

It is likely that numerous new regulations will be introduced in the years to come. High-Tech firms should develop a good communication link between management and the legislation makers. If High-Tech firms take an active role in the decision process then they will gain a deeper understanding and ensure their point of view is heard. Investors must have a good understanding of new legislation and how it is going to affect companies.

Develop an effective business model to gain a competitive advantage

High-Tech firms need to revise their current business models and make necessary adaptations, which will enable them to take advantage of the numerous opportunities the green revolution is presenting. The most innovative business models are likely to control the market place and ensure the longevity of the company, investors should be aware of changes to corporate structures, and an emphasis on new business areas.

Use scenario planning to develop effective plans

The current market place is very volatile and it is unclear in what direction the market is likely to go. Due to this uncertainty High-Tech companies should use extensive use of

scenario planning, this will facilitate the development of alternative options for the company, given adverse working conditions.

8.2 External Pressure on Firms

Investor awareness

Companies need to understand and develop a method of conveying relevant environmental information to their shareholders. It is important that the environmental information, as with financial information, is released at the most appropriate time, thus leveraging the most possible value out of the information.

Adopt GRI reporting methodology

The adoption of GRI reporting standards is important in order for the standardisation of environmental information. However, through the adoption of a standardised methodology, companies will see where they are underperforming, and what changes should be made. The required adoption of such environmental reporting is only a matter of time, thus a thorough understanding of the process is useful.

Inclusion into sustainability indexes

Companies should strive to be included in the sustainability indexes, to do this they need to meet the requirements of the indices. The neutral investors are not likely to make a significant difference, yet the growing population of green investors is likely to hamper the share price of companies, which are not included.

Invest in sustainable projects

A focus should be placed on developing and investing in sustainable projects. This does not mean financial returns should be neglected, but rather that financial value should be given to sustainability. The use of real-options valuation is useful in the measure of these programs, and should be adopted by companies.

Determine the effect of climate change on cash flow

It is vital that companies determine how climate change impacts their cash flows, it is through this relationship that climate change is likely to affect companies long run sustainability. Adopting effective monitoring and reporting methodologies, such as the GRI, can only achieve this.

Appendix 1

ACER

POLLUTION PREVENTION: Acer attempts to guarantee environmentally friendly products, which have low toxicity characteristics. Acer has a reduction policy of toxic substances extending into 2009. Acer has not eliminated many of the key toxic substance from their current products.

PRODUCT STEWARDSHIP: Acer recognises the future value associated with recycling old electronics products. They provide a number of recycling facilities that enable consumers to safely dispose of their products.

CLEAN TECHNOLOGY: Acer aims to minimise the load on the environment during their products life cycle. Acer does not have any green technology.

SUSTAINABILITY VISION: "The vision of the Acer aims at sustainable management and development of the enterprise via a triple-win strategy of economic growth, environmental protection, and social welfare."

QUANTITATIVE RESULTS:

- Eliminate PVC's, BFR's by 2009
- 80% of current products comply with the Energy Star standard

APPLE

POLLUTION PREVENTION: Apple helps to safeguard the environment by eliminating a number of toxic substances, over and above PVC and BFR's. A number of their products are now mercury and arsenic free.

PRODUCT STEWARDSHIP: Apple's holistic life cycle approach to recycling, includes using highly recyclable materials in products in addition to providing extensive take-back programs that enable consumers and businesses to safely dispose of used Apple equipment. Apple has started recycling programs in 95% of countries in which the products are sold.

CLEAN TECHNOLOGY: Apple currently does not have any clean products.

SUSTAINABILITY VISION: “Environmental protection is a priority for the conservation of precious natural resources and the continued health of our planet. Apple recognises its responsibility as a global citizen and is continually striving to reduce the environmental impact of the work we do and the products we create.”

QUANTITATIVE RESULTS:

- Try to remove PVC and BFR by end of 2008, most likely unsuccessful
- 2007: recycling volume grew by 57%, collected 9 million tons of e-waste
- Take back options in 95% of countries
- Offices and factories only 5% of CO2 emissions

DELL

POLLUTION PREVENTION: Dell uses a precautionary approach when including substances in their products. The aim is to eliminate environmentally sensitive substances from the products. This elimination is constrained by cost effective and safer alternatives. Dell places a high priority on pollution prevention.

PRODUCT STEWARDSHIP: Dell has introduced the ReGeneration program, which aims to include all stakeholders in the design of their products. The aim is to act in an environmentally friendly manner by engaging stakeholders. Dell offers numerous recycling plants to their customers and places an emphasis on reuse.

CLEAN TECHNOLOGY: Dell has not developed any clean technology thus far.

SUSTAINABILITY VISION: “Dell is committed to becoming the “greenest” technology company on the planet. For more than a decade, we have built environmental considerations into every stage of the product life cycle — from development and design, to manufacturing and operations, to customer use and end-of-life product disposition. While we’re proud of the significant progress we’ve made so far, we know there’s still much more to do. Dell's vision is to create a company culture where environmental excellence is second nature.”

