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**A Cost-Saving and Innovative Best-Practices Green IT Framework for Small  
and Medium Sized Enterprises (SMEs)**

by

Concepta McManus  
BBS (Information Systems Management)

A Research Dissertation submitted in partial fulfilment for the Degree of  
Masters of Science in Technology Management  
of the  
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Enterprise Research Centre,  
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**Certification of Authorship:**

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## **Abbreviations**

- BNET Business Network
- CA Computer Associates
- CSR Corporate Social Responsibility
- SME Small Medium-Sized Enterprise
- SMB Small Medium-Sized Business
- PC Personal Computer
- IT Information Technology
- IDC International Data Corporation
- IDG International Data Group
- TCO Total Cost of Ownership
- EPEAT Electronic Product Environmental Assessment
- EPA Environmental Protection Agency
- WEF The World Economic Forum
- CRT Cathode Ray Tube
- SSL Secure Socket Layer
- VPN Virtual Private Network
- MFD Multi Functional Device
- RBK Russell Brennan Keane
- RoHS Restriction of Hazardous Substances
- WEEE Waste Electrical and Electronic Equipment

## **Abstract**

The notion of Green IT in a micro, small or medium sized company (SME) is not well explored in current literature. The Green IT guidelines or the recommended activities outlined in literature are often more applicable to large organisations that have extensive resources to implement these Green initiatives. The purpose of this study was to develop a Green IT framework suitable for SMEs. In the process, the study sought to understand the levels of awareness of Green IT that currently exists among SMEs and find out about the current adoption rates of Green IT among SMEs. The study sought to also address potential barriers to and benefits of Green IT. Data was collected using three methods: observation, interviews and questionnaires.

The study demonstrated that as of August 2009, the level of awareness among SMEs regarding Green IT is low. Just over half of the SMEs surveyed, admit to not knowing, what practices belong to the Green IT category. SMEs in general are slow to adopt Green IT practices particularly when compared to their larger counterparts. SMEs are failing miserably to pick the 'low-hanging fruit', such limiting paper use and using power management tools.

The level of knowledge a firm possesses about Green IT is directly proportional to the rate at which it will accept and embrace new Green IT techniques. The study proposes a seven-step framework, a list of recommendations that can guide and direct SMEs through the implementation of a Green IT project and so addresses the gap identified in the literature.



## **1. Chapter One: Introduction**

### **1.1 Background to the Research**

Green IT, also called “Sustainable” IT or Green Computing is a fairly new concept. The few existing definitions of this concept can be described as vague. Simon Mingay outlined one such definition in a Gartner report in 2007 titled “Green IT: The New Industry Shock Wave”. It is defined as the “optimal use of ICT for managing the environmental sustainability of enterprise operations and the supply chain, as well as that of its products, services, and resources, through their life cycles.”

Proposed by Hiner (2008), Green IT is the computer industry’s effort to obtain a more sustainable civilisation. Jason Hiner (2008) of TechRepublic concludes that the answer is typically three-fold:

1. Minimize energy use
2. Reduce CO2 emissions
3. Better manage electronic waste

In October 2008 an article titled “Three Pathways to Greener IT” in [www.industryweek.com](http://www.industryweek.com) offered a similar three-fold solution as Hiner’s one. This is as follows:

1. Improve energy efficiency by reducing your carbon footprint.
2. Enable lifestyle changes that lowers impact on the environment
3. Reduce e-waste

Terrabytes Consulting (2009) describe Green IT as the established term for projects such as power management, consumption reduction, extending useful life of hardware, responsible disposal of equipment etc. Green IT projects vary from “datacentre virtualization to desktop-power management initiatives to cutting travel through videoconferencing and telepresence to leveraging technology and devising more fuel-efficient shipping routes” (Samson 2009).

Depending on whether you are a manufacturer, a manager or a user of technology, the concept of Green IT implies different meanings (Walsh, 2007, p.13). Walsh (2007, p.13) defines “Sustainable”, or “Green” IT as a catch-all term used to describe the manufacture, management, use and disposal of information technology in a way that curtails damage to the environment.

This last definition is the author’s preferred one as it sums up the concept well. It also correlates with the descriptions put forward by Hiner (2008) and in the article named “Three Pathways to Greener IT” referred to above. This introduction outlines the vagueness and complexity of the Green IT concept. Exactly what is classed as a Green IT initiative will become evident throughout this thesis.

## **1.2 Research Questions:**

The aim of the study is to address one primary research question:

*PQ1: “What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?”*

In addressing this primary question, the study will seek to answer the following 4 related secondary questions:

*SQ1: “What levels of awareness currently exist regarding Green IT among SMEs?”*

*SQ2: “What are the levels of adoption that currently exist regarding Green IT among SMEs?”*

*SQ3: “What are the barriers to implementing Green IT in SMEs?”*

*SQ4: “What are the benefits SMEs can achieve by implementing Green IT?”*

## **1.3 Significance of the Research:**

Since 2007 there has been widespread interest in Green IT. Recently the whole concept is gaining more attention as the global economy has slowed down. Green

initiatives can be applied to a business as part of a cost-saving exercise. The Green IT debate has moved on from 'save the planet' to 'save the organisation money', with the common denominator, use less energy (Robinson, 2009). Ted Samson (2009) stated in the article titled The Green IT leaders of 2009, "no matter an organisation's size or industry, it can realise business and environmental benefits through Green IT. Given the state of the economy and the environment, every project can make a difference".

According to Albert Esser (2008), going Green was in the past "associated with making some sort of a sacrifice". He was quoted making the above statement in an article written by Carolyn Duffy Marsan titled "Under Pressure: 10 Sources Pushing CIOs to Go Green", published on <http://www.peworld.com> on 9<sup>th</sup> July 2008. The notion that you must pay a premium price to obtain Green status is diminishing and companies are or should be looking towards Green IT to provide costs savings, innovative solutions and competitiveness.

According to article 2 of the Annex of Recommendation 2003/361/EC, the category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding 50 million euro, and/or an annual balance sheet total not exceeding 43 million. SMEs represent 99% of the total enterprises in the European Union (Commission 2003). The author will refer to micro, small and medium sized organisations as SMEs throughout the entire thesis. Both micro (0-10 employees) and small (10-50 employees) organisations will be collectively called 'small' for the purpose of this thesis.

The notion of Green IT in a micro, small or medium sized company is not well explored in current literature. As mentioned the definition of Green IT is vague. What constitutes a Green IT action differs from turning off printers and PCs at night to implementing server virtualization. The Green IT guidelines or the recommended activities outlined in literature are often more applicable to large organisations that have the extensive resources to implement these Green initiatives. A lot of the information on Green IT concentrates on virtualization and consolidation. These areas are excellent in their own right and although cost money, initially to implement, will end up saving the large firms money in the long run. The Green IT initiatives most

talked about such as virtualization may not be applicable or practical for a smaller company.

The author will investigate how smaller companies are embracing Green IT and what types of Green IT initiatives they have implemented or planned to implement in the future. The author will concentrate on those Green tactics that cost little or nothing to implement like turning off PCs and printers at night, using double-sided printing and utilising existing or new power management systems to turn off computers when idle.

These paper and energy savings are just some simple Green IT tactics that bring quick cost-savings and environmental benefits. This study proposes to address this “low hanging fruit” that is specifically suited to SMEs. It has often been thought that Green IT is not applicable to small and medium sized businesses. The author believes that is a mistake, businesses can make. All businesses pay bills, specifically energy bills so using Green IT to reduce their energy costs, while simultaneously lowering their carbon footprint, is a win-win situation for both the environment and their bottom line regardless of size. Businesses have to cut costs to stay competitive and reducing energy costs through the use of Green IT is more appealing than reducing headcount.

#### **1.4 Outline of the Thesis**

This study is broken into a total of 5 chapters. This chapter, chapter 1, outlines the overall structure of the thesis beginning with an outline of the background to the study and discusses the significance of the study to the area of Green IT research. Chapter 2 reviews the current literature with regard to Green IT. This chapter is broken down into 7 sections covering; an introduction, Green technology in general, Green IT along with the benefits and challenges associated with it, Greening SMEs, Green metrics, Green regulations, standards and certifications and a conclusion. Much of the data available on this topic is provided by Research Institutions such as Forrester, IDC and Gartner. The chapter includes a Forrester Research definition of Green IT. The aim of the chapter is to give the reader an overview of Green IT.

Chapter 3 discusses the research methodology employed in the study. It explains the rationale behind the author’s three-stage data collection approach. The chapter begins with a statement of the research questions and the reasoning behind choosing

observation, interviews and questionnaires to answer these research questions. The chapter goes on to explain why SMEs were chosen as a sector to focus on. A gap in the current literature, regarding Green IT for SMEs, was identified by the author thus influencing her decision to study this sector. The chapter then concludes with a description of the three data collection methods employed in the thesis.

Chapter 4 represents the findings from the three research methods applied in the study. Findings from observation were outlined first, followed by the findings from the interviews and finally results from the questionnaire were displayed graphically. The findings were all grouped into 4 headings; awareness, adoption, barriers and benefits. These headings were derived from the four research questions.

Chapter 5 will examine the implications of the study's findings. It will begin with a discussion on the findings from the three methods of data collection then it will outline whether these results managed to, successfully address, the 4 secondary research questions and will end with a proposed Green IT framework, suitable for SMEs, essentially addressing the study's primary research question. The chapter will discuss opportunities for further research and will end with an overall conclusion of the study's main findings and how the study contributes to academic research in the area of Green IT for SMEs.

## **Chapter Two: Literature Review**

### **2.1 Introduction**

The purpose of this chapter is to present the various bodies of research that have been carried out to date regarding Green IT.

*“Green IT is the design, manufacture, deployment and disposal of IT products and related materials in an environmentally responsible manner”.*

Source: IDC, 2007

The above definition appeared in a report written by Philip Carter, titled “Why Green IT Makes Business Sense” and was published by IDC in September 2008. In reference to this definition the thesis will concentrate mainly on the deployment and will touch slightly on the disposal. Global warming, greenhouse gases, climate change, being eco-friendly are all mantras with Green connotations. The word “sustainability” has close links to Green. In 1987, the World Commission on Environment and Development defined sustainability as the approach to economic development that “meets the needs of the present without compromising the ability of the future generations to meet their own needs” (Atlantic University Alliance 2004).

‘Corporate social responsibility’ (CSR) is another word, closely entwined with Green. CSR is defined in BNET business dictionary as a voluntary approach that a business enterprise takes to meet or exceed stakeholder expectations by integrating social, ethical, and environmental concerns together with the usual measures of revenue, profit, and legal obligation. CSR is bigger than ‘Green’ but ‘Green’ is a major component of CSR (Carter 2008, p18).

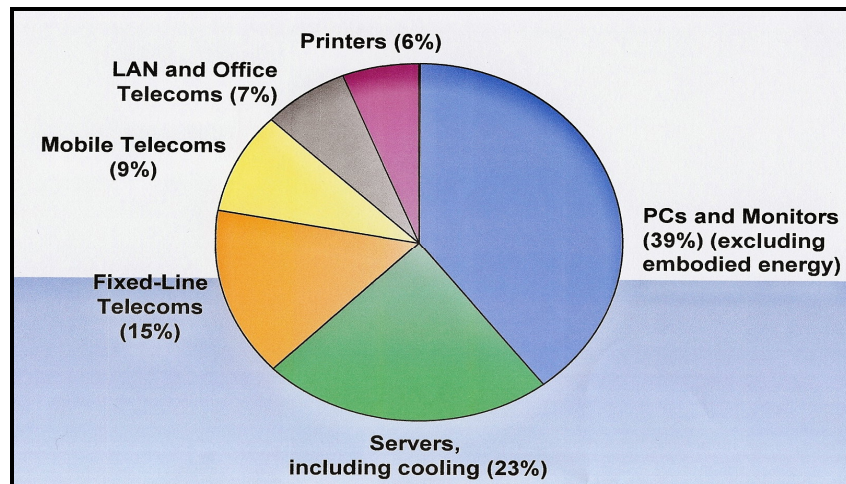
Green is the big buzz word of our time. The colour is heard so often these days that it loses its sentiment resulting in people often falling prey of Green fatigue. Velte’s (2008, p.3) notes in his book titled Green IT that “we get bombarded by the message so much that it’s easy to ignore”. This constant Green bombardment results in a high probability of ‘Green anything’ being dismissed as not relevant to businesses and not relevant to IT. It is often deemed only applicable to tree huggers and hippies. The World Economic Forum (WEF) a Geneva-based non-profit foundation best known for

its annual meeting in Davos, Switzerland proposed at the January 2007 meeting that climate change was the most significant shift that would impact business, technology, society and the global economy (Mingay 2007). There is only one planet which all individuals and businesses alike have to share.

This literature review makes several references to Forrester Research, Gartner research and IDC. Forrester Research, Inc. (Nasdaq: FORR) and Gartner, Inc. (NYSE: IT) are both well renowned information technology research and advisory companies. IDC is a subsidiary of IDG, an established technology media, events and research company. IDC is a global provider of market intelligence, advisory services, and events for the information technology, telecommunications, and consumer technology markets.

It has been suggested that IT has been both a cause of and solution to environmental problems. According to Gartner Research (2007) IT accounts for approximately 2% of global CO<sub>2</sub> emissions, equivalent to the aviation industry's output. In the same report Gartner Research (2007) suggests that "IT can contribute to control and reduce the 98% of CO<sub>2</sub> emissions caused by other activities and industries". Figure 2.1 outlines the breakdown of ICTs global CO<sub>2</sub> emissions.

Authors like Friedman (2007) reckons Green is the "next great global industry", dubbed the "Green bubble" or otherwise the world will not survive. It is no surprise then that Green as a concept has found a home in the IT industry. A McKinsey report from 2008 advocates that Green IT can help eliminate 7.8 metric gigatons of greenhouse gas emissions annually by 2020, equivalent to 15% of global emissions today (<http://www.mckinseyquarterly.com>).



**Figure 2.1: IT's Global CO2 Emissions**

**Source: Mingay, (2007, p. 6)**

In May 2007, a press release titled *Forrester: The Growing Interest in Green IT* mentioned a Forrester survey taken in the same year. 124 IT operations and procurement professionals of North America and Europe participated in this survey that showed that although 85% of them said environmental factors are important, only 25% of them have written Green criteria into their company's purchasing processes. O' Flynn (2008) in her paper titled *Approach to Green IT Business at Fujitsu Australia Limited* observes that "while organisations have embraced the concept of Green IT they fail to translate it into action".

Knights (2009) quotes Tom Weston, executive chairman at Sunrise Software, in her article titled 'Taking Green IT beyond the data centre', Sunrise Software carried out a survey regarding the adoption of Green IT in September 2008. The survey concludes that IT organisations were missing a trick. Weston postulates that "strong messages about Green strategies are not getting through, at least with regards to the office equipment". The rest of this literature review is broken down into various sections starting with section 2.2 on Green Technology on the whole and finishing with section 2.6 on Standards, Regulations and Certifications.

## **2.2 Green Technology on the Whole**

*"Green technology or clean technology is the application of the environmental science to conserve the natural environment and resources, and to curb the*



*negative impacts of human involvement. Green Technology is low-carbon technology and is environmentally friendlier than a comparable existing technology.”*

Source: <http://www.green-technology.org>

Green technology is coming into vogue. Green technology can help halt the world from suffocating under a blanket of carbon emissions (Smith and Woods, p.1). The reasons why some businesses choose to adapt environmentally friendly policies can vary from concern for the planet, cost savings, marketing advantage or a combination of all three (Pratt 2008). Smith and Woods (2009) refer to three huge challenges in relation to Green technology. These are:

- Rising global energy demand
- Energy security
- Carbon concerns

Former vice president Al Gore and his book and documentary film, “An Inconvenient Truth on climate change” are well renowned (Smith and Woods 2009, p.21). Smith and Woods (2009) cite figures from the Energy Information Administration (EIA) (2007). The EIA advocates that carbon emissions are predicted to increase from 26.9 billion metric tons in 2007 to 33.9 billion metric tons in 2030. President Obama, the 44th President of the United States, has put environmental issues at the very centre of his agenda and is concentrating on the development of a clean energy infrastructure.

A new business networking group has been established in Ireland for companies in the Green and clean technology sectors. This group’s focus is the promotion of the Green sector in Ireland. Dick O’ Brien reports on this new group in the Sunday Business Post May 2nd, 2009. Friedman (2008) believes “What IT was to the 80s and 90s, energy technology, will be to the early 21<sup>st</sup> century.” Parallel to this interest and growth in Green technology is the promotion and adoption of Green IT. Climate change and energy issues that affect both vendors and users congregate through Green IT (Davis 2007, p.6).

The Kyoto Protocol is defined in “Article 2” in The United Nations Framework convention on Climate Change. It is a protocol to the United Nations Framework convention on Climate Change (UNFCCC or FCCC), an international environmental treaty produced at the United Nations Conference on Treaty is intended to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate change”. Under Kyoto industrialised countries agree to reduce their collective CO<sub>2</sub> emissions. The Kyoto protocol is the biggest worldwide attempt to curb greenhouse gases (Smith and Woods 2009). In relation to Green technology, the world needs new ideas, new products, new financing and new brainpower (Smith and Woods 2009). The EU proposes that 20% of its energy usage will come from renewable sources – a goal beyond Kyoto requirements (IBM 2008).

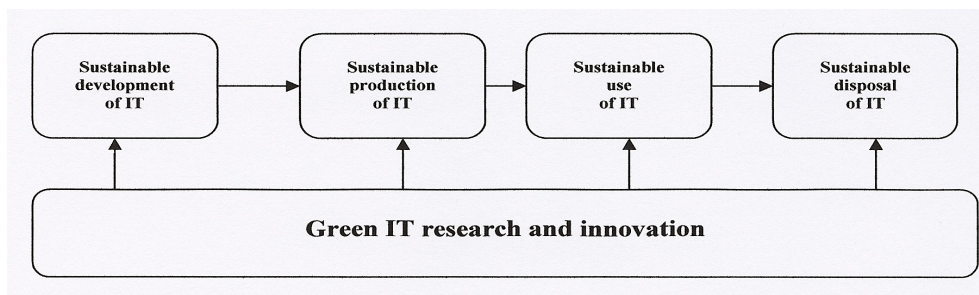
Increasing energy demands and costs, diminishing capacities, heightened awareness and rigorous regulatory scrutiny are some of the reasons why Green technology is the way forward (IBM 2008). It has been claimed incessantly that going Green is good for business financially and presents an opportunity for market leadership (Lash and Wellington 2007) resulting in the technology industry Greening at an impressive velocity (Maleshefski 2007). Several governments have taken an interest in Green. Green technology offers hope in these tough economic times as a potential job creator and a stimulus for global growth (Dickey et al 2008). However, others believe, that the pressing current economic problems will not be “solved by switching to hydrogen-power cars or installing solar panels on every roof” (Kahn 2009).

### **2.3 Green IT**

An article titled “Research and Markets: What is Green IT? Implementing Green IT, Discover the Cost-Effective Benefits” was published on [www.reuters.com](http://www.reuters.com) 23<sup>rd</sup> February 2009. It maintained there was a transition towards ‘Green’ or ‘energy-efficient’ computing due to the uncertainty around the effects human activities have on the environment as well as the credit crunch and rising costs. Stein (2009) reckons Green IT is really about two issues: making IT itself more energy efficient and going beyond that to leverage IT to reduce the carbon footprint of other operations. The introduction in chapter 1 stated Simon Mingay’s definition of Green IT. Forester Research defines it as:

*“IT suppliers and their corporate customers changing the way computing assets are designed, manufactured, operated and disposed of to gain efficiency and cost savings while reducing environmentally harmful impacts”.*

This definition appeared in a paper titled “Inquiry Insights: Green IT, Q3 2008” by Mines et al (2008). The Danish National IT and Telecom Agency employs an even simpler definition. Denmark’s Ministry of Science, Technology and Innovation drew up an Action Plan for Green IT as a way of making it easier for citizens, businesses and public authorities to choose energy-efficient IT solutions. This action plan is also referred to on the United Nations Climate Change Conference (COP15) website. Green IT is defined here “as research in and use of IT in an efficient and environmentally friendly manner”. In the same location a diagram (figure 2.2) is supplied, illustrating how Green IT should involve several phases in the lifestyle of a product.



**Figure 2.2: Green IT in Several Phases of Product Lifestyle**

Similar to figure 2, a Forester presentation in 2007 named “What Green means for IT” included a diagram (figure 2.3) showing how Green actions can affect the whole product life-cycle. This diagram provides more specific information than figure 2.2 regarding what can be done in each lifecycle phase. This thesis study will touch on the disposal phase but will concentrate mainly on the operation phase.

IT energy consumption can make up 10% to 30% of a firm’s office operations (<http://www.greenittools.com>). According to the World Computer Exchange, up to 40% of heavy metals in landfills come from electronic equipment (<http://www.worldcomputerexchange.org>). There are many Green IT initiatives that

involve small simple changes, are easy to implement and cost very little or nothing at all. Pratt (2008) dubs these easy to make changes as ‘low hanging fruit’. An article titled “Gathering Green Low-Hanging Fruit for Today and Stretch Goals for Tomorrow, to Save you Green by Going Green” by Pratt published in Computer World magazine on the 8<sup>th</sup> September, 2008, described this fruit as limiting paper use and using power management tools

<p><b>Design</b></p> <ul style="list-style-type: none"> <li>• Increase power efficiency</li> <li>• Improve power handling</li> <li>• Design for the environment</li> </ul>	<p><b>Manufacture</b></p> <ul style="list-style-type: none"> <li>• Cleaner manufacturing processes</li> <li>• Apply CSR principles to suppliers</li> <li>• Reduce use of hazardous substances</li> <li>• Minimize transport &amp; packaging impacts</li> </ul>
<p><b>Operation</b></p> <ul style="list-style-type: none"> <li>• Manage IT energy usage, in the data center and beyond</li> <li>• Actively manage environmental information</li> <li>• Implement green sourcing criteria</li> <li>• Source sustainable energy</li> </ul>	<p><b>Disposal</b></p> <ul style="list-style-type: none"> <li>• Reuse and refurbish systems</li> <li>• Recycle systems at end-of-life</li> <li>• Recycle consumables</li> </ul>

**Figure 2.3: Green IT Action Across the Product Life-Cycle**

**Source: Davis (2007 p.15)**

Every year the US devours million tons of copy paper, 2 billion books, 350 million magazines and 25 billion newspapers which results in paper manufacturing operations producing carbon dioxide and deforestation (Pratt 2008). Pratt (2008) cites London-based BT Group PLC as a company that embraced paper use reduction by setting printers to automatically use both sides of paper and moved printers from desktops to central office locations. According to the UK government advisory group Envirowise, power consumption is the largest controllable outgoing of any office (Young 2006). When evaluating power management tools, Pratt (2008) refers to Climate Savers Computing Initiative recommendation, i.e. set monitors to sleep after 15 minutes of inactivity and set system standby to occur after 30 minutes. Much of the thesis will focus on this ‘low-hanging fruit’.

Reducing computers energy consumption can have a positive outcome on an organisation’s electricity bill since as much as 55% of IT power usage is estimated to come from peripherals and PCs (Wass 2009). Examples of some third party power

management software packages are Surveyor software from Verdiem, Intel's vPro, Nightwatchman, energy star EZ GPO and Auto Shutdown PC Genius. Hardware vendors and Microsoft Windows provide their own built-in power management tools. Five clear reasons to adopt Green IT are listed in a 2007 Forester Research presentation (Davis 2007, p.9). These are:

1. To reduce the impact of energy consumption
2. To reduce costs of energy consumption
3. To meet customer expectations
4. To meet employee expectations
5. To stay ahead of forthcoming regulations

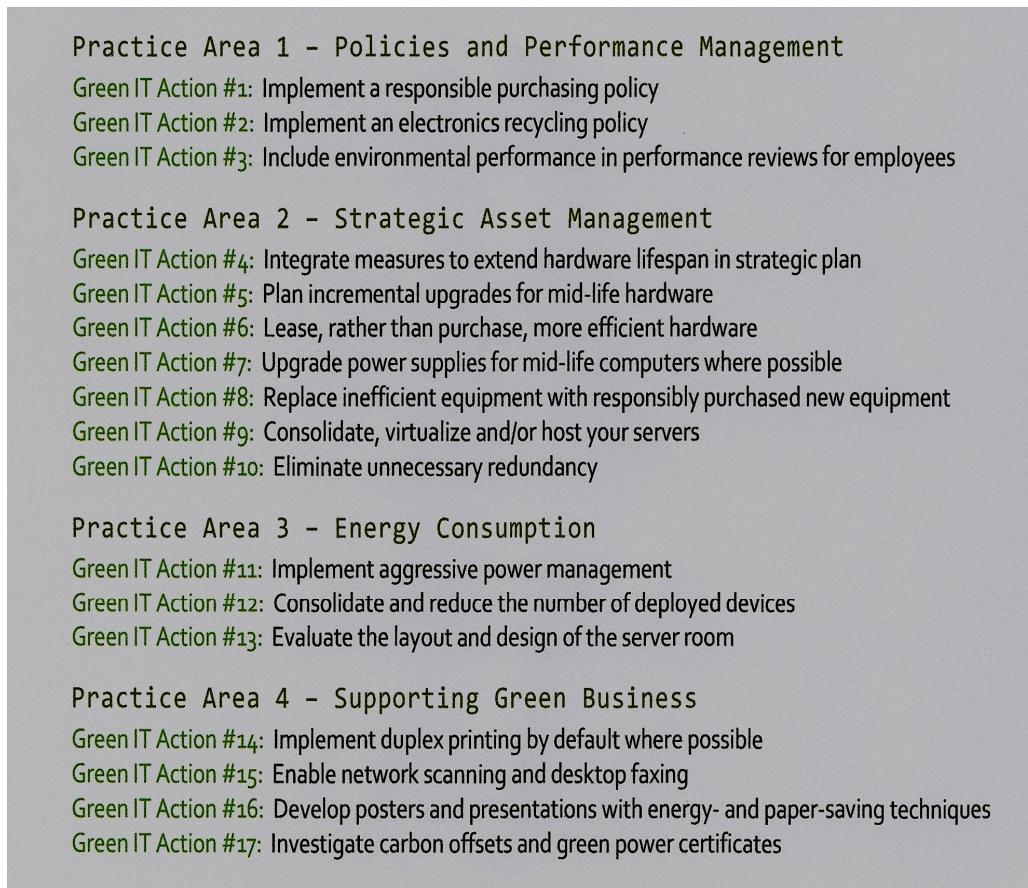


**Figure 2.4: What are Green IT Solutions**

**Source: Davis (2007, p. 18)**

While reviewing the literature on Green IT, the author found it difficult to devise a definitive list of Green IT practices. The two diagrams figure 2.4 and 2.5 were deemed to be the most successful in granting the reader an overview and clear understanding of what operations can attach the label Green IT.





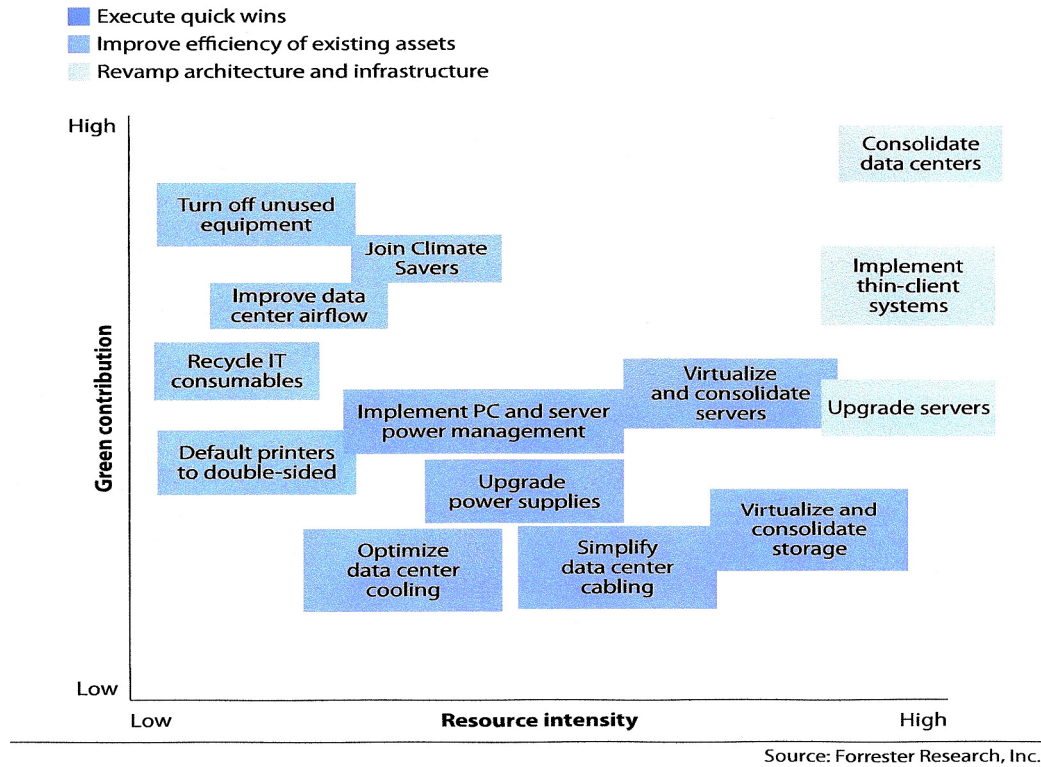
**Figure 2.5: Complete List of Green IT actions**

**Source: Terrabytes Consulting (2009)**

The low-hanging fruit concept referred to by Pratt (2008) was previously mentioned by Mines et al (2007, p.6) and he called the same thing ‘quick wins’. In Figure 2.6 these quick wins or ‘low-hanging fruit’ can be seen plotted low to medium on the x-axis i.e. resource intensity and correspondingly plotted medium to high on the Y axis i.e. Green contribution. Mines also spoke of defaulting printers to double-sided and turning off unused equipment. He added in improved data centre or server room airflow, recycling IT consumables and joining Climate Savers.

Green IT interest is accelerating in organisations primarily as a result of accelerating energy costs. Many organisations now have greater grasp of what Green IT means and are beyond the investigation stage of what can be done (Mines et al 2008 p.1). However, there may be a strong divide between understanding and actually implementing Green IT. A survey carried out by Business Information Systems (BIS)

group at University College Cork (UCC) found that few of the top 500 Irish organisations currently have Green IT policies in place (Doyle 2009).



**Figure 2.6: Mapping The Cost-benefit of Green IT Activities**

**Source: Mines (2007, p. 11)**

The research findings from this thesis may agree with Christopher Mines of Forrester Research that organisations have greater understanding of Green IT or may indicate the opposite as in awareness of what is actually Green IT may still be poor among firms. IT departments have an opportunity to start the overall Green movement of a firm as opposed to it being pushed onto them from the top as “another thorny project” (Mines et al 2007, p.3). Gaining employee buy-in can be an issue. According to Gartner Research’s Millman many employees are too set in their ways (Chapman 2009). Centrally controlled power management settings and defaulting automatic duplex printing is suggested as the best way to implement some Green IT initiatives. Bruno Zago, HP's environmental manager for Britain and Ireland quotes Lenin on this, which is: “Trust is a nice thing but control is better” meaning he advises the IT

department to bypass appealing to users' better nature and force them to comply with new Green ways of working (Chapman 2009).

### **2.3.1 Benefits of Green IT**

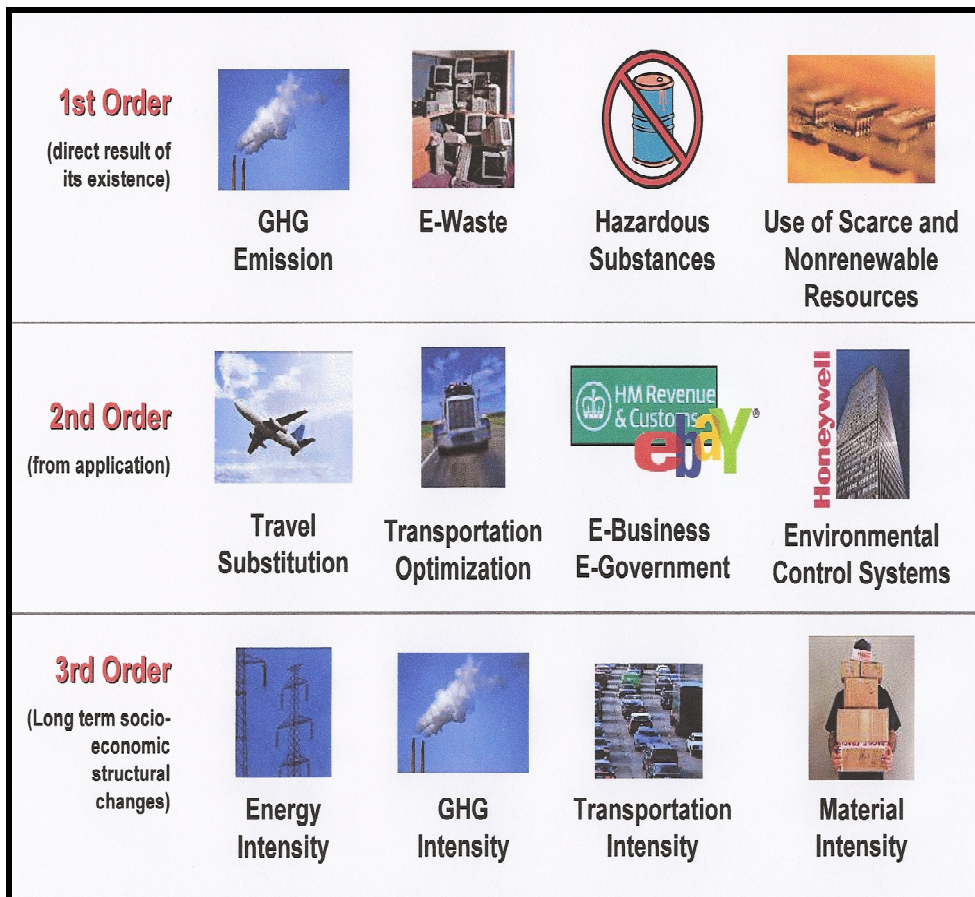
The following 5 main benefits of Green IT will be discussed. These are; benefit to the environment, cost-savings and cost-avoidance, compliance with regulations, benefit to organisation's reputation and improved efficiency.

#### **2.3.1.1 The Environment**

Green IT aims to minimise the use of hazardous materials, maximise energy efficiency and promote recycling and/or use of biodegradable products without negatively impacting productivity (Littlejohn Shinder 2008). Varying views may exist on environmental issues, but nearly everyone is in agreement, that something must be done to reduce the negative impact on the environment (Gonzalez 2009 p.3). Figure 2.7 indicates the first, second and third order of effects on the environment from IT. This figure is adapted from a Gartner presentation in 2007 by Simon Mingay. It gives an excellent instant visual overview of the knock-on effects of IT on the world's environment.

Predictions by many researchers such as Simon Mingay of Gartner, say we are heading towards a low-carbon economy (Hiner 2008). Simon Mingay of Gartner defines a low carbon economy "as an economy in which the growth of greenhouse gas emissions is halted and reduced, and in which greenhouse gases have a cost and/or are capped, enforced through one or more measures". Kyoto is one such measure (Hiner, 2008). Hiner (2008) believes reducing carbon dioxide (CO<sub>2</sub>) emissions and electronic waste could shortly become economic necessities, "if and when governments start regulating them and associating fines for non-compliance". Manufacturers are now producing products that require less power and they also employ better energy-efficiency manufacturing processes that emit less CO<sub>2</sub> ([www.industryweek.com](http://www.industryweek.com)).





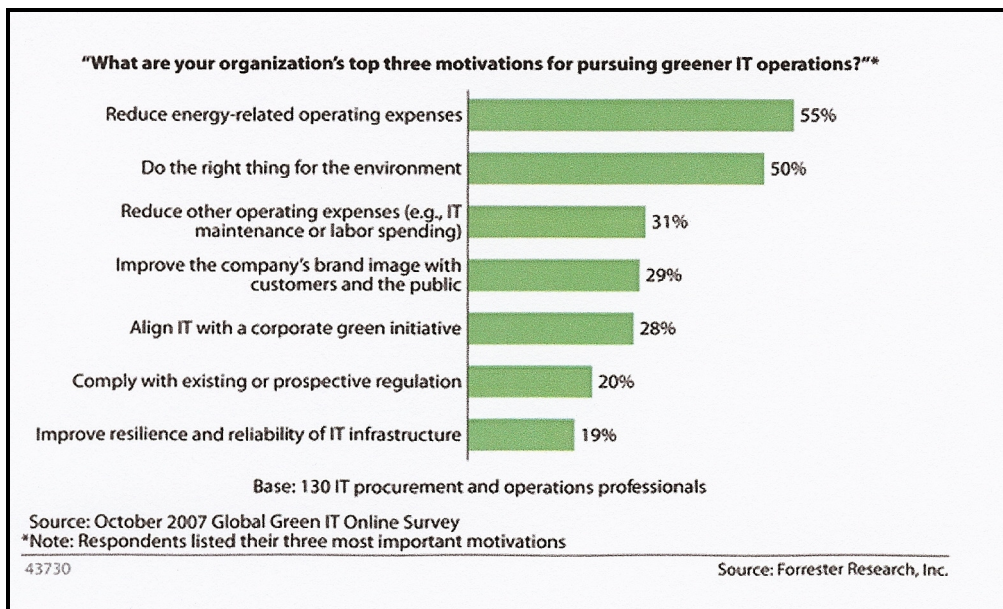
**Figure 2.7: The Effects of IT on Environmental Sustainability**

**Source: Mingay (2007)**

Two percent of the refuse landfills in the U.S. are electronic waste. However, 70% of overall toxic waste comes from discarded electronic equipment ([www.industryweek.com](http://www.industryweek.com)). Green IT advocates the safe and proper recycling of IT equipment i.e. reuse, repurpose and recycle. This means reducing the load on already heavily burdened landfills and avoiding sending harmful toxic materials to landfills (Littlejohn Shinder 2008, p.1). Some computer vendors have schemes in place to take back computers and peripherals for recycling (Littlejohn Shinder 2008). Providing an IT infrastructure that enables video-conferencing facilities can bypass the need to commute to meetings, saves on travel time, saves fuel and saves on “the wear on the world’s travel infrastructure” ([www.industryweek.com](http://www.industryweek.com) 2008). An IT infrastructure that enables employees to home-work offers similar advantages for the environment such as reducing the office lighting and heating bill.

### 2.3.1.2 Cost Savings and Cost Avoidance

The most celebrated benefit of Green IT is the cost-saving aspect. The U.S. Postal Service is reported to have made savings of \$2.25 million from implementing Green IT practices (DiRamio 2009). Back in 2007, the results of a Forrester global Green online survey indicated that reducing energy costs was the biggest driver for organisations in relation to Green IT. See Figure 2.8. In February 2009, the results of another survey were published by Computer Associates (CA). These findings indicated that the “biggest influences to adopting Green technology were the cost-saving implications” (Knight 2009). These findings were consistent with Forrester survey results from two years earlier.



**Figure 2.8: October 2007 Global Green IT Online Survey**  
**Source: Forrester Research, Inc summarised in Ashford (2007)**

In February 2009, Reuters a global provider of news and information, published the findings of their Business Insights report. It examined the impact that businesses and IT have on the environment. The key findings were displayed on the 23<sup>rd</sup> February 2009 in an article titled “What is Green IT? Implementing Green IT, Discover the Cost-Effective Benefits” on Reuters website [www.reuters.com](http://www.reuters.com).

These findings are:

- Total global energy demand is predicted to increase by 60% to 2030, with emerging economies, China and India together accounting for 45% of this increase.
- Switching to ‘Green’ energy-efficient PCs and turning off PCs at night would equate to annual savings of around £305,000 for a typical FTSE 200 company. Computers with ‘sleep’ mode use 60% to 70% less energy than PCs without, equating to \$15-\$40 savings in energy costs per PC per year.
- Worldwide data centres waste 875m kWh of energy every year an equivalent to 436m kilograms of CO<sub>2</sub>. The number of servers in data centres is increasing annually by 18%. Virtualization of servers in the data centre can increase efficiency, reduce power consumptions and result in important cost savings.

The main driver behind organisations’ adoption of Green IT appears to be the potential for cost-savings. To quote Bruno Zago of HP from the Sunday Business Post Sunday 7<sup>th</sup> June of this year, “you will only get a customer to invest in Green IT if they can see a financial incentive to do so”. A 2008 PriceWaterhouseCoopers survey of 148 technology company executives illustrated that economic rather than philanthropic reasons have been the motivation behind Green IT initiatives (DiRamio 2008). It’s actually the repugnance of increasing energy bills that is driving change (DiRamio 2009).

According to Frank Gens, IDC senior vice president of Research, “once a distant afterthought, economic advantages, including reductions in operations costs, are driving Green IT adoptions” (<http://cio.tekrati.com> 2007). Fortunately, these Green IT initiatives, driven purely by the potential to save money, tend to be beneficial for the environment as well (Gralla 2008). Gralla (2008) conjures up the very fitting label ‘accidental environmentalist’ for those IT managers whose primary concern is the bottom line but end up Greening their IT infrastructure at same time.

Much recent research from IDC, Gartner and Forrester has indicated that strong links exist between environmental sustainability and profitability. Rakesh Kumar of Gartner Research states that companies now spend 10% of their technology budgets on energy and this is a reason behind the growing interest in energy-efficient products (DiRamio 2008).

Some companies use IT to enable Greener operations. One such company is UPS the world's largest package delivery company. By using IT they managed to modify their transport software to “reduce the number of left-hand turns the trucks would make on their routes” (Salomone 2008 p. 29). As stated by to a New York Times article, this decrease in left hand turns saved the company “roughly three millions gallons of gas and has reduced CO2 emissions by 31,000 metric tons” (Salomone 2008, p. 29). John Madden of Industry Analyst Ovum advises IT professionals to reinforce the cost saving element of Green IT when putting it to a company board (Murray 2007). He recommends explaining to them the implications of using inefficient technology and the “ability to invest in other areas is impacted because of the need to invest in rising energy costs” (Murray 2007).

### **2.3.1.3 Comply with Regulations**

It is strongly predicted that organisations, specifically IT organisations, will come under scrutiny for their practices in relation to Green IT (Hiner 2008 p.2). Rakesh Kumar of Gartner believes that “the Green issue is not going to go away as there is too much at stake” (Pratt 2009). In Ireland, the main legislation in relation to Green IT is the WEEE Directive 2002/96/EC, an EU Directive founded on the principle of "Producer Responsibility" (<http://www.weeeireland.ie>). The Waste Electrical and Electronic Equipment (WEEE) means producers, manufacturers and distributors are responsible for their products once they turn into waste. The WEEE Directive covers 10 categories of Electrical and Electronic Equipment. IT and telecommunications equipment falls into one of these categories. WEEE aims to prevent waste of electrical and electronic equipment and to advocate the reuse, recycling and recovery of such wastes (<http://www.weeeireland.ie>).

Producers, retailers and consumers (business and private individuals) are obliged to abide by the WEEE legislation. The Environmental Protection Agency and local authorities have responsibility for enforcing different aspects of the WEEE Regulations (<http://www.epa.ie>). WEEE also means many manufacturers and retailers must take back products for recycling. Businesses are required to do the right thing and bring old IT discarded equipment when to civic amenity sites that are provided by the local authorities so that it can be disposed of in a proper manner. This

service is free for private individuals but businesses have to pay for same (Geaney 2009).

#### **2.3.1.4 Enhance the Organisations Reputation and CSR Status**

TechRepublic's article titled 'Cashing the Check on Green IT' notes that the 'Greenness' of an organisation has become a competitive differentiator for some like Google, Microsoft and Sun. Organisations are often seen bragging about their Green commitments as it presents an opening to save money as well as do the right thing (<http://downloads.techrepublic.com.com>).

However in relation to SMEs, CSR can be a tricky issue. They are often more worried about survival than being seen doing the right thing. There are sometimes dubious of the benefits of CSR. It is acknowledged by many that SMEs have restrictive resources and so cannot be expected to operate CSR practices, which were created for large companies and are impractical for SMEs (Roach 2002). Studies have shown links between good CSR and profitability and that both customers and employees both prefer environmentally aware companies. Dave Stangis, former Director of CSR at Intel considers CSR, sustainability and Green as the key components for success in business in the 21<sup>st</sup> century as opposed to just being nice supplements (Shah 2009).

#### **2.3.1.5 Improved Efficiency and Productivity**

Steve Palmer, president of SOCITM, a professional association for ICT managers in the public sector in the UK, notes that going Green can improve the quality and delivery of frontline services as well as cut costs (Kobie 2009). Until recently most companies only considered the initial acquisition costs when purchasing servers and client PCs. The total cost of ownership (TCO) was not considered. TCO of IT equipment is a combination of the cost of deploying, maintaining, disposing, of electricity consumed and the cooling costs employed (Carter 2008). Now and in the future performance per watt is becoming a decisive factor in the performance of hardware. Green IT can streamline IT processes. For example, by replacing local desktop printers with centrally located multifunctional devices that offer print, fax, scan and copy facilities all in one, higher utilisation of IT equipment is achieved. Green tactics can make your operations more efficient (Littlejohn Shiner 2008).

### **2.3.2 Barriers and Challenges to Green IT**

Being aware of potential barriers and inhibitors to Green IT is vital (Mines, et al 2007, p.5). Mines et al (2007, p.5) advise that both behavioural and procedural inertia should be anticipated in advance.

#### **2.3.2.1 Culture**

Deal and Kennedy (1982) define culture as “the way we do things around here.” Ray (1986) believes that culture enables resistance to change. To overcome an organisational culture where the business does not care about being ‘Green’, IT managers are advised to push the cost savings aspect of Green IT (Washburn, 2009). The financial benefits, as opposed to the intangible environmental benefits, often have more persuasive power. Often renaming Green IT as ‘energy-efficient’ IT or Lean IT will help create a better business case (Washburn, 2009).

#### **2.3.2.2 Costs**

Being environmentally friendly has the perception of costing more. Although certain Green IT initiatives can cost there are actually several that are free. Pratt (2008) describes these as power management tools and reducing paper use. General Electric saves €2.5 million per year as a result of enabling existing power management settings (Washburn, 2009).

#### **2.3.2.3 Prioritisation**

A way to overcome the barrier of the complexity involved in deciding on where to start in the organisation’s Green IT project e.g. PCs, servers or printers, is to have a Green IT baseline (Washburn, 2009). A Green IT baseline will give the firm a good estimation of how much energy is consumed by IT and where to start making savings in that consumption.

#### **2.3.2.4 Budget Ownership**

The energy budget may be shared with or owned by another functional department (e.g. facilities). If an IT manager believes that Green IT can positively benefit the bottom line of the firm then they are advised to use the hard data from the Green IT baseline to convince other departments to collaborate (Washburn, 2009).

## 2.4 Greening the IT infrastructure of SMEs

Green IT is applicable to all size organisations. According to Climate Savers Computing Initiative (2009), “the average desktop PC in use, wastes nearly half the power it pulls from the wall – and there are currently over 1 billion PCs in deployment globally and 2.25 billion expected by 2015”. Started by Google and Intel in 2007, the Climate Savers Computing Initiative is a non-profit group of environmentally-conscious consumers, businesses and conservation organisations. David LaGesse agrees with Climate Savers in his article called “The PCs Dirty Little Secret: It wastes Power Shamelessly” featured on <http://www.usnews.com> on the 17<sup>th</sup> April 2008. “Most consumers don't think of the computer as a place to start in saving energy,” says Barbara Grimes of Climate Savers Computing Initiative.

*“SMEs comprise the fabric of all societies. Change their attitude towards the environment and we have a chance to achieve sustainable development. Ignore them and we all suffer.”*

Hillary (2000)

According to Groundwork (1998), SMEs make up 99.8% businesses in the UK alone (Taylor et al 2003) and Stokes and Rutherford (2000) claims they “are providing around 60% carbon-dioxide emissions” (Taylor et al 2003). Wilson (2001) claimed in “The Development of SMEs in Ireland and SME Support” that in 2001 there was 160,000 SMEs registered in Ireland. 98% of all non-agricultural employment in Ireland is in SMEs with less than 50 people and turnover of less than €4 million per annum (Wilson, 2009). SMEs represent 99% of the total enterprises in the European Union (Commission 2003).