QUANTITATIVE RESULTS:

- Lowest carbon intensity in the industry, aim to reduce by a further 15%
- Reduced amount of packaging by 5440 tons
- Recycled/Reused more than 95% of non-hazardous waste
- Recovered 116 million kg of discarded material

HP

POLLUTION PREVENTION: HP recognises the responsibility that they hold for ensuring that environmental standards are met. In order to ensure this, 95% of their products were audited for hazardous materials. However, suitable progress has not been made regarding the elimination of some toxic substances.

PRODUCT STEWARDSHIP: HP has progressed significantly with the provision of greater reuse and recycling facilities. This progress is not enough as the number of end-of-life products is growing at a faster rate. HP is responding with a growing take-back program.

CLEAN TECHNOLOGY: HP does not have any clean technology

SUSTAINABILITY VISION: "Our three global citizenship priorities — supply chain responsibility, climate and energy, and product reuse and recycling — are more critical than ever to our business success. These are the areas that reflect growing customer demands and where we can make the greatest contribution."

QUANTITATIVE RESULTS:

- Yearly energy saving 350 million Kwh, equivalent to $25 million
- 50 million Kwh energy credits purchased
- Reduction of CO2 by 82160 tons, decrease of 5%
- Reduce GHG emissions to 25% below 2005 levels by 2010
- Annual recycling value of 113000 tons
- 3 million hardware units produced

LENOVO

POLLUTION PREVENTION: All of Lenovo's new products are evaluated for volatile organic compounds and other chemical emissions. With such a focus Lenovo has managed to avoid the emission of 564000 pounds of volatile chemicals.

PRODUCT STEWARDSHIP: Lenovo consistently engages customers, NGO's and other stakeholders in order to develop environmentally friendly products. Lenovo also focuses on end-of-life for their products. This ensures product take-back is available for all customers. During calendar year 2006, Lenovo managed or financed the proper disposal of more than

3700 metric tons of end of life or returned products from customers, with less than 1.8 percent being land filled.

CLEAN TECHNOLOGY: Lenovo has not developed any clean technology thus far.

SUSTAINABILITY VISION: "Lenovo is committed to exhibit leadership in environmental affairs in all of its business activities. Corporate strategies, policies and guidelines must support this commitment to leadership in environmental affairs."

QUANTITATIVE RESULTS:

- 1% of Lenovo's total plastic usage in 2007/08 from recycled sources. Aim to have 4% by 2008/09
- Prohibit PVC use in products in excess of 25 grams, eliminating by 2009
- 17275 tons of recycling, 50% reused and 42% recycled
- GHG emissions 73566
- 10% of energy from renewable sources

LGE

POLLUTION PREVENTION: LGE has introduced an Eco-Design strategy, which aims to reduce the environmental impact of a product's development, production, and circulation while improving efficiency of resources, recyclability, and reducing hazardous materials. Many LG products use the eco-design: washers, TVs, notebooks, and phones. LG's products are resource and energy efficient, generating less waste.

PRODUCT STEWARDSHIP: LGE have introduced numerous take-back facilities, which enable consumers to return end-of-life products. LGE have designed many of their products for the end-of-life stage, which facilitates the recycling process.

CLEAN TECHNOLOGY: LGE does not have any current clean technology. However, they monitor the energy-efficiency of their products, aiming to reduce the emissions. In the long run LGE aims to develop new technology, which works with renewable energy.

SUSTAINABILITY VISION: "LG Electronics has an environmental management strategy and is also developing environmentally friendly products to create a cleaner, safer world. It will reduce environmental production impact in response to environmental issues."

QUANTITATIVE RESULTS:

- Cannot get rid of all toxic waste by 2007, reduction of 14003 tons of Hazardous chemical substances, still use 46730 tons
- Collected/Recycled 1.09 million items in 2007, 16% increase over 2006
- Collection per country/region: Korea 36633 tons, Japan 1665 tons, EU 49004 tons, USA 256 tons
- Non-recyclable, 1472 tons acid waste, 1452 tons organic solvent waste, 4190 tons sludge, 263821 tons of trash, 4525 others

NOKIA

POLLUTION PREVENTION: In order to prevent pollution Nokia aims to use approved, tested and sustainable materials and substances in their products; improve the energy efficiency of their devices, applications and enhancements including chargers; develop smaller and smarter packaging for their products.

PRODUCT STEWARDSHIP: Nokia believe that it is important to involve the people who use their products via eco software and recycling. The newly developed Eco Declaration provides basic information regarding energy efficiency, packaging, disassembly and recycling. Nokia reports that the usage phase of their products accounts for a third of the energy of the total life cycle, of which two thirds can be wasted. To overcome this Nokia is focusing on more efficient chargers.

CLEAN TECHNOLOGY: Nokia has realised the need for renewable energy and clean technology. They have developed a number of chargers, which operate with solar power, cranks or even windmills. This is in an aim to mitigate climate change in the future.

SUSTAINABILITY VISION: “Our vision is a world where everyone being connected can contribute to sustainable development. We want to shape our industry and drive best practices.”