	Head Count	Annual turnover	Annual Balance sheet
Medium	<250	<€50 Million	<€43 Million
Small	<50	<€10 Million	<€10 Million
Micro	<10	<€2 Million	<€2 Million

**Table 2.1: European Commission SME Definition**

**Source: European Commission (2003), summarised in Nicholas et al, (2008)**



With such a high number of SMEs in operation in the European Union, their impact on the environment is therefore an important consideration (Taylor et al, 2003). Table 2.1 shows the threshold limits for micro, small and medium sized enterprises as defined by the European Commission (2003).

Revell (2004) conducted research in collaboration with Professor Robert Blackburn at Kingston's Small business Research Centre. The findings of the research were reported in an article titled "SMEs Not Convinced of Need to Go Green". Revell (2004) spoke about the ecological footprint of SMEs being very significant and they are "estimated to be responsible for 60% of commercial waste and eight out of 10 pollution accidents".

ISME head of Research, Jim Curran (2009) advises that "rebuilding confidence is the key to ensuring SMEs are able to survive" these current difficult economic times of 2009. Curran (2009) believes "this requires the introduction of workable policies... to create the right conditions for SMEs to prosper". A Green IT policy would be worth including in these above mentioned workable policies, one that is driven by potential cost-savings and cost-avoidance initiatives.

For the purpose of this literature review, the author will include literature regarding SMBs as in small medium sized businesses as well as literature on SMEs. The SMBs arguments correlate with the SMEs case. However, the author feels obliged to highlight to the reader that the SMEs and SMBs definitions shows that they mean different things. Whatis.com defines SMB as an abbreviation for small and medium-sized business, sometimes seen as small and midsized business. In relation to SMBs, "A business with 100 or fewer employees is generally considered small, while one with 100-999 employees is considered to be medium-sized" (Whatis.com). SME is an abbreviation for small and medium-sized enterprise. A SME can have up to 250 employees.

An IDG white paper titled "SMBs make strides as Green IT Moves forward" by Carol Hilderbrand published in February 2009, concludes that SMBs show better understanding of the business value of Green IT than in previous years. The results of a 2009 survey from IDG Research are outlined in this white paper. It outlines that



overall SMBs are tackling more-complicated and more-strategic Green IT projects that they had in the past. For example, SMB rates have risen in the following areas (Hildebrand, 2009, p5):

- Consolidating server/systems (40 to 44%)
- Using energy-efficient servers (63-70%)
- Educating employees/business about energy use (31 to 34%)
- Upgrading to more-efficient computing technology (30 to 35%)
- Upgrading data centre cooling systems (16 to 18%)

She concludes in this white paper that enterprise or larger companies have generally embraced Green IT earlier than SMBs as they have the physical and financial resources to do this. However, SMBs are covering more ground now than ever in their Green IT journey (Hildebrand, 2009). Hilderbrand's comparison of survey results with previous years indicated this and also that there is an increased awareness of the benefits of Green IT within the SMB community.

An article titled "Dell pushes the Green revolution to SMBs" by Tuazon published on InfoWorld (<http://www.infoworld.com/>) on the 9<sup>th</sup> June 2009, deliberated that going Green "was not only good for the environment but also fundamental for small businesses" as it can help save money. In the same article, Raymond Biggs vice president for small/medium business and home office research, IDC (2009) notes that "this is not 'tree hugger' Green, this is 'save money' Green, driven by the cost-saving benefits of adopting Greener technology".

Taylor et al (2003) document their findings in the paper titled "Achieving 'sustainable business': a study of perceptions of environmental best practice by SMEs in South Yorkshire". This paper showed that SMEs had low awareness levels of environmental impact. While in 2009 an IDG survey comparison conveyed that SMB familiarity with Green IT has grown by 8% in only four months. This statistic contrasts favourably with the previous findings of Taylor et al. The same IDG white paper goes on to say that this increased interest from SMBs in Green IT, is driven by the bottom line.

Taylor et al (2003) investigated the issues of sustainable business and environmental best practice within SMEs in South Yorkshire. Many businesses are oblivious to the significance of sustainability and the abstract image of this issue does not assist businesses to grasp its meaning and significance (Taylor et al 2003). Taylor et al's findings go some way towards understanding the relationship that exists between Green IT and SMEs. Groundwork (1998) says only 12% of SMEs thought that better environmental practice would save costs (Taylor et al 2003). The importance of encouraging SMEs to expand their environmental performance is now well recognised (Sherlock et al 2000). Sherlock et al (2000, p.51) outline possible explanations for SMEs reluctance to change in relation to environmental practices. These are:

- A lack of environmental awareness
- Limited access to resources (e.g. finance, expertise and information: O'Laoire and Welford 1996)
- Inappropriate environmental management techniques (Gibb and Davis)

Sherlock et al (2000, p.59) conclude that attempts to raise environmental or Green awareness must happen in conjunction with government policy and accompanying funding that "recognises environmental improvements as a key issue for business competitiveness". Hitchens et al (2003, p.55) declared in their paper "Competitiveness, Environmental Performance and Management of SMEs" that there was no convincing evidence that "firms with a better economic performance adopt more environmental initiatives". Their study showed that firms that improve their environmental performance do not always result in a positive economic outcome. This heavily contradicts the mantra that is being shouted since 2007 that being Green is not only good for the environment but good for business. Having said that, the reader should bear in mind that customers, employees, employers, supply chain partners and the public in general have become far more environmentally conscious and eco-sensitive since Hitchens et al's paper.

Both Pesonen (2001, p.45) and Sherlock et al (2000, p.51) allude to lack of resources as a reason why environmental improvements may be inhibited. Hillary (2004) echoes this resource limitation challenge (Studer et al 2008, p.286). Pesonen (2002, p.45)

cites lack of capacity and capabilities as added factors. Engaging SMEs with environmental change is a long-term process (Studer et al 2008, p.299)

## **2.5 Metrics for Green IT**

Steve Sams, vice president of site and facilities at IBM believes “energy is the new IT operational metric” (<http://cim.pennnet.com>, 2009). The motto you cannot manage what you cannot measure is true when it comes to Green IT. A business needs to know its baseline electricity usage by its IT equipment (Velte et al 2009; Mines et al 2007, p.5). To do that, facilities and IT should collaborate. Outside help from an electrician and the use of plug in energy monitors can also assist in this job. Companies should include all IT equipment assets, both in and outside the data centre or server room (Mines et al 2007 p.5).

For the data centre (also called server or comms room) businesses should assess the ratio of total power into the data centre over the power that gets to the computing systems (Mines 2007 p.5). The remaining power goes for auxiliary equipment including distribution, lighting and cooling (Mines et al 2007, p.5). The Green Grid, a global consortium of IT companies and professionals looking to improve energy efficiency in data centres (<http://www.thegreengrid.org>; Velte et al. 2008, p.255) defines this power usage effectiveness (PUE) ratio as:

**PUE = total facility power/IT equipment power.**

Another important metric is the Datacentre Efficiency (DCE) ratio (Velte et al 2008 p.256):

**DCE = IT equipment power/total facility power.**

The total facility power is the power as it is measured at the meter for the data centre or server/comms room.

Regarding client computing Carter (2008), of IDC recommends developing return on investment (ROI) and total cost of ownership (TCO) models for PCs that includes

electricity consumption. IT managers should be considering metrics in terms of materials used, recyclability and energy efficiency of all its IT hardware and think beyond the initial cost of devices (Carter 2008 p.19). Terrabytes Consulting (2009, p.11) recommend three strategies for measuring an organisation's overall IT equipment which are as follows:

- Estimate energy consumption: use hardware specification to develop consumption based on each type of device.
- Manually collect energy consumption data: measure a sample of computers and monitors using a plug-in monitor device. Terrabytes Consulting (2009, p.11) recommend one called a kill-a-Watt device. The author is aware of such plug-in devices on sale in Ireland from Maplin Electronics.
- Automated data collection: this option requires a capital investment to purchase computer power management software that will automatically track power consumption of all networked devices. This option also includes getting an electrician to analyse the server room or data centre (Terrabytes Consulting 2009, p.11).

Once a baseline has been established, then the performance metrics can be selected. The Green IT performance metrics that an organisation chooses will often depend on its audience (Terrabytes Consulting 2009, p.11). Terrabytes Consulting (2009, p.14-16) suggests some performance metrics in the Green IT Guide. Servers per employee, print devices per employee, IT energy consumption per employee, IT energy consumption per workstation, pages printed per employee and paper waste per employee are to name but a few (Terrabytes Consulting 2009, pp.14-16).

## **2.6 Standards, Regulations and Certifications**

Electronic waste, commonly referred to as 'e-waste', is any refuse created by the discard of these electronic devices as well as substances involved in their manufacture or use (<http://www.worldcomputerexchange.org/ewaste>). Understanding e-waste and the negative implications and dangers associated with it can help businesses and individuals appreciate the need to reduce it and avoid it ending up in landfills. Once in a landfill toxins from the e-waste can seep into soil and water supplies. The world

produces about 40 million tons of PCs, cathode-ray tube (CRT) screens, fax machines, games consoles, mobile phones and other e-waste annually (Kirkke 2008, p.50). According to Kirkke (2008, p.50), only 20% of this toxic waste is disposed of properly or recycled. E-waste is regularly exported by developed countries to developing ones, often in breach of international law (<http://www.greenpeace.org>). Philip Carter outlined in an IDC report published September 2008, four areas of regulations and standards that businesses and the general public should know about in relation to Green IT. These four areas are:

### 2.6.1 General

According to <http://www.epa.gov>, Electronic Product Environmental Assessment tool (EPEAT) was established in 2006 in response to growing demand by institutional purchasers for an easy-to-use evaluation tool enabling them to compare electronic products based on environmental performance, in addition to cost and performance considerations. EPEAT was developed using a grant by EPA and is managed by the Green Electronics Council (GEC) (<http://www.epa.gov>). EPEAT is an online tool that can be used to compare computer desktops, laptops and monitors based on their environmental attributes (<http://www.epa.gov>). The EPEAT tool is free and open to any purchaser, including individual consumers and small business purchasers (<http://www.epeat.net>). Jeff Omelchuck, Executive Director of EPEAT is quoted as saying “EPEAT’s mission is to make Green IT purchasing simpler and more transparent,” in a press release titled “Tech Data and EPEAT® Partner on Green IT Purchasing Efforts” published on the 8<sup>th</sup> April 2009 on the EPEAT web site. Table 2.2 (Velte et al 2008, p.152) shows the three levels of EPEAT certification.

Certification Level	Requirements
Bronze	Product meets all required criteria.
Silver	Product meets all required criteria plus at least 50 percent of the optional criteria that apply to the product type being registered.
Gold	Product meets all required criteria plus at least 75 percent of the optional criteria that apply to the product type being registered.

**Table 2.2: The three levels of EPEAT certification**

**Source: Velte et al (2008 p.152)**

### **2.6.2 Materials**

The Restriction of Hazardous Substances (RoHS) directive originated in the European Union and restricts the use of specific hazardous materials found in electrical and electronic products (<http://www.rohsguide.com>). Since 1<sup>st</sup> July, 2006, all applicable products in the EU market must pass RoHS compliance (<http://www.rohsguide.com>). Velte et al (2008 p.35) lists the six hazardous materials that are restricted in the manufacture of certain types of electronic equipment:

- Lead
- Mercury
- Cadmium
- Hexavalent chromium
- Polybrominated biphenyls (PBBs)
- Polybrominated diphenyl ether (PBDE)

### **2.6.3 Disposal**

The WEEE Directive 2002/96/EC mandates the treatment, recovery and recycling of electric and electronic equipment (<http://www.rohsguide.com>). Each country has adopted varying versions of the WEEE Directive, resulting in different rules and regulations existing across Europe (Velte et al 2008 p.36). Table 2.3 demonstrates these variances in European RoHS and WEEE laws. Kobie (2009) noted that in the UK the WEEE directive was not well understood by many consumers. Research from Dell indicated that the WEEE has been a “source of confusion” since it was launched in the UK resulting in the UK consumers ranking as “the worst tech recyclers” in Europe (Kobie 2009).

### **2.6.4 Energy Efficiency**

Energy star is a voluntary energy efficient program sponsored by the Environmental Protection Agency (EPA) in the U.S (<http://www.hp.com>). The Energy Star symbol is well-known. Computers and monitors have been certified under the energy program since 1992, printers since 1993 and faxes since 1994 (<http://www.energystar.gov>). In

May of this year the EPA rolled out the release 1.0 of the Energy Star for Servers specification (Prickett Morgan 2009). In order for a computer to be energy efficient (Energy-Star rated) it needs to meet the criteria outlined in Table 2.4 (Velte et al 2008, p.154). The website <http://searchdatacenter.techtarget.com/> states that the Energy Star symbol has become the international symbol for energy efficiency since the European Union adopted it in 2007 and Australia and New Zealand has already adopted the program. Climate Savers Computing web site claims a “A new Energy Star compliant PC or laptop uses 15 to 25 percent less energy on average than a standard new computer”.

80 PLUS is an electric utility-funded incentive program that aims to integrate more energy-efficient power supplies into desktop computers and servers (<http://www.80plus.org>). It demands computer power supply to be 80% efficient or better at 20%, 50% and 100% of rated power and to have a power factor of at least 0.9 (Chin, 2008). According to Chin (2008) practically every major computer manufacturer in the US is now using 80 Plus approved power supplies for some of its products. The efficiency of a computer power supply is the amount of energy it supplies, divided by how much energy is input. Energy Star's Computer Specification (V4) includes 80 Plus power supply requirements for desktop computers (Chin, 2008).



Country	Legislation Adoption Date	Details
Poland	October 20, 2005	<p>Polish law requires producers to register with the government. Fees are calculated according to a producer's annual net turnover. Producers also must keep data and information regarding users and treatment facilities.</p> <p>In Poland, point-of-purchase is considered when goods enter the Polish market, offering a narrower definition than under the EU WEEE Directive.</p>
Slovak Republic	April 29, 2005	Slovak law provides for a recycling fund into which producers pay quarterly, based on the difference between the recovery target and their actual recovery rate.
Slovenia	November 2004	Slovenia was granted a grace period until December 31, 2007 to meet EU WEEE Directive collection goals.
Spain	February 25, 2005	<p>Producers may fulfill their WEEE obligations individually or through a collective plan.</p> <p>Spain's WEEE law requires producers to design and manufacture equipment that is easier to dismantle, repair, and reuse.</p>
Sweden	2005	Swedish law requires producers to register with the EPA, finance the collection, recovery, and recycling, as well as mark new equipment for the Swedish market.
Switzerland	June 2005	<p>Switzerland had legislation in place in 1998.</p> <p>Its version differs from the EU's WEEE Directive in that buyers of EEE pay a recycling fee to finance collection and treatment.</p> <p>Retailers, distributors, producers, and importers are required to take back WEEE of the kind of goods they market, manufacture, or import.</p>
United Kingdom	January 2, 2007	<p>The law requires manufacturers to recycle and dispose of used electronic equipment.</p> <p>Plans include a national Distributor Takeback Scheme, with treatment facilities to handle recycling and keep producers informed of returned products.</p>

**Table 2.3: Variances in European RoHS and WEEE Laws**

**Source: Velte et al (2008, pp.37-39)**



Country	Legislation Adoption Date	Details
Austria	April 2005	Austria's WEEE ordinance requires that producers register, mark new equipment for the Austrian market, and finance the collection, recovery, and recycling of WEEE.
Belgium	2004	Belgium is one of three European nations that implemented electronic waste disposal legislation prior to the EU WEEE Directive, but changed its legislation to include the EU's mandates.
Cyprus	July 2004	Companies importing or retailing electronic equipment must register with the Environmental Service.
Estonia	April 2004	Regulations set requirements and procedures for marking electronic equipment, targets for collection, and recovery or disposal of equipment.  Estonia has been granted a grace period through December 31, 2008 to meet collection deadlines.
France	November 2006	The French decree implements the concept of producer responsibility for WEEE, and imposes WEEE takeback and recycling obligations. The decree imposes requirements with respect to product design, collection, recovery, financing, marking, and reporting. All producers are responsible for the collection and treatment of household WEEE.  The decree also establishes penalties for noncompliance.
Germany	March 2005	Producers or distributors of electronic equipment in Germany must register with a clearing house, a private institution operated and financed by producers. When registering, producers must provide a guarantee for the financing recycling costs and the type and quantity of electronic equipment that will be marketed, collected, recovered, or exported outside the European Union.  The law requires manufacturers to use the best available treatment, recovery, and recycling techniques in the disposal of WEEE.
Greece	March 2004	Producers and importers must hold a "certificate of alternative management," which varies depending on the territory in which the products are being marketed.  The Greek WEEE regulation varies from the EU directive with a directive that requires that costs for the treatment of WEEE must be clearly visible in all invoices issued throughout the distribution chain.
Hungary	August 10, 2004	Hungarian law requires producers to collect and treat an annually increasing percentage of the EEE they place on the market.  Producers must reimburse local authorities if they provide separate collection of WEEE from households.
Ireland	August 2005	Irish law requires producers and distributors of electronic equipment to register with the WEEE Register Society and join a compliance scheme to help meet their collection, recycling, and reporting requirements.  Producers are responsible for financing the takeback of WEEE.

**Table 2.3: Variances in European RoHS and WEEE Laws (Continued)**

**Source: Velte et al (2008, pp.37-39)**



Country	Legislation Adoption Date	Details
Italy	July 2005	<p>Italian law establishes a Supervision and Control of WEEE Management Committee that oversees a central Italian register and clearing house.</p> <p>Manufacturers fund the program according to their market share.</p> <p>Italian law also requires information to be supplied to consumers, such as the penalties for incorrect disposal.</p> <p>Producers must ensure recovery of at least 80 percent of end-of-life goods listed.</p> <p>Producers are required to register at their local Chamber of Commerce before placing equipment on the market. They must also provide a guarantee to ensure the financing of the proper disposal of EEE placed on the market after August 13, 2005.</p>
Lithuania	November 2005	Lithuanian WEEE legislation requires producers to register with the Environmental Protection Agency. Lithuania has been granted a grace period through December 30, 2008, to meet collection and recovery targets.
Luxembourg	January 2005	Luxembourg law requires all producers to register and provide a bank guarantee to cover WEEE management costs.
Malta	August 2004	Malta's law requires producers to finance collection, recovery, and recycling of WEEE. It also requires providing information to consumers about treatment sites. Producers should be able to fulfill obligations individually or through a collective.
The Netherlands	July 19, 2004	The Netherlands requires that producers guarantee they will finance the management of WEEE from private households for EEE placed on the market after August 13, 2005. Producers also must pay the costs of WEEE management in proportion to their market share for products placed on the market before August 13, 2005.
Norway	January 24, 2005	<p>Norway had enacted WEEE legislation in 1998, but amended its preexisting law with the EU's RoHS and WEEE.</p> <p>The law requires reporting obligations on manufacturers and importers.</p> <p>Producers and importers must be members of a takeback company that has been approved by the Norwegian Pollution Control Authority. Businesses can bring WEEE to dealers selling the same types of products, only if they make a new purchase. Businesses can also deliver WEEE to municipalities.</p> <p>Consumers can deliver WEEE free of charge to dealers selling the same types of products and can bring WEEE to municipalities, free of charge.</p>

**Table 2.3: Variances in European RoHS and WEEE Laws (Continued)**

**Source: Velte et al (2008, pp.37-39)**

Product Type	Tier 1 Requirements
Desktops, integrated computers, desktops-derived servers and gaming consoles	Standby (Off Mode): $\leq 2.0$ W Sleep Mode: $\leq 4.0$ W Idle State: Category A: $\leq 50.0$ W Category B: $\leq 65.0$ W Category C: $\leq 95.0$ W
Notebooks and tablets	Standby (Off Mode): $\leq 1.0$ W Sleep Mode: $\leq 1.7$ W Idle State: Category A: $\leq 14.0$ W Category B: $\leq 22.0$ W
Workstations	TEC Power (P <sub>tec</sub> ): $\leq 0.35 \times [P_{max} + (\# \text{ HDDs} \times 5)]$ W  Note: Where P <sub>max</sub> is the maximum power drawn by the system, # HDDs is the number of installed hard drives in the system.
Efficient power supply requirements	Internal power supplies: 80 percent minimum efficiency at 20 percent, 50 percent, and 100 percent of rated output and minimum Power Factor 0.9.  External power supplies: Either Energy Star qualified or meet the no-load and active mode efficiency levels provided in the Energy Start External Power Supply (EPS) specification.

**Table 2.4: Tier 1 Energy Efficiency Requirements Effective July 20, 2007**

**Source: Velte et al (2008, p.154)**

## 2.7 Conclusion

In summary, this chapter was an overview of the information and data relating to the research topic. As the name Green IT covers a multitude of areas, the researcher decided purposely to only include areas of relevance to this thesis. This means that areas like Greening your data centre or server rooms and virtualization were omitted

as these were deemed more suited to large organisations. In order to give the reader a good outline of the opportunities Green IT can bring to all sized organisations especially the cost-saving one, the author categorised this chapter into 6 suitable sections. These sections covered; a chapter introduction, Green technology in general, Green IT along with the benefits and challenges associated with it, Greening SMEs, Green metrics, Green regulations, standards and certifications and a conclusion. Much of the data available on this topic is provided by Research Institutions such as Forrester, IDC and Gartner. An obvious gap exists though when looking for a definitive Green IT framework suitable for SMEs. This study aims to close this gap and develop such a framework and in the process identify Green IT benefits and barriers while discovering the existing awareness and adoption levels of Green IT among SMEs.

## Chapter Three: Research Methodology

### 3.1 Introduction

Research is the “application of systematic techniques and methods in pursuit of answers to questions” (<http://www.esrcsocietytoday.ac.uk>). This chapter explains the research methodology chosen for use in the study and the rationale behind it. It also seeks to explain the research objectives. It begins with a statement of the primary and secondary questions to be addresses in the study and outlines the thinking and reasoning behind opting for the selected research methods.

### 3.2 Research Questions:

The study proposes to identify the Green IT practices most suited to SMEs dubbed ‘low-hanging fruit’ or ‘quick wins’. It aims to do this by evaluating the current awareness and adoption levels of Green IT among SMEs and by focusing on the benefits and identifying the potential barriers associated with Green IT. The author’s initial approach in carrying out this research involved reviewing a number of articles and reports on the topic of Green IT. The choice of a Green IT framework suitable for SMEs was chosen due to the researcher keen interest in the subject field. Her identification of a gap in the current literature regarding a definitive Green IT framework for SMEs was an additional reason for her decision to study this particular field.

The objective of the study is to address one primary research question:

*PQ1: “What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?”*

In addressing this primary question, the study will seek to answer the following related secondary questions:

*SQ1: “What levels of awareness currently exist regarding Green IT among SMEs?”*

*SQ2: “What are the levels of adoption that currently exist regarding Green IT among SMEs?”*

*SQ3: “What are the barriers to implementing Green IT in SMEs?”*

*SQ4: “What are the benefits SMEs can achieve by implementing Green IT?”*

### **3.3 Research Design**

Bryman and Bell (2003) defines a research method as “simply a technique for collecting data. It can involve a specific instrument such as self-completed questionnaires or a structured interview schedule or participant observation where the researcher listens and watches other”. The choice of research design in this study includes data collection analysis from three research methods:

- ✚ Participant observations where the author adopted the role as practitioner-researcher
- ✚ Interviews
- ✚ Questionnaires

After the author decided what she wanted to gain from the study, a decision to employ both quantitative and qualitative research was reached. Quantitative research is outlined by Sanders et al (2003, p.145) as “any data collection technique (such as a questionnaire) or data analysis procedure (such as graphs or statistics) that generates or uses numerical data”. Sanders et al (2003, p.145) define qualitative research as “any data collection technique (such as an interview) or data analysis procedure (such as categorising data) that generates or uses non-numerical data”.

Having selected a mixed method approach the author believes this will provide better opportunities to answer the research questions and provide better trust in the deductions made from the research findings as argued by Tashakkori and Teddlie (2003) (Saunders et al 2003, p.146). The multi-method research design is advised as best practice by (Saunders at al, 2007, p.145). Saunders et al (2003, P.147) claim it makes sense to use different methods to cancel out the ‘method effect’ and it leads to greater confidence being placed in the conclusions.

### **3.4 Selection of the Sector**

The reason behind the author's decision to focus the study of Green IT for SMEs is because she identified a gap in the literature regarding same. SMEs represent 99% of the total enterprises in the European Union (Commission 2003). With such a high number of SMEs in operation in the European Union, their impact on the environment is therefore an important consideration (Taylor et al, 2003). However, the author predicts that a high proportion of SMEs are dubious of the benefits of Green IT. The research methods employed in this study will help find out if this prediction is true. A recent report by research firm Vanson Bourne, conducted for Salesforce.com demonstrated that IT is classed as a 'necessary evil' by most UK small and medium sized enterprises (<http://www.computing.co.uk>). The same could be the true perception among several Irish SMEs in relation to IT in general. If this is the case, then Green IT is way down on the list of SMEs business priorities.

According to Article 2 of the Annex of Recommendation 2003/361/EC, the category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons. The term SME covers a multitude of business sizes and types. Evidently a medium company consisting of 150 employees (150 clients computers) will have an IT infrastructure far more sophisticated and advanced than the IT infrastructure of a smaller company consisting of just 20 employees (20 client computers) or less. Having acknowledged these variances the author believes selecting a sample that accurately and fully represents the SME community is a vital part of the research methodology.

In conjunction with the research on the topic Green IT among SMEs, the existing Green IT practices currently being employed in large organisations is also explored. The author feels this is necessary in order to build up a picture of which Green IT practices are suited to all sized organisations and which ones are not. Excluding large organisations from the research would inhibit the consistency and validity of the findings, as it is the large organisations that currently have the most exposure to Green IT practices. This wide-ranging research, covering both large and SME type organisations, allows for better comparison. Eventually a definitive Green IT framework most suited to SMEs should unfold. The research questions dictated the sampling frame.



### **3.5 Selection of Participating Organisations**

The study gathered data using a three stage process. The first was an observation of the author's own workplace; the second stage was a series of 5 interviews; and the third stage was the completion of 20 questionnaires. The author has worked for 6 years as an IT engineer in an IT services and support department of a medium sized chartered accountancy and financial services firm called Russell Brennan Keane (RBK). The IT department called technology solutions provides hardware and software solutions and IT support to both the 200 in-house employees (users) and to approximately 250 external clients. Many of its clients are also clients of the accountancy side of the firm. Established initially to satisfy a client's need, the IT department expanded and now accounts for 9% of the firm's overall turnover. By adopting the role as practitioner-researcher the author was able to observe first hand the Green IT experience of her workplace.

RBK Technology Solutions client base consists of mostly owner-managed SMEs. They either pay a yearly maintenance contract or pay per call-out for IT support of their IT infrastructure. The author's frequency of dealings with several of these clients and her familiarity with these SME managers and their IT infrastructures afforded her an opportunity to gain access to their opinions on Green IT. A selection of 8 of these RBK Technology Solutions clients participated in a questionnaire designed to address the awareness and adoption levels of Green IT amongst SMEs. The remaining questionnaires were completed by representatives of seven large organisations and 4 medium-sized ones. These other organisations had no connections to the author's workplace. In total the questionnaires were completed by 13 representatives of SMEs (firms with less than 250 employees) and 7 large organisations (firms with more than 250 employees).

### **3.6 Data Collection**

Data can be obtained from primary and secondary sources. The secondary research consisted of the literature on several aspects relating to Green IT and SMEs. The author engaged secondary data to address a number of research objectives. The main sources of secondary data were found in online sources, such as online journals, websites of Research Institutes, a few published books and online editions of offline academic journals and papers. Care was taken to ensure the data was not outdated as



Green IT is a fairly recent concept. Primary data was obtained through the above mentioned three-stage process; observation, interviews and questionnaires.

### **3.6.1 Observation:**

Delbridge and Kirkpatrick (1994) categorise the types of data generated by participant observation as 'primary', 'secondary' and 'experimental' (Saunders et al. p.289).

**Primary observations** as those where you wrote down what actually happened at the time (Saunders et al. p.290). **Secondary observations** are statements by observers of what happened and are the observer's interpretations (Saunders et al. p.290). **Experimental data** are those insights and evaluations the observer obtains as they experience the process (Saunders et al, p.290). The author was and still is involved in a Green IT project at her organisation. She kept a documented record of the project's progress as these records provide material that will be essential to the research.

The research data derived from author's own experience of Green IT can be classed as 'descriptive observation' or 'narrative account' as described by Robson (2002 p.320) (Saunders et al. p.290). The author was anxious to take the 'narrative account' and present it in a manner that enables the reader to get a clear picture of what is going on in her organisation in relation to Green IT. As a result of this concern, she picked specific observation categories to quantify the Green IT practices in her workplace. These categories were adapted from the Green IT Guide by Terrabytes Consulting (figure 3.1). The author used these categories as a coding schedule to add structure to her observations.

<b>Practice Area 1 – Policies and Performance Management</b>		
Implement a responsible environmentally aware purchasing policy	[	]
Implement an electronics and IT equipment recycling policy	[	]
Include environmental performance in performance reviews for employees	[	]
<b>Practice Area 2 – Strategic Asset Management</b>		
Integrate measures to extend hardware lifespan in strategic plan	[	]
Plan incremental upgrades for mid-life hardware	[	]
Lease, rather than purchase, more efficient hardware	[	]
Upgrade power supplies for mid-life computers where possible	[	]
Replace inefficient equipment with responsibly purchased new equipment	[	]
Consolidate, virtualize and/or host your servers	[	]
<b>Practice Area 3 – Energy Consumption</b>		
Implement aggressive power management	[	]
Consolidate and reduce the number of deployed devices	[	]
Evaluate the layout and design of the server room	[	]
<b>Practice Area 4 – Supporting Green Business</b>		
Implement duplex printing by default where possible	[	]
Enable network scanning and desktop faxing	[	]
Develop posters and presentations with energy- and paper-saving techniques	[	]
Use of videoconferencing/web meetings to reduce travel	[	]
Provide infrastructure to support telecommuting	[	]
Support electronic document management system i.e. paperless office	[	]

**Figure 3.1: Green IT Actions**  
**Source: Terrabytes Consulting (2009)**

### **3.6.2 Interviews:**

The 5 interviews were all carried out with IT professionals at management level at selected organisations over a 6 week period. 3 of these interviews were conducted with large organisations and 2 with medium-sized ones. The questions were loosely aligned with the questions in the questionnaire and heavily tied to the themes exposed in the literature review. However, these in-depth interviews afforded the researcher a chance to obtain detailed qualitative data on specific Green IT practices as well as obtaining a depiction of each organisation’s individual Green IT experiences. Figure 3.1 shows more details of these interviews. All of these organisations were based in

Ireland. Appendix 1 details a number of questions and prompts used during the interviews.

Interview No:	Interview Method	Job Title	Organisation's Size	No. of Employees	Description of Organisation
1	In-person	IT Manager	Medium	80	PC Manufacturers
2	Telephone	Process and IT Consultant	Medium	200	Buildings Materials Supplier
3	In-person	Principal Technical Specialist	Large	18,000	University
4	Telephone	IT Resources and Development	Large	310	Public Sector
5	In-person	Technical Coordinator	Large	560	Telecom Software Company

**Figure 3.2: Details of 5 interviews**

### 3.6.3 Questionnaires:

In contrast to in-depth and semi-structured interviews, the questions that are asked in the questionnaire in the study had to be exact and clear-cut prior to data collection as recommended by Saunders et al. (2007, p.361). A questionnaire was chosen in order to gather three types of data variables. These are illustrated by Dillman (2000) as opinion, behaviour and attribute variables (Saunders et al. 2007, p.362). The questionnaire designed for this study consisted of 30 questions (Appendix 2). In addition to these 30 questions, the start of the questionnaire asked the respondents to provide some demographic details and other basic information about their organisation e.g. quantity questions like the number of employees and number of printers.

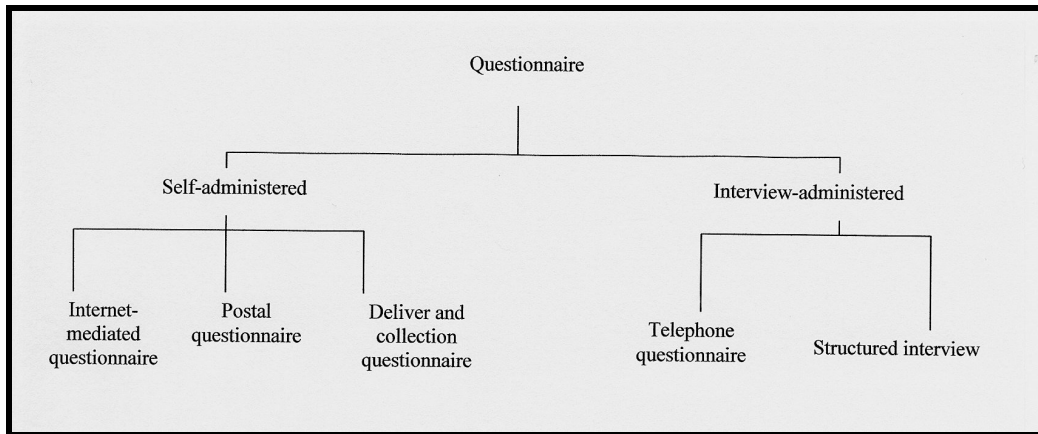
Q1 to Q13 are set up to collect data on attributes e.g. do you have air conditioning specifically for your server? Please tick the yes or no box. Q 14, a list question aims

to collect data on an organisation's current involvement with Green IT. Q15 to Q26 are all rating questions which are statements using a 5-point likert-style scale. The respondents are asked to rate each statement and select the option they most feel reflects their answer, as in strongly agree, agree, not sure, disagree or strongly disagree. These likert-style scale questions allows for interpretation of the various differentiating shades of opinion.

Q27 and Q28 are both ranking questions in which the respondent is asked to place things in order of importance. To conclude the questionnaire questions 29 and 30 are both category questions. The author designed these questions based on the list of Green IT actions outlined in Green IT guide from Terrabytes Consulting. She felt categorising Green IT actions in accordance with this list would be useful in gaining knowledge of the Green IT behaviours and attributes of organisations. In total 20 completed questionnaires were used in this study. A further 5 questionnaires were discounted from the study due to non-respondents.

Six of these completed questionnaires were self-administered via email. The rest of the questionnaires (from complete sample of 20) were interviewed administered as it was felt this would achieve a higher response rate. It would enhance the reliability of the data especially in relation to data from SMEs, many of whom have little experience of Green IT. These interviewed-administered questionnaires were carried out over the phone and in-person.

Since the researcher wished to capture a large volume of information, the questionnaire employed was quite long (30 questions). The length of the questionnaire was another reason why the interviewed-administered approach was chosen. Figure 3.2 illustrates various types of questionnaires and figure 3.3 shows details of the questionnaire participants used in this study.



**Figure 3.2: Types of questionnaires**  
 (Adapted from Saunders et al, 2007 p.357)

Respondent No:	Questionnaire Type	Job Title/Dept	Type of Business	No. of employees	Organisation's Size
1	Interview-administered	Office Manager	Construction	5	small (micro)
2	Interview-administered	Office Manager	Stainless steel fabrication	10	small
3	Interview-administered	Office Administration	Security Systems	6	small (micro)
4	Interview-administered	Office Manager	Restaurant, Guesthouse and Deli	5	small (micro)
5	Interview-administered	Office Manager	Plant and Part sales	12	small
6	Interview-administered	Financial Accountant	Safety Equipment	15	small
7	Interview-administered	Accounts	Construction	15	small
8	Interview-administered	Office Manager	Insurance Firm	10	small (micro)
9	Self-administered	IT Operations	Public Sector	9	small (micro)
10	Interview-administered	IT Manager	PC Manufacturers	80	medium
11	Interview-administered	Process and IT	Buildings material supplier	200	medium
12	Self-administered	IT Manager	Solicitors	155	medium
13	Self-administered	IT Manager	Accountancy firm	175	medium
14	Self-administered	Network Engineer	College	300	Large
15	Self-administered	IT Director	Accountancy firm	530	Large
16	Self-administered	IT Dept	Public Sector	330	Large
17	Self-administered	IT Manager	Beauty products Manufacturer	260	Large
18	Interview-administered	Technical Specialist	University	~18,000	Large
19	Interview-administered	IT Resources	Public Sector	310	Large
20	Interview-administered	Technical Coordinator	Telecom Software	560	Large

**Figure 3.3 Details of Questionnaire Participants**

### **3.7 Conclusion**

In summary, the study proposes to identify Green IT practices most suited to SMEs and in the process evaluate the current awareness levels and adoption rates of Green IT amongst SMEs, while concurrently stressing the benefits of and barriers to Green IT. The overall aim is to use the findings from above to develop a Green IT framework for SMEs. To achieve this, the study focused on a three-stage process of data collection that gathered a combination of qualitative and quantitative information using; observation, interviews and questionnaires.

A list of pre-defined categories of Green IT actions from Terrabytes Consulting (2009) was adapted slightly by author and used in the observation stage to code behaviour. Over a 6 week period a series of telephone and face-to-face interviews were conducted with a mix of both large and medium-sized organisations in order to obtain rich qualitative data.

To further enhance the reliability and completeness of the study's findings, information was also obtained using 20 questionnaires. Nine of these were from small companies (<50 employees), 4 were from medium organisations (50 – 250 employees) and 7 were from large organisations (>250 employees). Careful consideration was used in designing the questions for the questionnaire so as to ensure the validity and reliability of the information obtained.

In essence, the primary research questions that the study sought to answer was:

*PQ1: "What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?"*

## **Chapter Four: Findings**

### **4.1 Introduction**

The goal of this chapter is to discuss the findings from the three-stage data collection process outlined in the previous chapter. The primary objective of this study is to develop a definitive Green IT framework suitable to SMEs. In the process of this development, the researcher seeks to find answers to the following four secondary research questions:

*SQ1: “What levels of awareness currently exist regarding Green IT among SMEs?”*

*SQ2: “What are the levels of adoption that currently exist regarding Green IT among SMEs?”*

*SQ3: “What are the barriers to implementing Green IT in SMEs?”*

The literature review revealed some potential barriers to Green IT were: culture, costs, prioritisation and budget ownership.

*SQ4: “What are the benefits SMEs can achieve by implementing Green IT?”*

These answers to the above questions will ultimately contribute towards the unfolding of a Green IT framework for SMEs, essentially answering this study’s primary research question:

*PQ1: “What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?”*

Due to the large amount of data collected by the three methods applied in this study and due to the extensive number of questions in both interviews and questionnaires, the author has categorised the data collected under four different headings in order to highlight the main findings which were based on the four secondary questions. These headings are:

- ✚ Awareness
- ✚ Adoption
- ✚ Barriers
- ✚ Benefits

This grouping of the findings will assist in enabling further appreciation of the results obtained and also allow patterns of behaviour (if any exist) to unfold. Although the research question focuses on SMEs, data was collected from large organisations as well as from SMEs. The objective of this is to gain a thorough understanding of the topic ‘Green IT’ while comparing results from the various sized organisations. Comparison between both large companies and SMEs will assist in answering the primary and the secondary research questions. The findings from the research will be outlined in the following order:

- ✚ Findings from Participant Observations
- ✚ Findings from Interviews
- ✚ Findings from Questionnaires

## **4.2 Findings from Observation**

The author has first hand experience of Green IT, having been centrally involved in a implementing a Green IT project in her own organisation. The project was dubbed the ‘printer’ project. She will first give a general description of all the existing Green IT practices, currently employed by her organisation. Then she will proceed to give a detailed description of the Green ‘printer’ project. Finally, to conclude the discussion on observation, she will present the main findings from this method under 4 appropriate headings, which are: awareness, adoption, barriers and benefits.

### **4.2.1 Current Green IT Practices**

Figure 4.1 is a pre-defined list of Green IT actions adapted from Terrabytes Consulting (2009). It is used here by the author to code her observations. The Green IT practices or actions specific to RBK are represented by tick boxes. The 19 listed actions are grouped into 4 practices areas. These practice areas are: policies and performance management, strategic asset management, energy consumption and supporting Green business.



<b>Practice Area 1 – Policies and Performance Management</b>	
Implement a responsible environmentally aware purchasing policy	[ ]
Implement an electronics and IT equipment recycling policy	[ x ]
Include environmental performance in performance reviews for employees	[ ]
<b>Practice Area 2 – Strategic Asset Management</b>	
Integrate measures to extend hardware lifespan in strategic plan	[ ]
Plan incremental upgrades for mid-life hardware	[ ]
Lease, rather than purchase, more efficient hardware	[ x ]
Upgrade power supplies for mid-life computers where possible	[ ]
Replace inefficient equipment with responsibly purchased new equipment	[ ]
Consolidate, virtualize and/or host your servers	[ ]
<b>Practice Area 3 – Energy Consumption</b>	
Implement aggressive power management	[ ]
Consolidate and reduce the number of deployed devices	[ x ]
Evaluate the layout and design of the server room	[ ]
<b>Practice Area 4 – Supporting Green Business</b>	
Implement duplex printing by default where possible	[ ]
Enable network scanning and desktop faxing	[ x ]
Develop posters and presentations with energy- and paper-saving techniques	[ x ]
Use of videoconferencing / web meetings to reduce travel	[ x ]
Provide infrastructure to support telecommuting	[ x ]
Support electronic document management system i.e. paperless office	[ x ]

**Figure 4.1: Green IT Actions**

**Source: Terrabytes Consulting (2009)**

Immediately figure 4.1 demonstrates that RBK is most proficient in **Practice Area 4 - Supporting Green Business**. In this area, it has already implemented 5 out of the 6 listed Green IT actions. In contrast, RBK is far less represented in the other 3 practice areas. For example, in **Practice Area 1 - Policies and Performance Management**, RBK are a long way off including environmental factors in their purchasing policy as usually it's the cheapest computer that sways a purchasing decision rather than the environmental factors. However, the firm does have an IT equipment recycling

policy. Old discarded IT equipment is brought to the local designated civic centre in Tullamore where it is properly disposed of there.

The third action, listed in **Practice Area 1**, stems from an ideal world. Having environmental factors included in employees performance reviews, in the author's opinion, is a nice altruistic idea, but rarely seen in reality. Environmental factors are not part of an employees performance review in RBK. In **Practice Area 2**, RBK lease, rather than purchase their printer and multi-functional devices. This was a direct result of the Green 'printer' project. Similarly, as a direct result of the same project the action of consolidating and reducing the number of deployed devices was implemented.

Focusing in on the actions in **Practice Area 4**, RBK has duplex printing facilities but does not set them as default, leaving it up to the user to select the double-sided setting. It has enabled desktop faxing and scanning, developed posters and presentations with paper-saving techniques and strongly encourages use of video-conferencing and web meetings as an alternative to travel.

RBK's head office is located in Athlone. It has two branch offices in Dublin and Roscommon. More recently, the video-conferencing facility at the Dublin, Roscommon and Athlone offices has seen increased use for meetings. As observed by the author, video-conferencing is being heavily promoted, especially in the current tough economic times, as an alternative to travelling as this can greatly reduce travelling expenses. In previous years, little attention was given to the two Dublin partners travelling to Athlone for weekly meetings and in the process wasting valuable hours commuting.

All employees at management level have remote access to the email. All they need is a broadband connection. RBK uses technology called a RSA and Juniper solution, to provide secure access to their IT infrastructure and its data resources. This solution is a secure firewall with a SSL VPN connection and a special RSA secure identity tokens. Employees require a special remote access token (a small device, the size of a cigarette lighter), to be set up for them and also must be given a 4 digit pin number, to gain access to RBK's network from outside. Passwords for logging onto the RBK

network contain 10 digits (the 6 digits from the RSA token plus the 4 digit pin). The 6 digit number from the token is dynamic as it changes every 60 seconds whereas the 4 digit pin is static.

So essentially, a secure IT infrastructure has been provided to allow home-working but as a rule, home-working is not promoted. The remote access is only intended for checking emails after hours.. There is one employee however, who works permanently from her home in Carlow. On a daily basis, she manages to access the email server and other data resources that are situated in the Athlone office, from her Carlow home. All that was required to set her up was a good broadband connection (3Mb) and a RSA token specially set up for her to allow her authorised access to the RBK network.

The last action listed in **Practice Area 4**, is an electronic document management system. For some years now, RBK have been using an electronic document system called Fortis. This system enables all business documents; letters, emails, invoices, client's files, etc to be scanned into a database, indexed and retrieved easily at a later date. This avoids the need for copying documents in triplicate and shuffling papers from file cabinets to desks. One of the main reasons behind the firm's adoption of Fortis was because it was running out of storage space to store paper files. It also wished to streamline their business processes, shorten the paper trail, speed up searching for client's files, reduce waste and generally speed up workflow.

#### **4.2.2 The Green 'Printer' Project**

The 'printer project' the author observed as a practitioner-researcher involved evaluating all of the existing dedicated print, fax, copier, scanner devices including all of the multi-functional devices (MFDs) (copier, scanner, printer and fax all in one). Increasingly high printer maintenance costs, rising paper consumption, rising levels of paper waste, rising shredding costs and a general inefficient firm-wide printing system, inspired the firm to think Green, not to mention save money.

The main motivation behind this project was cost-savings and cost-avoidance. So RBK became an 'accidental environmentalist', a label that Gralla (2008) so aptly uses

when describing organisations like RBK. Although concern for the bottom line was the main driver behind the Green ‘printer’ project, the outcome meant the firm managed to Green its IT infrastructure by using less paper, creating less waste, taking up less space and saving a substantial amount of money in the process.

A contributing factor to the launch of this ‘printer’ project was the unrealistic expectations of some users that have evolved over the years. Expectations like, “I am a manager therefore I must have and deserve my own personal printer”. This mindset was common among some middle management. The firm had expanded rapidly in the last 10 years. In 2008, the annual Finance Accountancy magazine, recorded RBK as the biggest accountancy firm outside Dublin and the 9<sup>th</sup> largest accountancy firm in Ireland. This level of growth means the firm now employs approximately 200 people. The ‘printer’ project involved implementing 4 out of the 19 listed Green IT practices from figure 4.1. These were:

- **Practice Area 2 – Strategic Asset Management**  
Lease rather than purchase more efficient hardware
- **Practice Area 3 – Energy Consumption**  
Consolidate and reduce the number of deployed devices
- **Practice Area 4 – Supporting Green Business**  
Enable desktop faxing  
Develop posters and presentations on paper-saving techniques

The Athlone office had 42 printers in use, all of mixed makes and model. Looking around the office floor and seeing that practically every third desk had a local printer on it, while the MFDs were being underutilised. An opportunity to consolidate print devices was identified. An assessment was then carried out. This estimated the firm’s yearly spend on paper, cartridges, purchasing of new printers and maintenance costs. Other opportunities, like enabling faxing modules on MFDs was spotted thus allowing for the removal of dedicated fax machines and gaining better utilisation out of IT equipment.

From the assessment, a plan was made incorporating proposed changes. Communicating the intended changes to all, gaining support from top management and getting employee buy-in was essential for the project to work. As part of the communication process, presentations on paper saving techniques were sent via email to all staff. Figure 4.2 shows one of the images used in the presentation.

Six months after these Green tactics were implemented the IT department reassessed the situation. They measured progress such as paper usage and printer maintenance costs. Prior to implementing these Green initiatives, spending on paper, cartridges, purchasing costs of new printers and on maintenance, was on average €34,000 a year. The changes purposed were estimated to reduce this figure down to €26,000, a saving of €8,000. Reassessment showed that the firm had actually saved €6,950 as a result of proposed changes. The results were communicated to all concerned. The variances were a direct result of some senior management refusing to surrender their individual printers. The planned changes were as follows:

- Remove all local printers from all staff within the office with the few exceptions that satisfy certain criteria e.g. HR, Payroll and Reception.
- Have a dedicated printing area on each floor.
- Remove the current fax machines. Enable fax module on MFDs. Set up desktop faxing from PCs. Set up fax modules so that faxes will be received in email format only.
- The existing MFDs would be upgraded to have a confidential function on them meaning that documents will only print when a user enters a pin number.
- Enter into an annual lease agreement with a local printer support company to lease more MFDs. This agreement will enable the replacement of equipment with newer technology when necessary.
- Enter into an annual maintenance agreement with the same local printer support company.
- Enable duplex facility on printers.

Out of the initial 42 printers, 15 of them were removed. 10 of these 15 local printers were sold off to employees while the other 5 were disposed of in a proper manner.