QUANTITATIVE RESULTS:

- New charger uses 0.07 watts of power
- Bio plastics cover saves an estimated 15% energy and GHG’s
- 25% of energy derived from renewable sources
- Compact packaging reduced 5000 trucks on the road and saved 100 million euros
- Removed PVC

PANASONIC

POLLUTION PREVENTION: Panasonic acknowledge that many of their products are not compliant with the regulations introduced. Panasonic hopes to meet environmental requirements while at the same time meeting customer demands.

PRODUCT STEWARDSHIP: Panasonic strongly support the take-back program. Panasonic participated in 81 events and helped keep approximately 920,400 pounds of discarded electronics from ending up in landfills.

CLEAN TECHNOLOGY: Panasonic does not have any clean technology.

SUSTAINABILITY VISION: “Panasonic's concerns for environmental protection and sustainability date back to our founder, Konosuke Matsushita and his belief of putting people before products. Today, our company's Environmental Statement pledges that we will practice prudent, sustainable use of the earth's natural resources and the protection of our environment.”

QUANTITATIVE RESULTS:

- Green products increase from 47 in 2006 to 79 in 2007
- Reduced power consumption by 1/6
- CO2 emissions in 2007 are 398000 tons
- Replaced 6 prohibited substances

SONY ERICSSON

POLLUTION PREVENTION: Sony Ericsson aims to produce the best products in the world, while at the same time eliminating any harmful or unwanted substances. In order to maintain an edge, Sony Ericsson monitors numerous reports and through their environmental design they are able to ensure the safety of their products.

PRODUCT STEWARDSHIP: Sony Ericsson recognises the importance of product ‘take-back’ and recycling. Sony Ericsson takes responsibility for all the products they develop, and focus on recycling and reuse. Sony Ericsson participates in both voluntary and required collection and recycling schemes in many countries around the world.

CLEAN TECHNOLOGY: Currently, Sony Ericsson does not produce any products that would be defined as “clean”. They are in the process of development.

SUSTAINABILITY VISION: “With the GreenHeart™ concept, Sony Ericsson is looking to the future, to ensure the full life cycle of a mobile phone can be made more environmentally friendly. Once the technology reaches maturity, new techniques and materials will then be included in the portfolio and a market wide launch. One ‘eco’ product by itself will not make a difference but by learning through this concept study we are ensuring the entire portfolio in future will be more sustainable.”

QUANTITATIVE RESULTS:

- October 2001 released first bromine free product
- Electrical consumption per manufacturing unit decreased by 24% while number of units produced increased by 77%
- 15200 tons CO2 contribution from manufacturing and 228800 from transportation
- 500 collection points for recycling
- 1 million phones collected in the EU during 2006

TOSHIBA

POLLUTION PREVENTION: Toshiba is attempting to manage its chemicals waste. Toshiba recognises the need to reduce harmful emissions into the environment. Toshiba has set a goal of reducing emissions into the air and water by 50%.

PRODUCT STEWARDSHIP: Toshiba is focusing on the development of environmentally conscious products, which will have a minimal impact on the environment during their life cycle. Toshiba also recognises the need to promote a recycling-based society.

CLEAN TECHNOLOGY: Toshiba has introduced new life cycle planning into their product developments, which attempts to reduce the environmental impact of their products. Toshiba currently do not have any clean technology.

SUSTAINABILITY VISION: “Toshiba believes that companies are part of the fabric of society and can only survive and prosper in the long run if they work for, and earn the trust, of society. We recognise that short-term progress and profit cannot come at the expense of long-term environmental sustainability. That is why Toshiba has created a stream of essential, life-enhancing products and services that have earned society's trust.”

QUANTITATIVE RESULTS:

- 60% of CO2 emissions from digital products usage
- 80% of CO2 emissions from home appliance usage

- 2006, only 28% of products did not contain prohibited substances, now 48%

Table 17 FTSE4GOOD sector segmentations

High Impact Sectors	Medium Impact Sectors	Low Impact Sectors
Agriculture	DIY & Building Supplies	Information Technology
Air Transport	Electronic and Electrical equipment	Media
Airports	Energy and Fuel Distribution	Consumer / Mortgage Finance
Building Materials (includes Quarrying)	Engineering and Machinery	Property Investors
Chemicals and Pharmaceuticals	Financials not elsewhere classified (see right)	Research & Development
Construction	Hotels, Catering and Facilities Management	Leisure not elsewhere classified - (Gyms and Gaming)
Major Systems Engineering	Manufacturers not elsewhere classified	Support Services
Fast Food Chains	Ports	Telecoms
Food, Beverages and Tobacco	Printing & Newspaper Publishing	Wholesale Distribution
Forestry and Paper	Property Developers	
Mining & Metals	Retailers not elsewhere classified	
Oil and Gas	Vehicle Hire	
Power Generation	Public Transport	
Road Distribution and Shipping		
Supermarkets		
Vehicle Manufacture		
Waste		
Water		
Pest Control		

Source: FTSE4GOOD, 2008

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