The most noteworthy result of this entire project was the streamlining of the fax process, a simple but important business process. Ultimately the ‘dealing with incoming faxes’ process was reduced from 4 steps to 2 steps. Chapter 5 will illustrate more details of this process and how this particular Green initiative made life easier for the RBK’s secretaries.



**Figure 4.2: An Image used in RBK  
for a Presentation on paper-saving techniques**

### **4.3 Summary of Observation Findings**

#### **4.3.1 Awareness**

Prior to the ‘printer’ project, RBK’s awareness of Green IT was low. Presentations to all staff, outlining what the new printer policy entailed, helped to raise employees’ awareness of Green IT. However the author advocates that RBK have a lot more Green IT opportunities left to exploit e.g. centrally controlling power management on PCs and monitors.

### **4.3.2 Adoption**

Getting employees to adopt new ways of doing things can be difficult. Detailed instructions with coloured graphics were emailed to all employees illustrating how to use the new confidential print function. The author also spent 2 days training users on confidential print. Although RBK has adopted 8 out of the 19 Green IT practices listed in figure 4.1 they have yet to embrace the ‘low hanging fruit’, meaning it has yet to adopt aggressive power management and initiatives such as defaulted duplex printing.

### **4.3.3 Barriers**

Mines, et al (2007, p.5) cited behavioural and procedural inertia as potential barriers to Green IT. The author can concur with their finding. The biggest barrier encountered in the ‘printer’ project was not the complexity of implementing technical changes but, the resistance from certain managers over surrendering their printer. Providing confidential print facilities acted as compensation to those that had to relinquish their printer. Similar barriers were encountered when RBK first adopted Fortis, their electronic document management system. As a way of monitoring and policing employee’s use of Fortis, a full-time document management administrator was hired to ensure proper procedures were being followed and to get people to use the system to its full potential.

### **4.3.4 Benefits**

The primary benefit of the ‘printer’ project was cost-savings. A reassessment 6 months after the project, demonstrated that the firm had actually saved €6,950. Perceived secondary benefits and tertiary benefits were; a reduction in the firm’s carbon footprint and improved efficiency of some of its business processes. The efficiency obtained from the improved fax process will be discussed in detail in chapter 5. The confidential print facility means a user needs to enter in their pin number on the printer in order to actually print anything. The advantage of this is, if a user never collected their print jobs, as in never enter in their credentials on the printer, then the print job would be deleted from the queue after 12 hours. This would save on paper, reduce waste and lower shredding costs.

#### **4.4 Findings from Interviews**

Data was collected from 5 interviews, 3 from large organisation and 2 from SMEs (medium sized companies). As 3 out of the 5 interviewees wished to keep their name and their organisation's name confidential, the interviews will be referred to as interview 1, interview 2, etc. as illustrated in figure 4.3. The questions in the interviews were loosely based on the questionnaire and heavily tied to the themes exposed in the literature review. Interviewees discussed at length their individual Green IT experiences. In keeping with the observation method, the findings from the interviews will be presented using the same four categories: awareness, adoption, barriers and benefits.

##### **4.4.1 Awareness**

Interview 1 was an interview with Cyril Macken, the IT Manager from a PC manufacturer named Alienware. Alienware custom built computers specially designed for gaming. It has 70 employees, 14 servers and 12 printers. The company has always been Green conscious, as it has been its policy to minimise waste, since its establishment. There was always a conscious effort to avoid printer sprawl. Like RBK, Alienware could be classed as accidental environmentalists as the main driver behind its Green efforts was cost-savings.

Only 2 of the 5 organisations interviewed knew, what percentage of their organisation's energy use, came from their IT equipment. Alienware was one of those. This was mainly due to the fact that three years earlier the company experienced over loading of the incoming power supply into their building in Athlone. In order to overcome this problem, power consumption was monitored and measured and a plan to implement aggressive power management on PCs and monitors was implemented. Cyril estimated that, if he excludes the power used in the actual manufacturing of the PCs, then, 35% of the power used by the building is attributed to office IT equipment.



Interview No:	Interview Method	Job Title	Organisation's Size	No. of Employees /PC Users	Description of Organisation
1	In-person	IT Manager	Medium	80	PC Manufacturers
2	Telephone	Process and IT Consultant	Medium	200	Buildings Materials Supplier
3	In-person	Principal Technical Specialist	Large	18,000	University
4	Telephone	IT Resources and Development	Large	310	Public Sector
5	In-person	Technical Coordinator	Large	560	Telecom Software Company

**Figure 4.3: Details of 5 interviews**

The answers provided by each of the interviewees to the following 4 questions greatly contributed in establishing the current awareness level in each organisation on the subject of Green IT. These following questions were taken from the questionnaire in appendix 2.

- *Does your organisation include environmental factors in purchasing decisions regarding IT equipment?*
- *Are your organisation's employees aware of the environmental impact of IT equipment?*
- *Is your organisation fully aware of what initiatives/actions are categorised as Green IT?*
- *Is your organisation aware of current environmental certifications for IT equipment such as EPEAT and Energy Star?*

Cyril's answer was no, when asked if the organisation included environmental factors in purchasing decisions regarding IT equipment. When asked if the company's employees were aware of the environmental impact of IT equipment, Cyril believes

they are aware. For example, many employees on their own initiative take responsibility for sending off their printer toners for recycling.

Alienware is fully informed of what actions are categorised as Green IT. The fact that it has embraced several Green IT actions such as aggressive power management demonstrates this. When it comes to Energy Star rating and EPEAT certification, it is also well informed and would consider the power consumption and heat output of potential IT equipment when purchasing.

Interview 2 was with an IT consultant from a medium-sized firm specialising in building materials. It has 200 computer users, 15 servers and 12 multifunctional devices MFDs. It has no dedicated print, scan or copier devices. All of these devices have been consolidated. It only uses MFDs. However, it has 6 dedicated fax machines. It includes environmental factors and considers the TCO of IT equipment when purchasing. It is also very knowledgeable on Energy Star ratings. The main driver behind their Green 'consolidation of print device' project was to achieve better utilisation of equipment. It also wished "to follow best-practice procedure", as quoted from this IT consultant's own words.

Other Green IT practices implemented by this medium-sized firm were defaulting duplex printing, consolidating and virtualisation of servers, implementation and promotion of web-conferencing and implementation of desktop faxing. Overall the company's Green IT strategy is in line with the company's overall strategy which heavily encourages sustainable development, such as corporate social responsibility schemes where sand that has been taken from quarries during production of building materials is reused in wildlife parks.

Interview 3 was with Brendan O' Looney, a principal IT technical specialist at the National University of Ireland, Galway (NUIG). The knowledge obtained from this interview was invaluable. Brendan felt passionately about the topic of Green IT and spoke about it in an enthusiastic manner. He had overseen a project in NUIG which involved implementing power saving settings on over 1,650 desktop computers in specified teaching areas in the university. He maintained that the university achieved cost-savings in the region of €100,000 as a direct result of this Green initiative.

The assessment phase took 6 months. It was time-consuming in measuring the current power consumption of PCs. Outside assistance from electricians was required. Close collaboration between the IT and the Facilities department was essential also. The software package selected to manage the power settings was Auto Shutdown PC Genius. Essentially, computers inactive for more than 60 minutes shutdown completely automatically. Accordingly awareness of Green IT is high in NUIG, but like the other organisations cost-savings was the main motivation behind the university's Green efforts.

Brendan commented on 2 Forrester Research conferences in 2008 that he attended in the UK, were on Green IT and raised his awareness about potential Green IT practices that could be implemented. Following this 'power management' project the university's IT purchasing policy began to include environmental factors. As a rule, NUIG only purchase desktops that have an A or B energy star rating. NUIG also had knowledge on the percentage of energy use in the university that was accredited to IT equipment as this was a starting point for their 'power management' project.

Interview 4 was with the IT manager of an IT department in an Irish public sector organisation. The IT manager interviewed explains how his firm has 300 users, 20 servers and 15 MFDs. Similar to the building materials supplier firm (interview 2) this organisation had consolidated printer devices. Having a multitude of printers on random desks, all different makes and models can be a nightmare to maintain and administer, as explained by the IT manager of the public sector company. There was no consistency, as a myriad of different cartridge types was required. This organisation advocates that it includes environmental factors when purchasing IT equipment.

This interviewee believed that the employees of his organisation were very aware of the environmental impact of IT equipment. He added though that this was partly due to an awareness campaign that was directed to the employees from the top management. Being a public body, this organisation is heavily influenced by the government. If the government is pushing for Greener IT in general, then it will filter

down to their organisation and to his IT department. Similar to the last three interviews, this organisation was very knowledgeable on the subject of energy ratings.

The last interview, interview 5, was with a technical coordinator from a telecom software company. This company's approach to Green IT is strongly and positively influenced by its head office in Sweden. The overall organisational strategy would push for waste reduction and promote sustainable development. It has implemented certain Green IT practices and plans to do more. One of the biggest changes they made was with its printing set up. Prior to this Green change, when a user prints out a document, a full header or separator page with the user's name on it was printed first, resulting in wasting a whole page for every single print job. The elimination of this extra page had a huge impact, by reducing waste and saving paper consumption.

#### **4.4.2 Adoption**

As a way of measuring the 5 organisations acceptance of Green IT, the author will present deductions from the interviewees' replies to the following four questions which were adapted from the questionnaire (appendix 1).

- *Please describe your company's current involvement with Green IT?*
- *With reference to figure 4.1 (list of Green IT Actions), please tick the box beside the Green IT practices that your organisation has introduced.*
- *Does your organisation have power management implemented on PC and peripherals?*
- *Does your organisation encourage reducing unnecessary printing?*

Four out of 5 of the interviewees surmised that their organisations had implemented some Green IT practices and had plans to implement more of them in the future. The exception was the building materials supplier (interview 2). The interviewee representing this organisation stated that although the company had instigated several Green IT practices, it had no further plans to implement anymore. For NUIG, following the success of the power management project for its 1,650 PCs in specified teaching areas, it plans to roll out the same power settings to another 3,000 staff PCs.

Interviewees were invited to examine the list of Green IT actions from figure 4.1, and select the actions most relevant to their own organisations. Upon analysing the interview transcripts, the researcher identified an obvious pattern. All of the 5 organisations were most active in **Practice Area 4 – Supporting Green Business**.

For example, Alienware had implemented all practices here except an electronic document management system. The building materials supplier (interview 2) had applied all 5 practices listed in this practice area. It was especially proficient in web-conferencing and used software from Tanberg called See & Share which allows shared documents to be viewed online. NUIG had also employed all of these practices. Brendan O' Looney spoke at length about the pharos print system that the university has introduced in conjunction with defaulting duplex printing. Pharos is a secure or confidential print facility. Brendan gave the author a demonstration in how Pharos works, which is as follows:

- A user sends a file to a network printer
- The job is sent to a centralised print server (instead of a specific printer)
- At their convenience, the user enters their authentication credentials or swipes their ID card in to the pharos printer nearest to them
- The user then has the option to confidentially print her document immediately or to delete a document if they decide they don't want it
- If the user does not authenticate and collect printed document, the print job is deleted after 12 hours

The public sector organisation (interview 4) had implemented 3 out of 5 listed practices in **Practice Area 4 – Supporting Green Business**. They did not provide tele-commuting facilities or had developed presentations on energy-saving tips. As for the telecom software company (interview 5), it had extensive experience of all 5 practices listed.

All 5 organisations interviewed, had enabled duplex printing as default and had a formal policy encouraging the reduction of paper use. Two of them spoke in detail about their organisations Intranet which allowed for documents like training manuals and HR policies to be published as opposed to being printed and copied.

In conclusion of this review of these organisations, it was noted that all 5 of them have some form of power management installed on their network. Three of them, the building materials supplier, the public sector organisation and the telecoms software company (interview 2, 4 and 5), use power management on monitors only. Alienware and NUIG employ aggressive power management for desktops and monitors. In Alienware's case it uses Energy Star EZ GPO power management software, which puts monitors into standby after 10 minutes idle time and desktops are put into hibernation between 7pm and 7am. NUIG uses a PC based-solution called Auto Shutdown PC Genius. It turns desktops off after 60 minutes of inactivity and applies the same to monitors after 20 minutes of idle time.

#### **4.4.3 Barriers**

When asked about the barriers they encountered when implementing Green IT practices, similarities exist between the 5 organisations. Both Alienware and the telecom software company reported that cost was the biggest inhibitor. Brendan O'Looney of NUIG also made reference to this barrier, as the 'power management' project cost them approximately €10,000 in labour costs and another €5,000 for monitoring tools. Both the building materials provider and the public sector organisation (interview 2 and 4 respectively) commented on the resistance from employees, which they experienced when removing their printers from them during their consolidating print device operations. Regarding barriers encountered, the IT consultant from the building materials supplier said, "I took away 1 manager's local printer and he was furious".

Brendan O'Looney of NUIG mentioned that the IT maintenance people raised concerns over how the desktop computers would receive software updates from the server, which is scheduled nightly, if these same machines were off. However, NUIG use Wake-On-LAN software to overcome this barrier. Wake-On-LAN sends out a magic packet to the network card of a computer. If the computer is shutdown without being plugged out, Wake-On-LAN can switch it on and allow software to be remotely downloaded.

#### 4.4.4 Benefits

Three out of 4 of the organisations, Alienware, NUIG and the telecom software provider, cited cost-savings as the main benefit they received from their Green IT projects. The public sector company classed cost-savings as a secondary benefit while their main benefit was the reduction in their carbon footprint. The building materials supplier claimed the main benefit they received, was increased efficiency of their IT equipment.

#### 4.5 Findings from Questionnaires

In keeping with the other methods, the findings from the questionnaires will be represented using the same four categories; awareness, adoption, barriers and benefits. The questionnaire contained over 30 questions including likert-style, ranking and category questions.

<p style="text-align: center;"><b>Awareness</b></p> <p><i>SQ1: “What levels of awareness currently exists regarding Green IT among SMEs?”</i></p>	<ul style="list-style-type: none"> <li>▪ Q4 Considered Total cost of ownership</li> <li>▪ Q8 Knowledge of % of energy use attributed to by IT</li> <li>▪ <b>Q9 Environmental factors in purchasing</b></li> <li>▪ <b>Q12 Employees awareness of environmental impact of IT</b></li> <li>▪ Q15 Potential benefits</li> <li>▪ <b>Q17 Fully aware of what is a Green IT action</b></li> <li>▪ Q22 Aware of Green IT actions that cost little</li> <li>▪ <b>Q23 Aware of EPEAT and Energy Star.</b></li> <li>▪ Q30 Green IT practice that are planned for future</li> </ul>
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**Figure 4.4: Questions Addressing Awareness of Green IT**



<p style="text-align: center;"><b>Adoption</b></p> <p><i>SQ2: “What are the levels of adoption that currently exists regarding Green IT among SMEs?”</i></p>	<ul style="list-style-type: none"> <li>▪ <b>Q3 Power management</b></li> <li>▪ <b>Q5 Reduce printing</b></li> <li>▪ Q6 Video-Conferencing</li> <li>▪ Q7 Home-working</li> <li>▪ Q10 Actively recycle old IT equipment</li> <li>▪ Q11 Written recycling policy</li> <li>▪ Q13 Extending lifecycle of IT equipment</li> <li>▪ <b>Q14 Company’s current level of involvement in Green IT</b></li> <li>▪ <b>Q29 Green IT practice(s) that have been implemented</b></li> </ul>
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**Figure 4.5: Questions Addressing Adoption of Green IT**

<p style="text-align: center;"><b>Barriers</b></p> <p><i>SQ3: “What are the barriers to implementing Green IT in SMEs?”</i></p>	<ul style="list-style-type: none"> <li>▪ Q16 Consistent with strategy</li> <li>▪ Q18 Are the costs justified?</li> <li>▪ Q19 Support from top management</li> <li>▪ <b>Q20 Do you have enough resources?</b></li> <li>▪ <b>Q24 Willing to pay a premium?</b></li> <li>▪ Q25 Is the recession discouraging investment?</li> <li>▪ <b>Q28 Perceived Barriers</b></li> </ul>
<p style="text-align: center;"><b>Benefits</b></p> <p><i>SQ4: “What are the benefits SMEs can achieve by implementing Green IT?”</i></p>	<ul style="list-style-type: none"> <li>▪ Q18 Are the costs justified?</li> <li>▪ <b>Q21 Influence of energy costs</b></li> <li>▪ Q26 Recession is a motivator</li> <li>▪ <b>Q27 Perceived benefits</b></li> </ul>

**Figure 4.6: Questions Addressing Barriers and Benefits associated with Green IT**

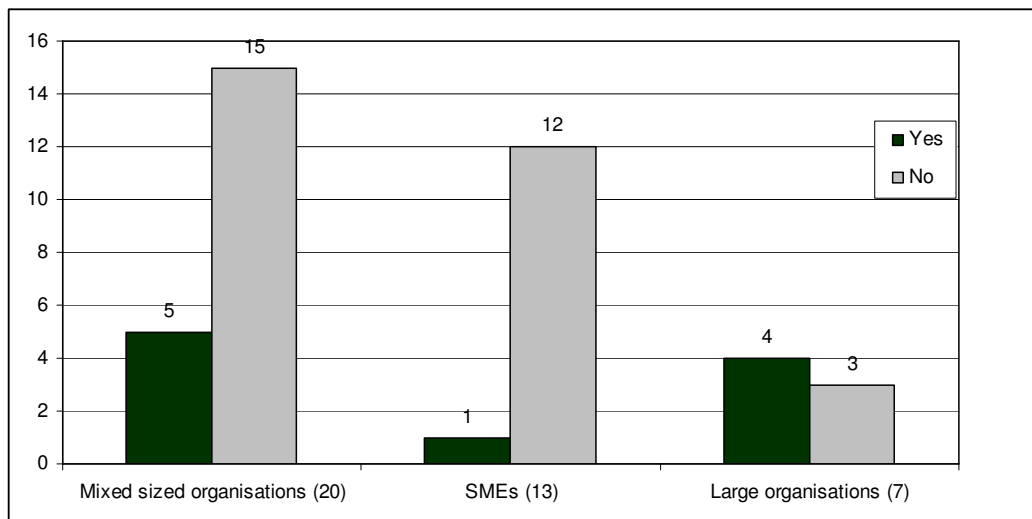
Twenty eight of these questions are collated under the previously mentioned categories (refer to figures 4.4, 4.5 and 4.6). The other 2 questions, Q1 and Q2 were designed to find out how sophisticated an organisation’s IT network was. Findings from 13 selected questions, highlighted in bold, in figures 4.4, 4.5 and 4.6 are further illustrated below.

#### 4.5.1 Awareness

The results from Q9, Q12, Q17 and Q23 give an indication of the level of knowledge organisations have in relation to Green IT. These results are:

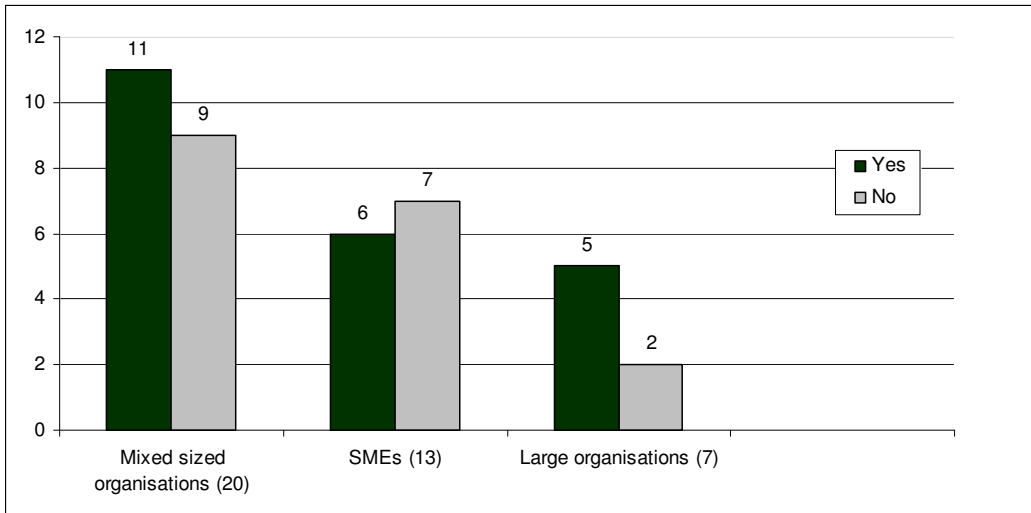
*Q9: Does your organisation include environmental factors in purchasing decisions regarding IT equipment?*

An overwhelming majority of the organisations (of the 20 surveyed), do not include environmental factors in purchasing decisions regarding IT equipment. By focusing on the SMEs alone, 12 out of 13 surveyed i.e. 92%, do not include environmental factors in their purchasing decisions. Refer to figure 4.7 for details.



**Figure 4.7 Results from Q9**

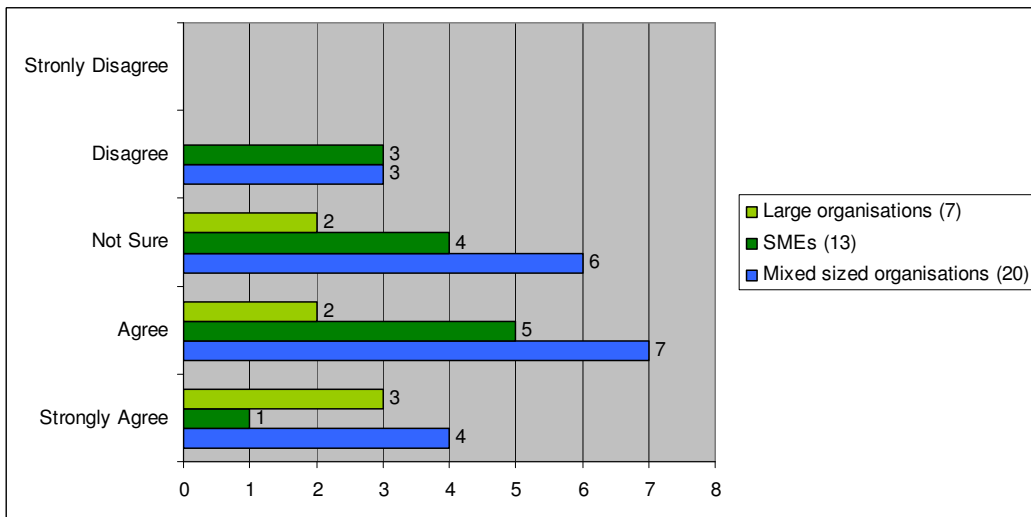
*Q12: Are your organisation’s employees aware of the environmental impact of IT equipment?*



**Figure 4.8 Results from Q12**

Figure 4.8 illustrates that 9 out of the 20 organisations surveyed stated that their employees were aware of the environmental impact of IT equipment. Focusing in on the 13 SMEs surveyed, 6 of them (46%), believe their employees were conscious of the environmental impact of IT equipment.

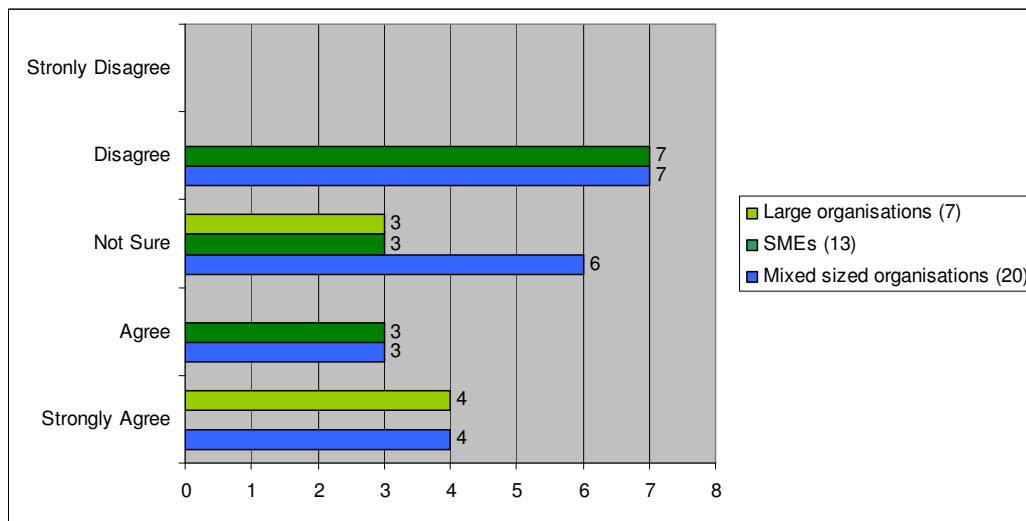
*Q17: Your organisation is fully aware of what initiative/actions are categorised as Green IT.*



**Figure 4.9 Results from Q17**

A breakdown of the findings from Q23 can be seen in figure 4.9. They are represented by dark green on the graph, whereas large organisations are shown in light green. The sample of 20 mixed sized organisations can be seen in blue.

*Q23: Your organisation is aware of current environmental certifications for IT equipment such as EPEAT (a system to help purchasers evaluate, compare and select electronic products based on their environmental attributes) and Energy Star.*



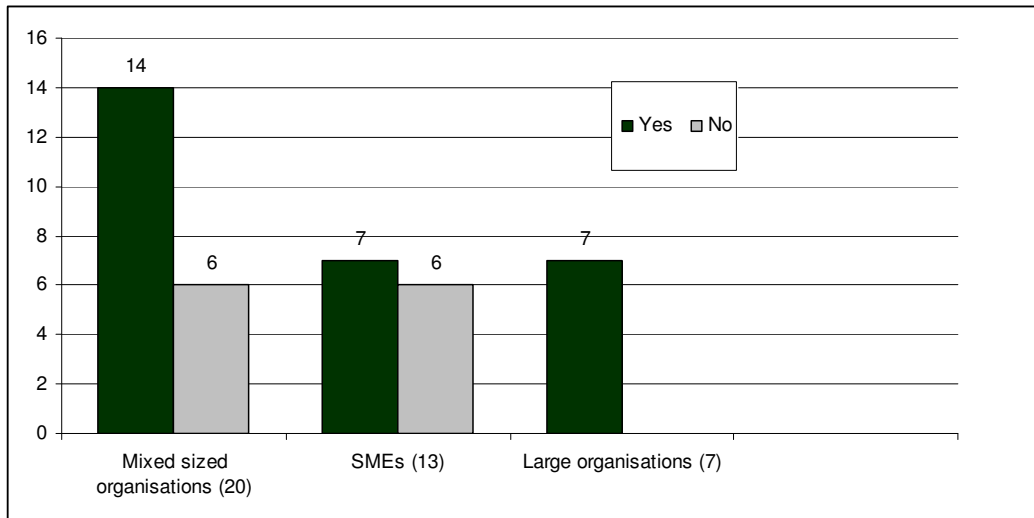
**Figure 4.10 Results from Q23**

Figure 4.10 graphed the results from Q23 from the organisations surveyed. Knowledge of specific energy certifications is low among SMEs. Out of the 13 SMEs surveyed, 3 agreed to the statement in Q23, 7 disagreed and 3 of them were not sure.

#### **4.5.2 Adoption**

The results from Q3, Q5, Q14 and Q29 give an indication of the current level of adoption that exists in organisations in relation to Green IT. Q3 and Q5 revolve around the ‘low hanging fruit’, referred to by Pratt (2008). These are small simple changes that cost little or nothing to implement such as power management and reduction of paper use.

*Q3: Does your organisation have power management implemented on PC and peripherals?*

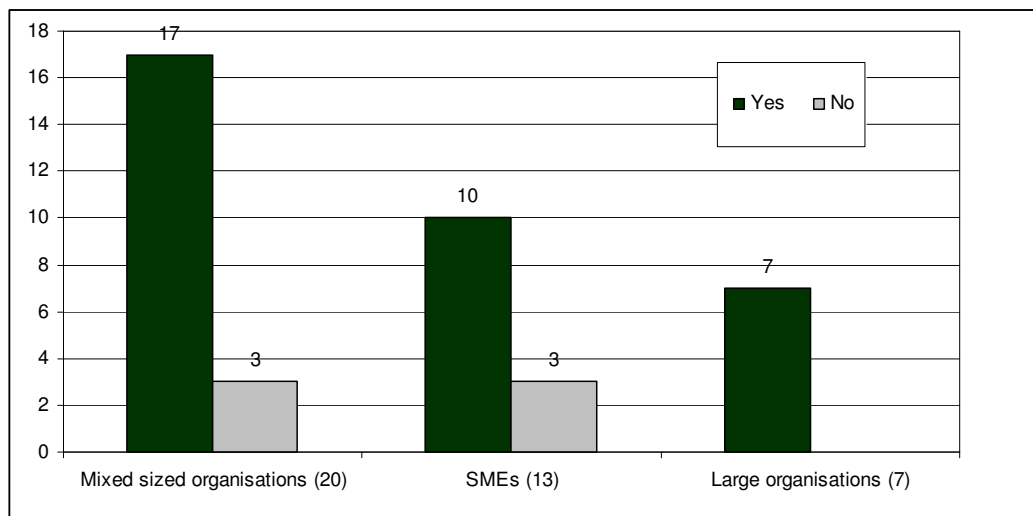


**Figure 4.11 Results from Q3**

Figure 4.11 gives a breakdown of findings from Q3. As can be seen all of the large organisations surveyed have applied power management whereas only 7 out of the 13 SMEs have it.

*Q5: Does your organisation encourage reducing unnecessary printing?*

Figure 4.12 shows that all of the large organisations (7 in total) promote the reduction of paper use as well as 10 out of 13 i.e. (77%) of the SMEs.

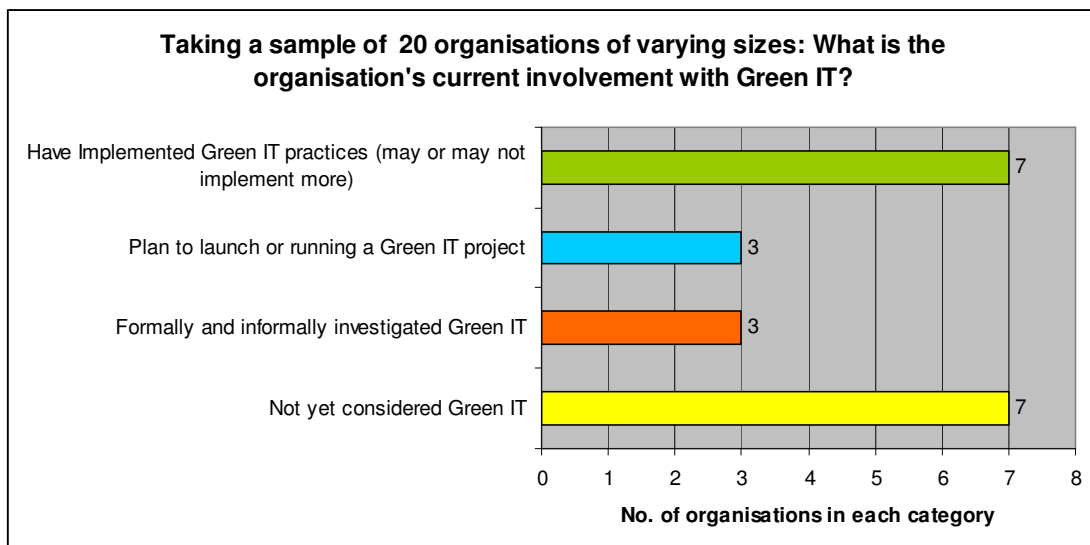


**Figure 4.12 Results from Q 5**

Q14 asked the respondents to select the option that best described their organisation's current involvement with Green IT. They were given a choice of 8 options and none of the respondents selected the last option which was *other: please specify*. The replies to Q14 give a concise indication of an individual organisation's current position on Green IT. The replies are illustrated in figures 4.13, 4.14 and 4.15. For ease of understanding, the remaining 7 options were further collated into 4 categories and plotted as bar charts. This provides visual representation as to the number of organisations that fall into each category.

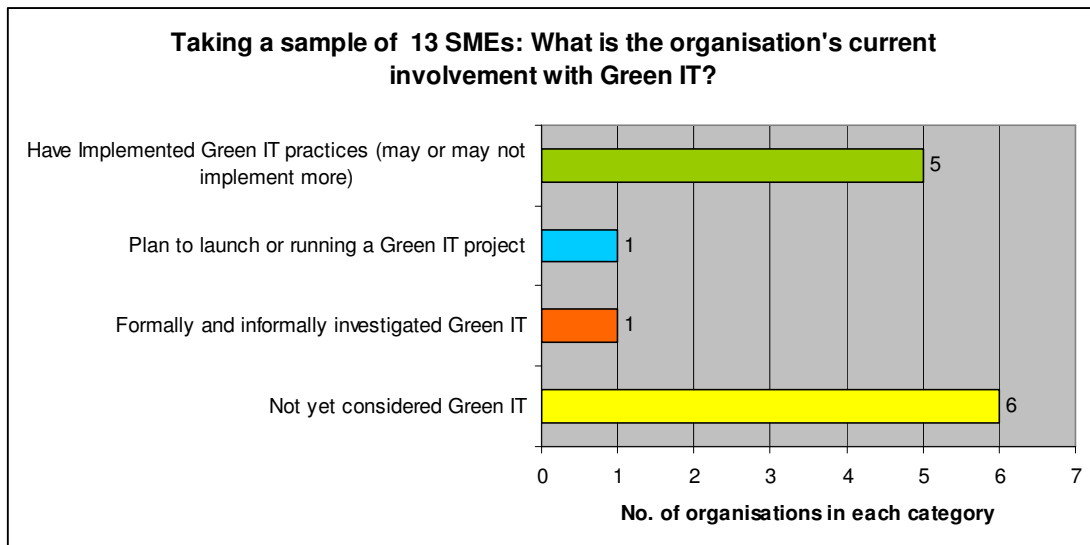
Seven of the organisations surveyed had not yet considered Green IT while 3 of them have either formally or informally looked into it. Three more of the respondents state their organisation is either planning to launch or currently running a Green IT project. The remaining 7 organisations have already implemented some Green IT practices. However some of these organisations (2 medium-sized ones) believe their Green IT journey has reached its destination.

In summary, out of the sample of 20 mixed-sized organisations, 35 % have not yet considered Green IT, 15% have formally or informally investigated Green IT, another 15% are planning to launch or are running a Green IT project and 35% have already implemented some Green IT practices.

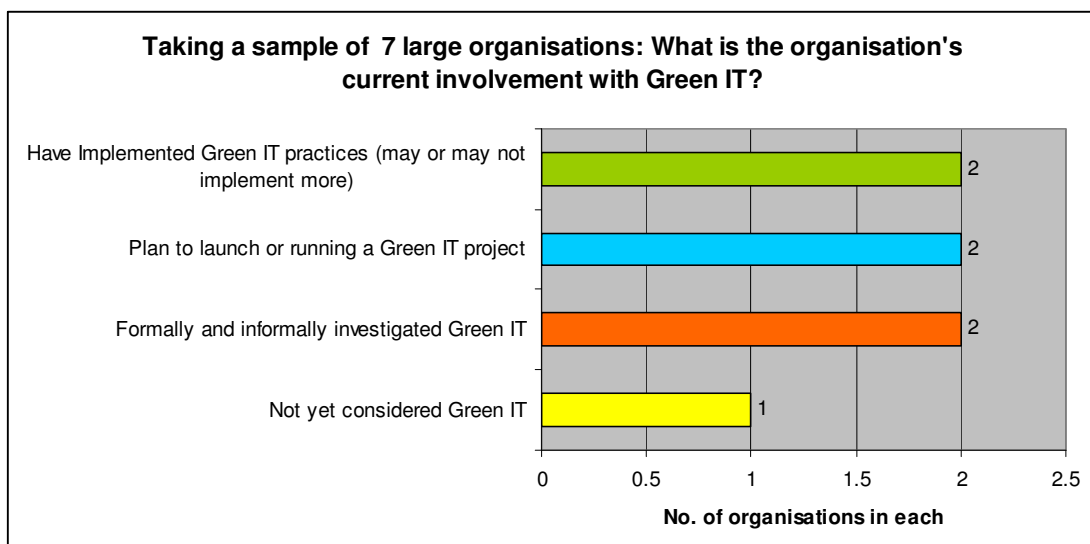


**Figure 4.13: Breakdown of 20 mixed-sized organisations**

In order to focus specifically on the adoption rates among the 13 SMEs, figure 4.14 demonstrates the further breakdown of each SMEs individual position on Green IT. At a glance of this figure (4.4), a worryingly 46% of SMEs (out of sampled 13) had not yet considered Green IT thus indicating a very low adoption rate among this sector. However, approximately 38% have implemented some form of Green IT practice.



**Figure 4.14: Breakdown of 13 SMEs**



**Figure 4.15: Breakdown of 7 large organisations**

To further highlight the low adoption rate of Green IT in the SME sector, a comparison can be drawn with the findings from the sampled 7 large organisations.

Figure 4.15 shows that 4 out of the 7 large organisations surveyed, i.e. (57%) have implemented Green IT practices or plan to or are running a Green IT project. Only 1 large organisation had not yet considered Green IT, thus further crystallising the differences in adoption rates between SMEs and large organisations in relation to Green IT.

Respondents were asked in Q29 to select from a list of 19 Green IT actions (see figure 4.1) the ones that their organisation had already implemented. The results revealed the following:

Regarding the 9 firms (<50 employees):

- Two of these companies indicated that they had not yet implemented any of the actions from the list in figure 4.1, but had plans to implement power management, desktop faxing and a purchasing policy which included environmental considerations.
- The other 7 of these small firms, all selected the “*integrate measures to extend hardware lifespan in strategic plan*” option under **Practice Area 2- Strategic Asset Management**.
- None of them saw having a formal recycling policy, a priority, with the exception of one firm.
- Power management has not yet been implemented by 8 of these firms. Some of them even leave their desktops switched on 24 hours a day. Three out of these 8 firms have plans to instigate new power settings while 5 of them have no such plans.
- On the positive side, 8 out of 9 of these firms actively encourage the reduction of paper use.

Regarding the 4 medium-sized firms (50-250 employees):

- Evaluation of the questionnaires showed that all 4 of these firms were most proficient in **Practice Area 4 – Supporting Green Business**.
- Two of them have no intention of further developing their Green IT initiatives.
- Medium firms in contrast to small firms are more likely to have applied the following practices: video conferencing, energy saving presentations and telecommuting (home working)



- Two out of the 4 medium firms have power management installed on their network.
- All 4 of them have duplex printing set by default.

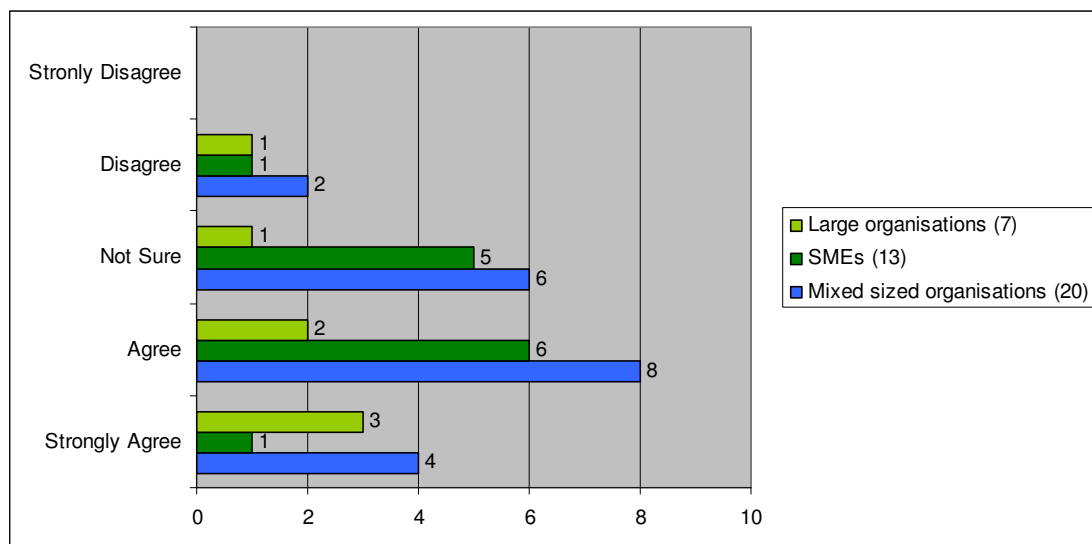
Regarding the 7 large companies (more than 250 employees):

- Six out of 7 of these companies appeared to be concentrating their Green efforts in consolidating and reducing the number of deployed devices such as printers.
- All of the 7 companies seemed to be most active in **Practice Area 3 – Energy Consumption** and in **Practice Area 4 – Supporting Green Business**.
- Six out of 7 of these companies centrally manage computer power settings while the other company has plans to implement this soon.

### 4.5.3 Barriers

The answers given in the questionnaires to Q20, Q24 and Q28 assist in indentifying potential barriers associated with Green IT.

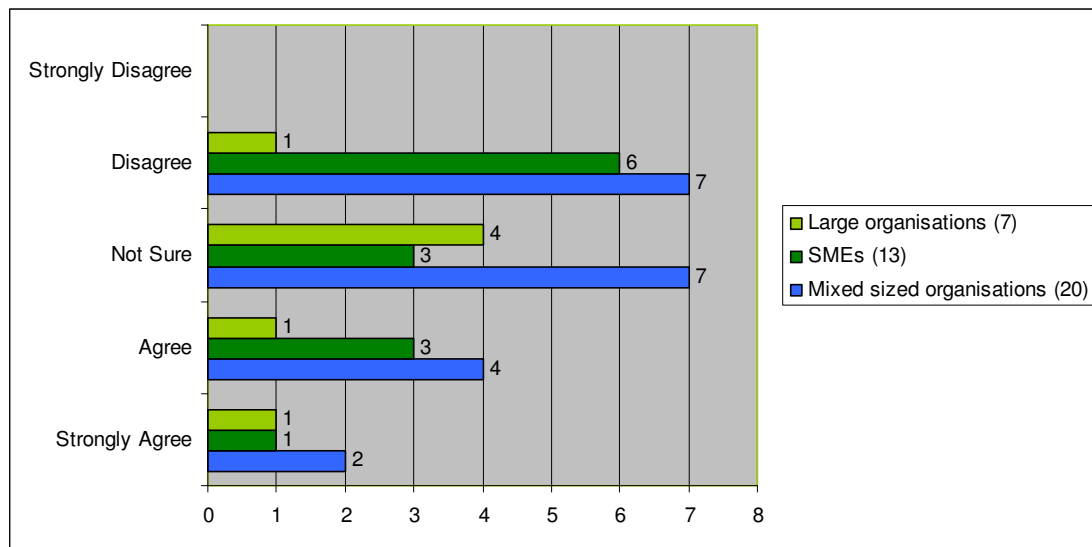
*Q20: Your organisation has sufficient resources to implement and maintain Green IT practices?*



**Figure 4.16: Results from Q20**

Having insufficient resources, both financial and human, can be a barrier to Green IT. Figure 4.16 shows 5 out of 13 SMEs are not sure if they have sufficient resources to implement Green IT actions.

*Q24: The statement your organisation is willing to pay a premium for energy-efficient IT?*

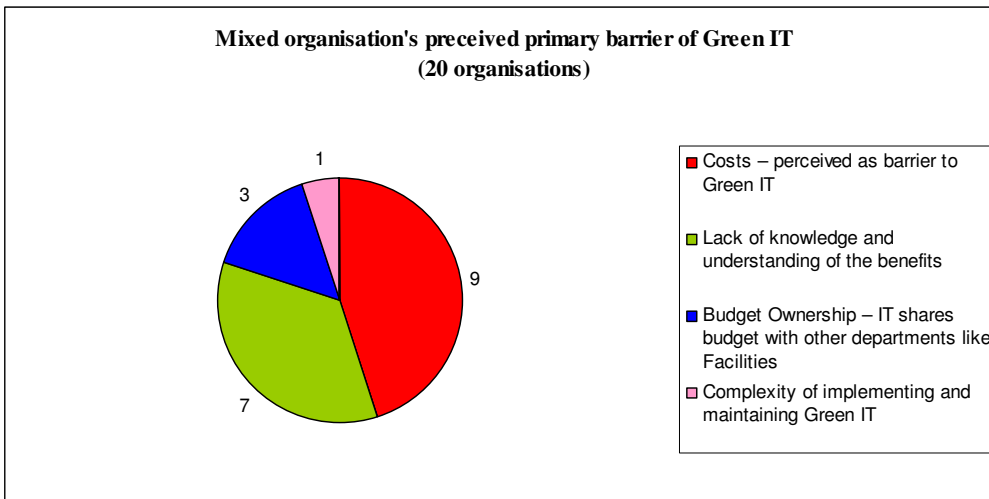


**Figure 4.17: Results from Q24**

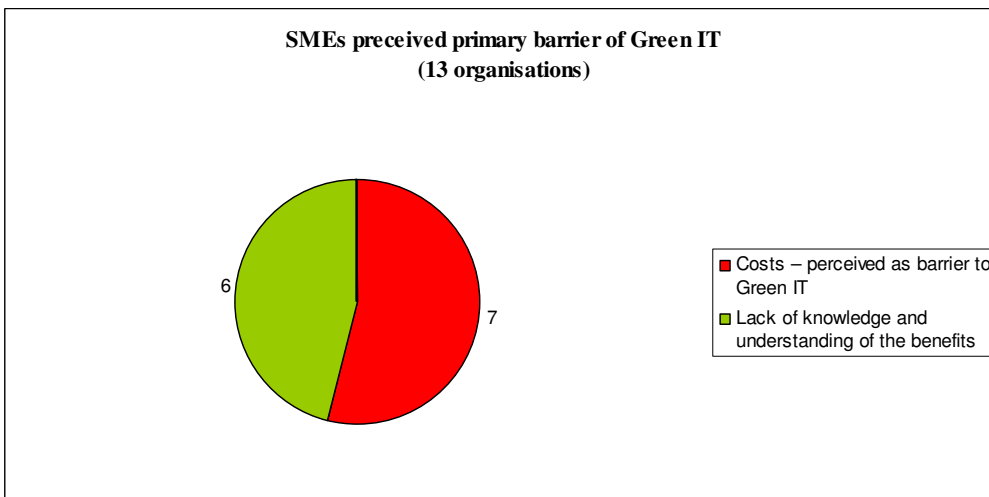
Q28 asks the respondents to select the barriers associated with Green IT in order of relevance to their organisation. The results are reflected in 4 pie charts 4.18, 4.19, 4.20 and 4.21.

It is visually clear from figures 4.18 and 4.19 that both *costs* (shaded in red) and *lack of knowledge and understanding of the benefits of Green IT* (shaded in green) are perceived to be the primary barriers to Green IT, regardless of organisation's size.

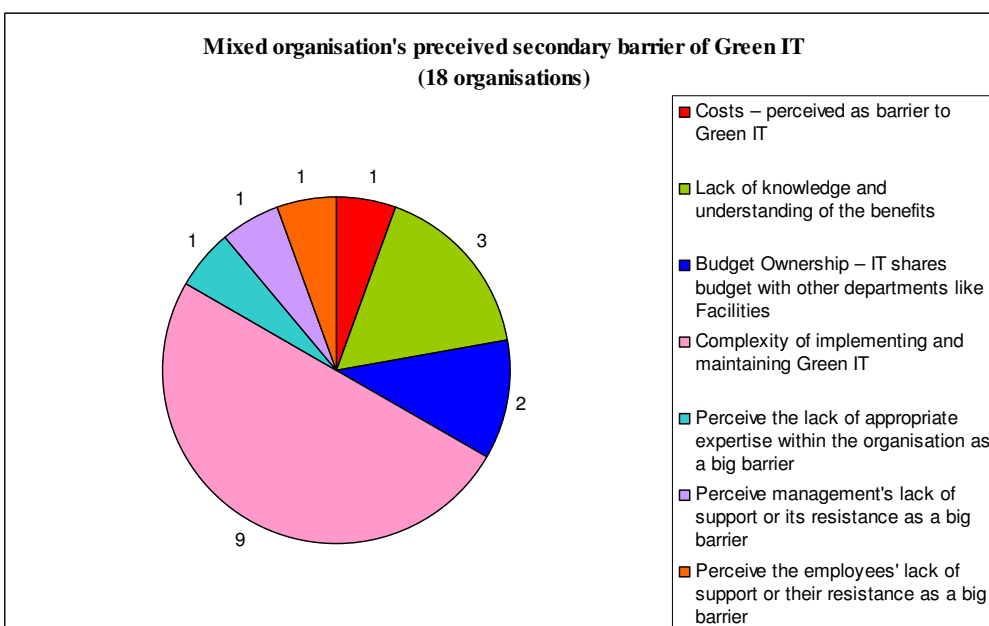
Not all the respondents selected a secondary barrier when answering this question. This is illustrated in figures 4.20 and 4.21.



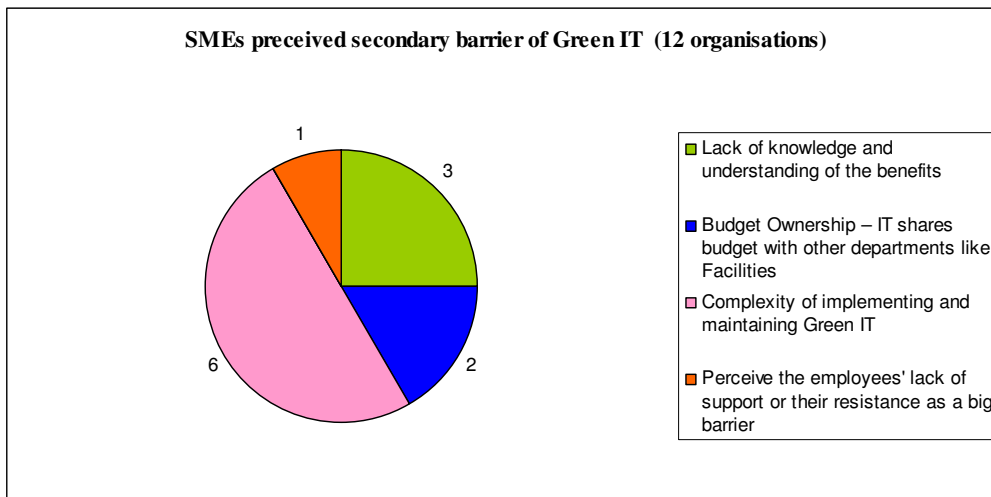
**Figure 4.18 Results from Sample of 20 Organisations**



**Figure: 4.19 Results from Sample of 13 SMEs**



**Figure: 4.20 Results from Sample of 18 Mixed-Sized Organisations**



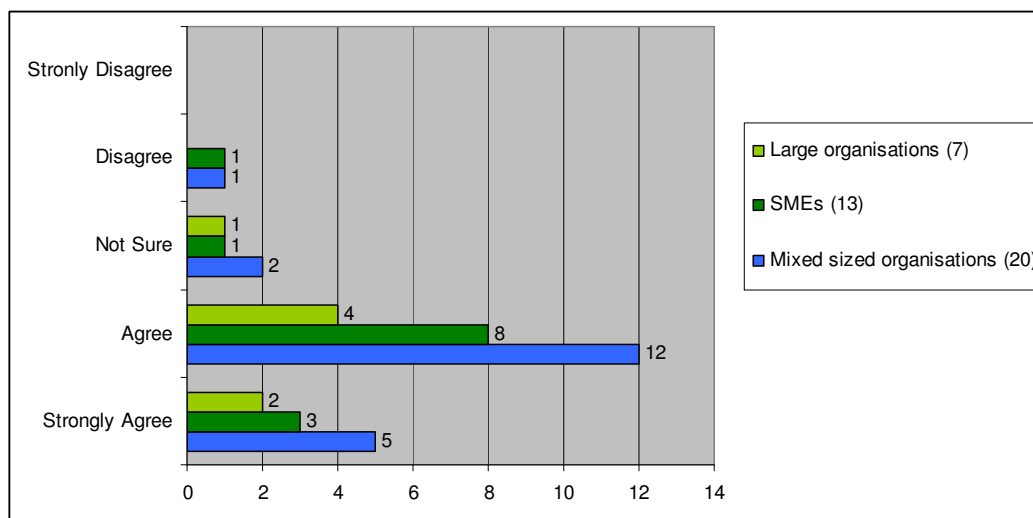
**Figure: 4.21 Results from Sample of 12 SMEs**

*Complexity of implementing and maintaining Green IT* was rated as a secondary barrier by 50% of the all sized organisations surveyed (shaded in pink).

#### 4.5.4 Benefits

Investigation of the benefits associated with Green IT meant reviewing the answers to Q21 and 27.

*Q21 Energy costs will heavily influence your organisations adoption of Green IT practices?*



**Figure 4.22: Results from Q21**

In this section, the findings are analysed to show the benefits Green IT can offer. The secondary research from the literature review highlighted 5 main benefits as follows: kinder to the environment, cost-savings, regulation compliance, improved reputation and increased efficiency. Since the advantages associated with choosing the Green IT way, need to be substantial and significant in order to grab the attention of SMEs, the findings from the primary research are noteworthy.

Q27 from the questionnaire was a ranking question in which the respondents were asked to place the listed 8 Green IT benefits in order of importance in relation to their individual organisation. The majority of respondents selected only their top three benefits in order of importance. Upon examination of the entire sample of 20 organisations (7 large and 13 SMEs), an overwhelming majority selected *reduce energy consumption and saving money* as their primary perceived benefit (refer to fig 4.23).

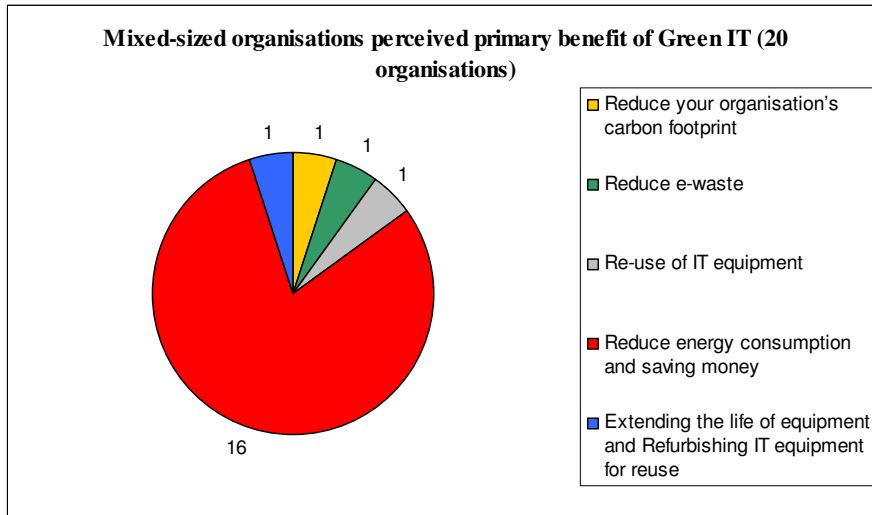
Figure 4.24 further scrutinises this emphasis. Concentrating solely on the 13 SMEs, this pie chart illustrates their first choice of benefit. An overwhelming consistency exists in their perceived primary benefit and that of the entire sample (20 organisations), (highlighted in red in both pie charts figures 4.23 and 4.24). The perceived secondary and tertiary benefit most popular among all of the sampled organisations is demonstrated in figures 4.25 and 4.27. Evaluation is restricted to the SME sector in figures 4.26 and 4.28. Clear comparisons between all 4 pie charts can be drawn.

From figures 4.25 and 4.26 it is obvious that *extending the life of equipment and refurbishment for reuse of IT equipment* as well as *reducing waste* are the most popular perceived secondary barriers. The same two benefits appear as organisation's choice of tertiary benefits as evident in figures 4.27 and 4.28.

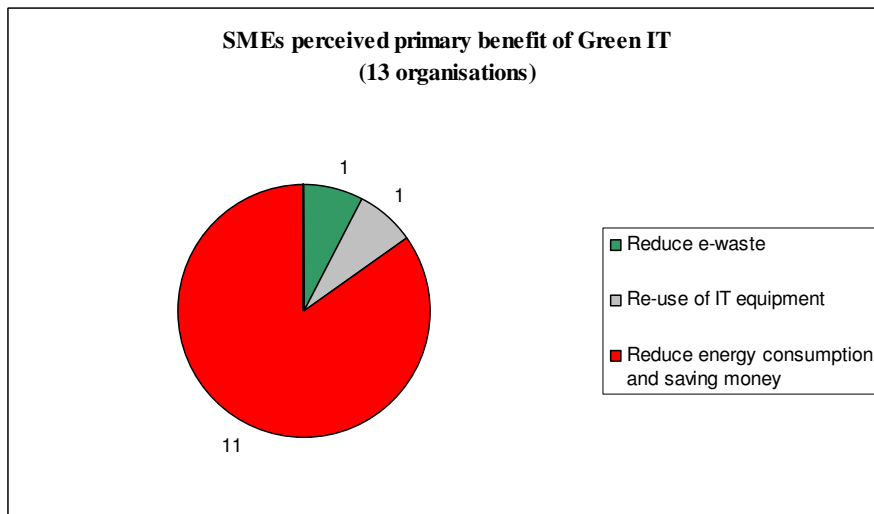
#### **4.6 Conclusion**

This chapter displayed the results obtained from the research. These results were categorised under four headings: awareness, adoption, barriers and benefits. Findings from observation, interviews and questionnaires were presented in that order. The aim

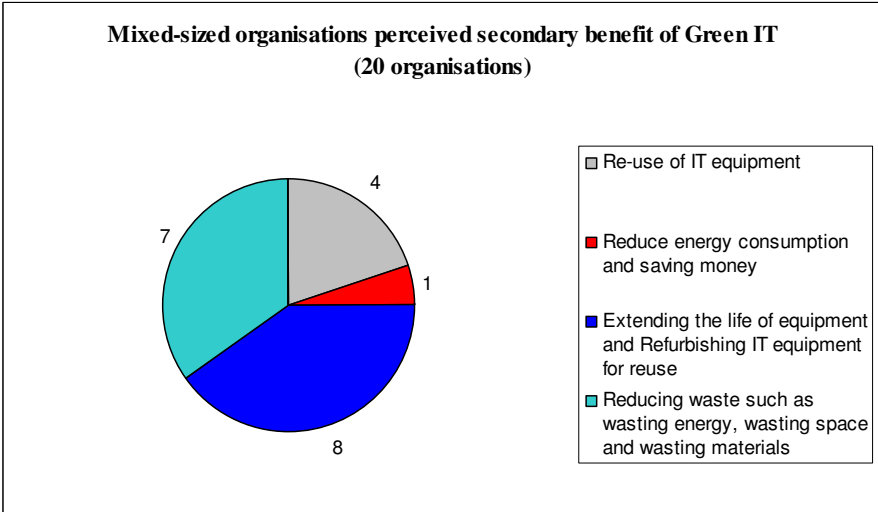
is to answer the 4 secondary research questions and equipped these answers subsequently be able to answer the study's primary research question.



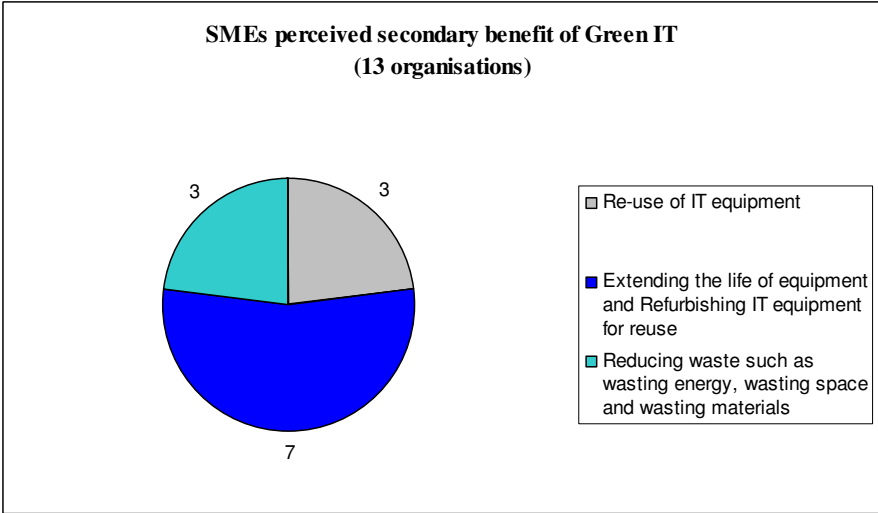
**Figure 4.23**



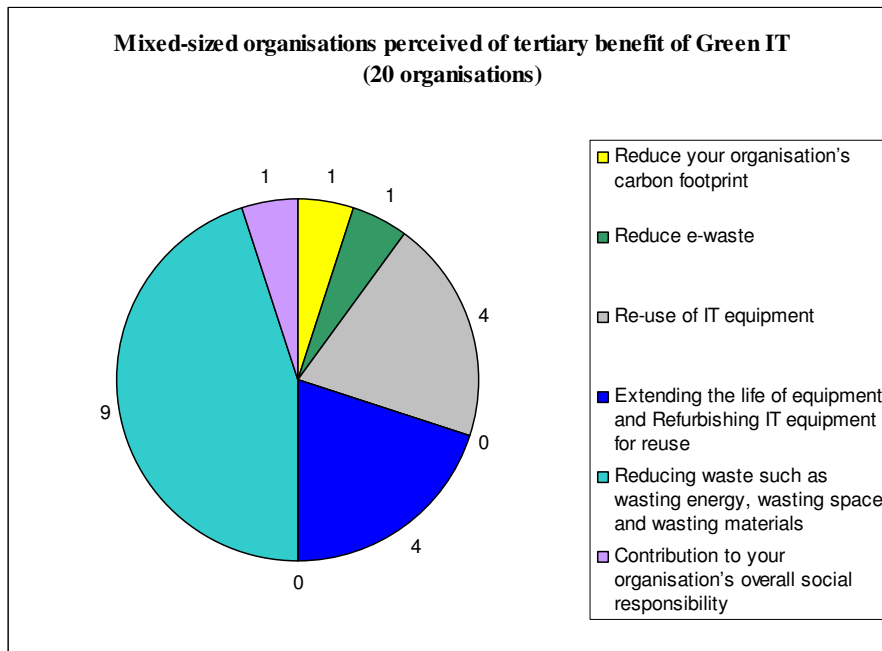
**Figure 4.24**



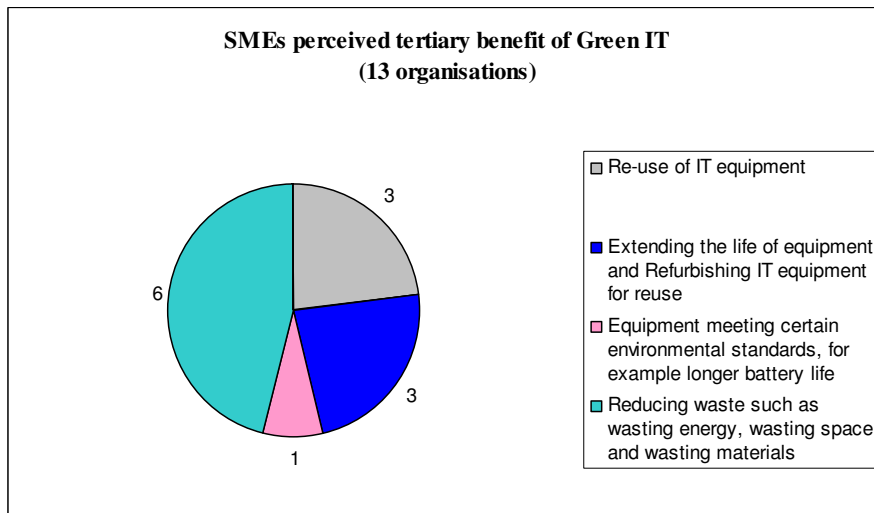
**Figure 4.25**



**Figure 4.26**



**Figure 4.27**



**Figure 4.28**



## **Chapter Five: Discussion and Conclusions**

### **5.1 Introduction:**

The objective of this chapter is to draw a conclusion on the findings of the research. The aim of this thesis is to seek an answer to the following primary question.

*PQ1: “What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?”*

This chapter will now examine the implications of the study’s findings. It will begin with a discussion on the findings from the three methods of data collection then it will outline whether these results managed to successfully address the secondary research questions and will proceed to outline a proposed Green IT framework suitable for SMEs, essentially addressing the thesis primary research question. The chapter will discuss opportunities for further research and will end with an overall conclusion of the study’s main findings and how the study contributes to academic research in the area of Green IT for SMEs.

### **5.2 Analysis**

The author remarks that, on the subject of Green IT, the words awareness and adoption are closely interconnected. An organisation is unlikely to think of, never mind embrace a new Green IT solution, if it has no prior knowledge of it or if it is unfamiliar with it. The findings in chapter 4 reinforce this statement. When carrying out interview-administered questionnaires the author noticed that many of the small organisations (<50 employees) did not know what Green IT meant.

#### **5.2.1 Observation Analysis**

In RBK’s case there was a need to consolidate print devices. Presentations to staff on the rising costs of paper consumption, printer maintenance and cartridges reinforced the business case to go Green. Although RBK has adopted several Green IT practices, it still has a long way to go on its Green journey. It is failing miserably to pick the ‘low-hanging fruit’ refers to by Pratt (2008) such as centrally controlling power management settings and defaulting duplex printing. Other potential initiatives belonging to this ‘low hanging fruit’ category are the installation of timer switches for

printers and turning off equipment when not in use such as test servers and spare computers. Transforming behaviours and mindsets is a big part of the Green movement. Regular communication with all persons involved in the Green IT project can assist also in raising awareness on the subject. Communication in the form of presentations containing hard facts and figures e.g. estimation of potential cost-savings mitigates the risk of user resistance. Notwithstanding user buy-in can make or break a Green IT project as witnessed by the researcher in her organisation.

### **5.2.2 Interview Analysis**

All interviewees except one, reported cost-savings as the main benefit Green IT has to offer them. The exception was the public sector company as it established that the main benefit it experienced from Green IT was a reduction in its organisation's carbon footprint. This is most likely because the profit seeking organisations have different priorities than the public sector ones. All of the 5 interviewees have some form of power management tool installed, such as windows group policy or specific third party software and all have enabled duplex printing as default. Therefore these firms have captured the 'low hanging fruit' successfully.

Brendan O' Looney of NUIG offers a clever suggestion for SMEs. He purposes that the savings on electricity that a small/medium-sized firm makes, resulting from power management implementation, should be put towards the firm's Christmas party or social club. This incentive would encourage Green thinking. Cyril Macken of Alienware remarked on SMEs lack of financial resources as a barrier to Green IT. He echoed the same sentiments expressed in the literature review by Pesonen (2001, p.45) and Sherlock et al (2000, p.51). Cyril advises SMEs to make better use of their existing IT equipment such as power management and limiting paper usage, as these can positively impact the firm's bottom line, while costing little to implement.

### **5.2.3 Questionnaire Analysis**

Findings from the questionnaires and interviews, confirmed the authors predictions, that organisations' and especially SMEs' main interest in Green IT, is its potential cost-savings aspect. Lessening the organisations impact on the environment is less of a concern for SMEs, but it is a nice bonus all the same. In relation to gauging individual organisations' current involvement in Green IT, figures 4.14 and 4.15 from

Chapter 4, allows for easy comparison between the 9 large organisations and the 13 SMEs that were surveyed. As suspected the adoption of Green IT occurs at a much slower rate for SMEs than for large companies. Six out of 13 of SMEs had not yet considered Green IT compared to only 1 out of the large organisations, having not yet considered it. Large organisations have the most to gain from Green IT in terms of cost-savings. Nevertheless operational expenses need to be managed in any business regardless of size and Green IT can help that process.

Lack of knowledge on the subject of Green IT is most likely due to lack of available information. As mentioned previously the whole concept of Green IT is relatively new. In the author's opinion lack of available information is a large contributing factor towards poor awareness among SMEs on the subject and hence a reason for their slow rate of adoption of Green IT practices. Figures 4.4, 4.5 and 4.6 grouped 28 questions under 4 headings. The author decided to analyse only 13 of them in detail as she felt those selected questions (bolded) were the most relevant ones in tackling the research objectives.

### **5.3 Research Questions**

The author will demonstrate if the results obtained in the study are adequate to answer all the research questions.

#### **5.3.1 Secondary Research Questions**

The study sought to address 4 secondary research questions:

***SQ1: "What levels of awareness currently exist regarding Green IT among SMEs?"***

In answering this question the author explores the mutually dependent relationship between awareness and adoption. The degree of knowledge an organisation has on the subject of Green IT will heavily determine its acceptance of and support for any new Green IT initiatives. The author postulates that the level of awareness regarding Green IT among SMEs is low since 53% of them admitted to being unsure of what activity falls into the Green IT category. Another 77% of SMEs have no knowledge of energy-efficient certifications for IT equipment such as energy star. Knowledge of energy star ratings appears to be most prevalent among larger companies.

Larger companies most likely have a dedicated IT department equipped with the necessary information, skills and resources to implement Green IT actions. Smaller organisation especially ones with less than 50 employees do not have this luxury. 92% of SMEs do not include environmental factors in their purchasing decisions. The author deduces that this may be due to the 10% premium most often charged for energy-efficient products. On a positive note 46% of SMEs declared that their employees were aware of the impact of IT equipment on the environment.

***SQ2: “What are the levels of adoption that currently exist regarding Green IT among SMEs?”***

The close connection between awareness and adoption comes into play again. The take up of Green IT practices has been faster among medium-sized firms (50 – 250 employees) than among the smaller ones (0-50 employees). Green IT initiatives that cost little or nothing to implement but result in massive cost-savings are dubbed as ‘low hanging fruit’. Defaulting duplex printing and centrally controlled power management tools fall into this category.

Duplex facilities often exist on printers already, but have never been used. Lack of knowledge is most likely the cause of this. Although third party power management software can be purchased, existing windows-based power management can also be leveraged using group policy. ‘Low hanging fruit’ does not require huge (if any) investment and the pay back is quick. In addressing the question above the author examined SMEs adoption of this ‘low hanging fruit’.

Power management and double-sided default printing are good starting points for SMEs on their Green IT path. The study showed that 54% of SMEs surveyed use some form of power management. Even so, 2 of these SMEs revealed that they leave on their computers 24 hours a day. They are obviously unaware that according to Climate Savers Computing Initiative (2009), “the average desktop PC in use, wastes nearly half the power it pulls from the wall”. The author deduces from the interview-administered questionnaires that although power management may have been activated locally on some computers this is not intentional and is not centrally

controlled. The promotion of reduction of paper use is one area that all SMEs appear to be embracing, as 77% of them advocate minimising paper consumption. Although the study identified that 38% of SMEs had implemented Green IT practices of some kind, a worrying 46 % of them have yet to consider Green IT.

***SQ3: “What are the barriers to implementing Green IT in SMEs?”***

The literature review in chapter 2 reveals that potential barriers to Green IT are: costs, culture, prioritisation and budget ownership. In addressing the question above the author will investigate, whether or not the research findings from chapter 4 agreed or disagreed with the literature.

Results from the questionnaire indicate that there is an overwhelming consistency in all organisations’ choice of primary and secondary barriers regardless of their size. For instance 45% of the 20 mixed-sized organisations select *costs* as their primary barrier while a remaining 38% selected *lack of knowledge and understanding of the benefits associated with Green IT* as their main barrier. Consequently upon closer analyses of the primary barriers that were chosen by the 13 SMEs, the results are similar to the main barriers identified by large organisations (figures 4.18 and 4.19).

53% of SMEs pick *costs* as their primary barrier while 43% pick *lack of knowledge and understanding of the benefits associated with Green IT*. Prioritisation is more of an issue for larger organisations than for SMEs. Budget ownership affects large and medium-sized organisations (50-250 employees) but is not applicable to smaller organisation (<50 employees).

An interdependent relationship between all 4 research questions unfolds here. In figures 4.18 and 4.19, the *lack of knowledge of the benefits of Green IT* option was selected by many organisations as one of the primary barriers to Green IT. This in turn creates a domino effect. If SMEs do not know about Green IT, then it means that opportunities do not get identified and so as a result adoption of Green IT is low.

In line with the literature, the research study acknowledged costs as a perceived primary barrier to Green IT projects (figure 4.24). The author recommends that SMEs

first implement the frequently referred to ‘low hanging fruit’ or quick wins. The evident success of these changes will help gain employee buy-in, for more sophisticated Green IT initiatives. The *complexity of implementing and maintaining* Green IT was perceived by 53% of SMEs as a secondary benefit associated with Green IT. While 23% of SMEs selected *re-use of IT equipment* and another 23% selected *reducing waste* as their perceived secondary Green IT benefit.

***SQ4: “What are the benefits SMEs can achieve by implementing Green IT?”***

Five benefits that Green IT can achieve for all types of organisations were outlined in the literature review chapter. These were: lowering impact on the environment, cost-savings, regulation compliance, improved reputation and increased efficiency. From the research findings, it is obvious regarding Green IT that a strong consistency exists in organisation’s choice of primary benefit regardless of its size (figures 4.23, 424). Eleven out of 13 surveyed SMEs selected *reduce energy consumption and saving money* as their primary benefit. These results can be compared with Forrester’s 2007 Global Green IT Online survey. Forrester reported that 55% out of 130 surveyed participants cited reduce energy-related operating expenses as their main motivation for pursuing Green IT. In this study 85% of SMEs considered cost savings and reduced energy consumption as their main driver behind Green IT. Extending the life of equipment and refurbishing IT equipment for reuse was considered by 7 out of 13 SMEs to be the secondary benefit of Green IT. Figure 4.22 reinforces this cost-saving aspect, indicating that rising energy costs will heavily influence an organisations probability of adopting Green IT practices.

By comparing findings from the 20 mixed-sized organisation with the findings from the 13 SMEs it can be easily seen that *the reducing your carbon footprint* benefit is not considered by SMEs as relevant. This fortifies previous assumptions regarding SMEs, that is, they are not overly concerned for the environment and are more interested in the bottom line impact. The author suspects this occurs too because CSR and company reputation such as being seen as Green, appear to be less of an imperative for the SMEs than for their larger counterparts.

To draw a close on the potential benefits Green IT can offer SMEs the author wishes to briefly touch on how a particular Green IT practice improved the efficiency of a business process in her workplace. She witnessed how this particular Green IT initiative streamlined one of the business process by reducing the number of steps involved, removing waste thereby focusing on value-added steps and speeding up the entire process. The process was the ‘deal with incoming faxes’ process. Fax machines were configured to direct incoming faxes to an email mailbox. The secretaries were granted access to these fax mailboxes. Incoming faxes no longer arrived in physical paper format. This new set up not only reduced paper use, it improved the efficiency of the ‘deal with incoming faxes’ process.

Essentially prior to this Green IT change, the secretaries would get up from their desks and check the fax machine for faxes. They would deal with them by scanning a copy of the hardcopy fax into their email. They would then open their email and forward on this particular fax to the intended recipient in the office. The introduction of the faxes in email format reduced the steps in this business process from 4 down to 2. Now the secretaries just keep an eye out for new email in the fax mailbox and forward these faxes onto their intended recipients.

### **5.3.2 Primary Research Question**

The above discussions in relation to the secondary research questions have been merely acting as a platform for the next part of this assessment. Following on from deliberations on awareness, adoption, barriers and benefits, the author will now lead the reader up to the crux of the thesis that is the provision of the ultimate answer to the primary research question:

*PQ1: “What is the best-practice cost-saving innovative Green IT framework most suited to SMEs?”*

After careful review of the literature and thorough analysis of the findings obtained using the study’s selected research methodology, the author proposes a Green IT framework appropriate to SMEs individual needs. This framework is made up of 7 steps (figure 5.1) and they are as follows:

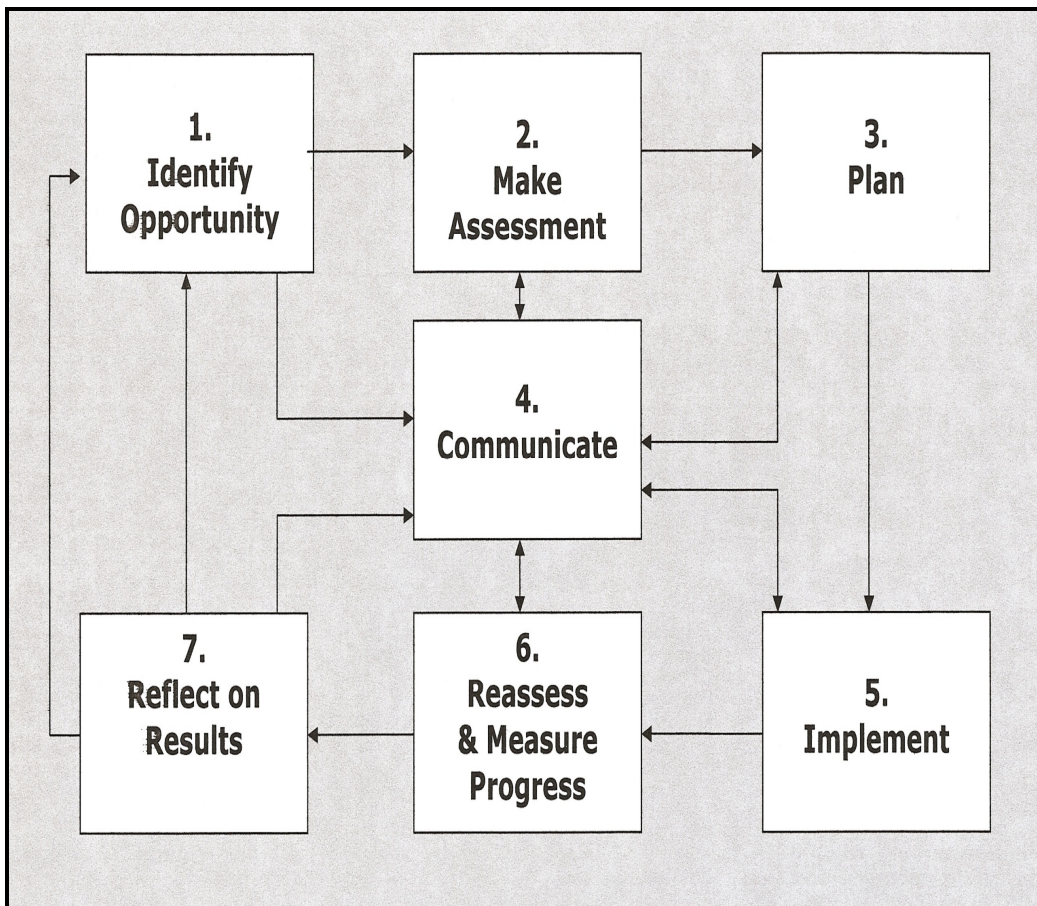
1. Identify Opportunity
2. Make Assessment
3. Plan
4. Communicate
5. Implement
6. Measure Progress
7. Reflect on Results

1. **Identify Opportunity:** The benefits Green IT can offer an SME are: helping the environment, cost-savings, regulation compliance, improved reputation and improved efficiency. The first step for SMEs on their Green IT path is to identify the various opportunities Green IT can offer. Whether the SME's motive be: save the company money, improve on its efficiency, improve its image, comply better with regulation or save the planet, Green IT can assist in that task. SMEs that are quipped with the knowledge of what is Green IT and of the benefits it can offer will be better able to spot opportunities than those firms with little or no awareness of Green computing. These firms will be able to easily recognise areas suitable for improvement and where to make cost-savings (e.g. on paper or power).
  
2. **Make Assessment:** This step involves monitoring and measuring of entities such paper usage, power consumption. At this step SMEs should establish their own baseline energy use and find out how much energy is being consumed by IT equipment alone. As described in the literature review in chapter 2, outside assistance may be required from electricians. Plug-in energy monitors can also assist in this task. Once a baseline has been established then performance metrics can be selected. The type of performance metrics used will be specific to each SME's individual requirements. Suggested metrics from the literature review are: print devices per employee, IT energy consumption per employee, IT energy consumption per workstation, pages printed per employee and paper waste per employee. Equipped with information from this assessment phase SMEs can make informed decisions as to which Green IT practices that would be most appropriate to them.



3. **Plan:** SMEs must make a detailed plan prior to implementation of any Green IT practices. It is at this stage that barriers to the Green IT project should be anticipated and a plan should be made to mitigate the risk of user resistance. When selecting what practices to implement it is recommended to work off a pre-defined list of Green IT practices such as the one supplied from Terrabytes Consulting (2009) as outlined in figure 4.1 in chapter 4.
4. **Communicate:** The purpose of the communication phase is to raise awareness internally and also externally with equipment suppliers. It is recommended that the organisation must clearly communicate its plan regarding Green IT practices and explain to all parties involved why it is choosing this route. Clear communication and close collaboration between various departments involved in the project (such as IT and facilities) is also an essential key to success. This collaboration between departments will be more of an issue for medium sized firms than small ones (<50 employees). If anything communication should be easier in SMEs than larger firms as SMEs tend to be less bureaucratic and more flexible. The importance of the communication phase is clearly illustrated in figure 5.1. Feedback is crucial throughout the 7-step framework.
5. **Implement:** In accordance with the pre-defined list of Green IT practices (figure 4.1) Green IT actions can be classed into four practice areas. These are policies and performance management, strategic asset management, energy consumption and supporting Green business. Practices can be implemented head-on or as part of a pilot scheme. Barriers such as behavioural inertia should be anticipated prior to implementation of practices.
6. **Measure progress:** It is crucial that progress be measured. The old catch phrase you can manage what you can't measure is very true. Comparison of post project's IT consumption of energy use can be compared with the original IT baseline. Analysis on whether or not the implemented Green IT initiatives have brought the company cost-savings is important. Results from this stage will encourage or discourage future Green IT projects. Questions like: is there less waste, is the electricity bill lower, has efficiency improved, or is there now better utilisation of equipment, are answered.

**7. Reflect on results:** The results and measurements from the previous measure progress phase is evaluated and examined here. A decision to implement more Green IT practices may be made following the success of the previously implemented one. As can be seen from figure 5.1 the results from this step will feed back into stage 1 and the whole process begins again. For instance, to start, a small or medium-sized firm could follow the 7-step framework by installing duplex printing as default. Next they could repeat the whole 7 steps and install power management tools.



**Figure 5.1: Proposed Green IT Framework Suitable for SMEs**

#### **5.4 Further Research**

Comparisons between the Lean Methodology and Green Movement have been made (Greener 2008). The author feels an investigation into the link between Lean and Green would be an ideal topic for further research. Lean is effectively a constant search to develop and implement methods which optimise a business process by trying to link the value added steps of the process while eliminating or reducing the wasteful non-added value steps. Green concentrates its efforts on decreasing the carbon footprint. Greener (2008) believes, 'Lean' can guide your organisation to 'Green' while Cooper (2009) argues that these approaches are not the same so should not be compared nor confused. Interviewees were asked their opinion on whether they felt there was a connection between the 2 philosophies. The general consensus from all of them was that, although Lean and Green mean different things, they are not mutually exclusive as they both focus on waste reduction.

If a bigger sample was used in the research methodology then richer and more varied data could have been collected. Consequently all of the organisations surveyed except for 1, were located in Ireland. Further research could extend the study to include SMEs from other European countries.

#### **5.5 Overall Conclusion**

The study demonstrated that as of August 2009, the level of awareness regarding Green IT is low. Just over half of the SMEs surveyed, admit to not knowing, what practices belong to the Green IT category. SMEs in general are slow to adopt Green IT practices particularly when compared to their larger counterparts. The study identified that a worrying 46 % of SMEs surveyed, have yet to consider Green IT.

The level of knowledge a firm possesses on the subject of Green IT will greatly determine the rate at which it will embrace any new Green IT technique. In conjunction with that, raising awareness on the potential benefits and barriers associated with Green IT can accelerate the adoption process of new Green IT ways.

In relation to Green IT the barriers that SMEs encounter are: costs, lack of knowledge and understanding of the benefits associated with Green IT, culture, resistance from

employees, resistance from top management and budget ownership. The study revealed that the benefits SMEs can achieve by implementing Green IT are: being kinder to the environment, cost-savings, regulation compliance, improved reputation and increased efficiency.

Upon reflection of the findings from the study, the author proposes a list of guidelines for SMEs, in relation to their approach to Green IT projects. These guidelines make up a 7-step framework. The steps are as follows: Identify Opportunity, Make Assessment, Plan, Communicate, Implement, Measure Progress and Reflect on Results. The author's proposed 7-step framework essentially addresses the primary research question of the study.

This proposed framework contributes to academic research on Green IT and it provides direction and guidance to SMEs as to how to proceed with a Green IT project. It can be tailored to SMEs individual needs and it combines the right mix of creativity and discipline into a structured yet flexible process.

This framework is a cost-saving one, as the study focused on those Green tactics that cost little or nothing to implement ('low-hanging fruit') like turning off PCs and printers at night, using double-sided printing and utilising power management systems to turn off computers when idle.

This framework is called a best practice one, as it is, in the author's opinion, the most efficient and effective way of completing a Green IT project. Figure 5.1 shows that the framework is based on repeatable procedures. Green IT development is still at an early stage. The author expects the technology behind Green IT solutions to be ever-evolving and improving hence why the framework is called an innovative one.

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## **Appendix 1: Interview Questions**

### **General Questions Provided to Interviewee in Advance of Interview:**

1. What if any, kind of Green IT initiatives has your organisation implemented?
2. What kind of Green IT initiatives does your organisation plan to implement in the future?
3. What kind of barriers did your organisation come across when it was implementing Green IT initiatives?
4. According to a Green IT guide composed by Terrabytes Consulting, Green IT initiatives for the IT department can be organised into four major categories. Please examine these categories and select the initiatives your organisation has implemented or plans to implement in the future.

#### **Practice Area 1 – Policies and Performance Management**

Implement a responsible environmentally aware purchasing policy

Implement an electronics and IT equipment recycling policy

Include environmental performance in performance reviews for employees

#### **Practice Area 2 – Strategic Asset Management**

Integrate measures to extend hardware lifespan in strategic plan

Plan incremental upgrades for mid-life hardware

Lease, rather than purchase, more efficient hardware

Upgrade power supplies for mid-life computers where possible

Replace inefficient equipment with responsibly purchased new equipment

Consolidate, virtualize and/or host your servers

#### **Practice Area 3 – Energy Consumption**

Implement aggressive power management

Consolidate and reduce the number of deployed devices

Evaluate the layout and design of the server room

#### **Practice Area 4 – Supporting Green Business**

Implement duplex printing by default where possible

Enable network scanning and desktop faxing

Develop posters and presentations with energy- and paper-saving techniques

Use of videoconferencing / web meetings to reduce travel

Provide infrastructure to support telecommuting

Support electronic document management system i.e. paperless office



### **More Specific Questions Asked during the Interview:**

1. How many employees in the organisation?
2. Tell me about your experience of Green IT?
3. Do you use power management on your computers or peripherals such as monitors?
4. How many
  - a) Client computers (desktops and laptops),
  - b) Servers,
  - c) Dedicated printers, scanners, copiers and faxes,
  - d) Multi function devices (MFDs)

Has your organisation got?

5. Do you use virtualization?
6. The facilities department often needs to collaborate with IT for many Green IT projects. Did you find this collaboration difficult?
7. Do you plan to replace computers every 3 or 4 years?
8. Do you have dedicated computer suppliers?
9. What was main motivation behind your Green IT project?
10. Were computer users and employees aware of Green IT before you started the Green IT project?
11. There are a lot of small changes that can be made in an organisation in relation to Green IT that don't cost little or nothing at all, such as reducing printing and power management. Do you agree?
12. Green has an old image of costing money and of sacrifice, do you agree?
13. What are the benefits of this Green IT project?
14. Do you have an official procurement policy?
15. Do you have a policy to minimise unnecessary printing?
16. Is double-sided / duplex printing defaulted?
17. Can a user change the printer default settings?
18. Does your organisation support other Green initiatives outside IT?
19. Is there promotion to use video conferencing facilities instead of travel to meetings?
20. What about home working, is it encouraged?
21. What barriers and limitations did you encounter when implementing the Green IT project?

22. How did you overcome those barriers?
23. Did the Green IT initiative you introduce improve ease of administration?
24. Did the Green IT initiative you introduce provide significant cost-savings?
25. What is plan for the future regarding Green IT?
26. The Lean methodology is all about reducing and eliminating waste, and streamlining processes with the result being that organisations become more efficient, improve productivity, become more competitive and therefore increase revenue. Specifically the Toyota lean process defines seven wastes that should be identified: motion, processing, transport, excess inventory/backlog, defects, delays and overproduction. Do you believe that lean and Green are linked?
27. Do you ever lease rather than purchase IT equipment? Leasing is classed as a Green IT action in Terrabytes Consulting Green IT guide.
28. Do you use confidential or private secure printing?

## Appendix 2: Questionnaire

**Date:** \_\_\_\_\_ **Name:** \_\_\_\_\_

**Job Title:** \_\_\_\_\_

**Company Name:** \_\_\_\_\_

**Confidentiality:** Do you wish to keep either your name or the name of your organisation, confidential in the final submitted thesis? (Please tick one)

Yes

No

**No. of employees:**

1-10	[ ]
10 – 50	[ ]
50 – 100	[ ]
100 – 150	[ ]
More than 150	[ ]

**Please describe the nature of your company's business:**

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**No. of client computers (desktops and laptops):** \_\_\_\_\_

**No of Servers:** \_\_\_\_\_

**No of dedicated Printers:** \_\_\_\_\_ **No of dedicated Copiers:** \_\_\_\_\_

**No of dedicated Scanners:** \_\_\_\_\_

**No of dedicated fax machines:** \_\_\_\_\_

**No of Multifunction devices i.e. printer / scanner / copier all in one:** \_\_\_\_\_

**No of Multifunction devices i.e. printer / scanner / copier / fax all in one:** \_\_\_\_\_

1. Do you have a dedicated server room / comms room / data centre? (Please tick one)

Yes

No

---

2. Do you have air conditioning specifically for your server (s)? (Please tick one)

Yes

No

---

3. Does your organisation have power management implemented on PC and peripherals? (Please tick one)

Yes

No

---

4. In relation to IT equipment the total cost of ownership (TCO) is sum of the cost of deploying, maintaining, disposing, electricity/power consumption and also cooling costs which is significantly greater than the acquisition cost. Does your organisation consider the TCO of IT equipment when purchasing?

Yes

No

---

5. Does your organisation encourage reducing unnecessary printing?

Yes

No

---

6. Do you promote travel reduction by use of videoconferencing and /or web meetings?

Yes

No

---

7. Do you promote travel reduction by use of home-working?

Yes

No

---

8. Do you know what percentage of your organisation's energy use is attributed to IT equipment?

Yes

No

---

9. Does your organisation include environmental factors in purchasing decisions regarding IT equipment?

Yes

No

---

10. Does your organisation actively recycle old IT equipment?

Yes

No

---

11. Does your organisation have a written policy regarding recycling of old IT equipment?

Yes

No

---

12. Are your organisation's employees aware of the environmental impact of IT equipment?

Yes

No

---

13. Does your organisation actively try to extend the lifecycle of your IT equipment?

Yes

No

---

**14. Which of the following statements best describe your company's current involvement with Green IT? (Please tick one).**

We have not considered Green IT yet [ ]

We have spoken informally about Green IT [ ]

We have formally investigated Green IT [ ]

We are planning to launch a Green IT project [ ]

We are currently running a Green IT project [ ]

We have implemented some Green IT practices but will not be implementing anymore [ ]

We have implemented some Green IT practices and are planning to implement some more Green IT practices [ ]

Other: (Specify) [ ]

For each of the following statements please tick the box that matches your views most closely:

**15. Green IT offers, or has the potential to offer, your organisation significant benefits.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**16. Green IT is consistent with your overall organisational strategy.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**17. Your organisation is fully aware of what initiatives/actions are categorised as Green IT**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**18. The cost of implementing Green IT practices is justified by the benefits to be received.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**19. The top management team in your organisation is pro-actively supporting and leading the drive for Green IT practices.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**20. Your organisation has sufficient resources to implement and maintain Green IT practices.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**21. Energy costs will heavily influence your organisations adoption of Green IT practices.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**22. Your organisation is aware of several Green IT practices that cost very little or nothing at all to implement such as double sided printing and turning off IT equipment when not is use.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**23. Your organisation is aware of current environmental certifications for IT equipment such as EPEAT (a system to help purchasers evaluate, compare and select electronic products based on their environmental attributes) and Energy Star.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**24. Your organisation is willing to pay a premium for energy-efficient IT products.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**25. The current recession of 2009 is discouraging investments in Green IT.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

---

**26. The current recession of 2009 is actually a motivator for Green IT.**

Strongly  
Agree

Agree

Not Sure

Disagree

Strongly  
Disagree

**27. Perceived Benefits of Green IT**

**Please number each of the benefits listed below in order of importance to your organisation. Number the most important 1, the next 2 and so on. If a factor has no importance at all, please leave blank.**

- Reduce your organisation's carbon footprint [ ]
- Reduce e-waste [ ]
- Re-use of IT equipment [ ]
- Reduce energy consumption and saving money [ ]
- Extending the life of equipment and Refurbishing IT equipment for reuse [ ]
- Equipment meeting certain environmental standards, for example longer battery life [ ]
- Reducing waste such as wasting energy, wasting space and wasting materials [ ]
- Contribution to your organisation's overall social responsibility [ ]

Comment:

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**28. Perceived Barriers to and challenges associated with Green IT**

**Please number each of the 9 barriers listed below in order of relevance to your organisation. Number the most important 1, the next 2 and so on. If a factor has no importance at all, please leave blank.**

- Culture – The business does not care about being Green [ ]
- Costs – perceived as barrier to Green IT [ ]
- Prioritisation – Not sure what to Green first (PCs, printers, servers) [ ]
- Lack of knowledge and understanding of the benefits [ ]
- Budget Ownership – IT shares budget with other departments like Facilities [ ]
- Complexity of implementing and maintaining Green IT [ ]
- Perceive the lack of appropriate expertise within the organisation as a big barrier [ ]
- Perceive management's lack of support or its resistance as a big barrier [ ]
- Perceive the employees' lack of support or their resistance as a big barrier [ ]

Comment:

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**29. Please tick the box beside the Green IT practice below that your organisation has introduced. Please leave blank if your organisation has not implemented the practice.**

**Practice Area 1 – Policies and Performance Management**

- Implement a responsible environmentally aware purchasing policy [ ]
- Implement an electronics and IT equipment recycling policy [ ]
- Include environmental performance in performance reviews for employees [ ]

**Practice Area 2 – Strategic Asset Management**

- Integrate measures to extend hardware lifespan in strategic plan [ ]
- Plan incremental upgrades for mid-life hardware [ ]
- Lease, rather than purchase, more efficient hardware [ ]
- Upgrade power supplies for mid-life computers where possible [ ]
- Replace inefficient equipment with responsibly purchased new equipment [ ]
- Consolidate, virtualize and/or host your servers [ ]

**Practice Area 3 – Energy Consumption**

- Implement aggressive power management [ ]
- Consolidate and reduce the number of deployed devices [ ]
- Evaluate the layout and design of the server room [ ]

**Practice Area 4 – Supporting Green Business**

- Implement duplex printing by default where possible [ ]
- Enable network scanning and desktop faxing [ ]
- Develop posters and presentations with energy- and paper-saving techniques [ ]
- Use of videoconferencing / web meetings to reduce travel [ ]
- Provide infrastructure to support telecommuting [ ]
- Support electronic document management system i.e. paperless office [ ]

**30. Please tick the box beside the Green IT practice below that your organisation plans to introduce. Please leave blank if your organisation has no plans to implement the practice.**

**Practice Area 1 – Policies and Performance Management**

- Implement a responsible environmentally aware purchasing policy [ ]
- Implement an electronics and IT equipment recycling policy [ ]
- Include environmental performance in performance reviews for employees [ ]

**Practice Area 2 – Strategic Asset Management**

- Integrate measures to extend hardware lifespan in strategic plan [ ]
- Plan incremental upgrades for mid-life hardware [ ]
- Lease, rather than purchase, more efficient hardware [ ]
- Upgrade power supplies for mid-life computers where possible [ ]
- Replace inefficient equipment with responsibly purchased new equipment [ ]
- Consolidate, virtualize and/or host your servers [ ]

**Practice Area 3 – Energy Consumption**

- Implement aggressive power management [ ]
- Consolidate and reduce the number of deployed devices [ ]
- Evaluate the layout and design of the server room [ ]

**Practice Area 4 – Supporting Green Business**

- Implement duplex printing by default where possible [ ]
- Enable network scanning and desktop faxing [ ]
- Develop posters and presentations with energy- and paper-saving techniques [ ]
- Use of videoconferencing / web meetings to reduce travel [ ]
- Provide infrastructure to support telecommuting [ ]
- Support electronic document management system i.e. paperless office [ ]