VICTORIA UNIVERSITY OF WELLINGTON

*Te Whare Wananga o te Upoko o te Ika a Maui*

# Assessing Green Information Technology/ System capabilities and practices within a University context

A Case Study presented to the

## School of Information Management

## Victoria University of Wellington

in partial fulfilment of the requirements for the course on

MMIM590: Case Study Research Project

By

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# Case Study Abstract

The IT industry has responded to the call for change, with the looming climate change agenda, through greening of technology (Green IT) and finding ways to green by technology (Green IS). The extant literature on Green IT/IS has also developed to recognise the role IT/IS can play in supporting organisation's environmental sustainability objectives. There is a demand for research and case studies to inform the development of best practices and identification of innovative measures to combat climate change through IT/IS. Universities represent organisations that are large technology users. This this case study analyses the Green IT/IS practices of a University through two academic frameworks: G-readiness and Eco-goals. To support the demand for information in this area, this case study seeks to understand the Green IT/IS practices and capabilities of a University through the G-readiness goals and align these to eco-goals. Through this exploration a maturity benchmark is established and recommendations provided to enhance Green IT/IS activities.

**Keywords:** Green IT, Green IS, eco-goals, g-readiness maturity, environmental sustainability

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# 1 Executive Summary

## 1.1 Green IT/IS practices and capabilities within a University Context

Universities represent one of the largest users of technology. While the IT industry has made strides in greening their operations and services, this case study seeks to explore the Green IT/IS practices and capabilities within a University context. A New Zealand University is used in the case study.

### 1.1.1 Case Study Objectives

Through information collected from 7 semi-structured interviews with Green IT/IS stakeholders, online research and reports made available by the organisation, the case study sought to support the objectives of identifying Green IT/IS activities, understanding the forces on these activities, exploring perspectives, assessing overall Green IT/IS effort, activities and how they aligned with eco-goals and finally to identify opportunities for improvement.

The selected academic frameworks used as an analysis approach include the (Molla, Cooper, & Pittayachawan, 2011) G-readiness framework and Eco-goals framework.(Brooks, Wang, & Sarker, 2012). The G-readiness framework provides a means of benchmarking an organisations Green IS effort and the Eco-goals framework supports the alignment of Green IS activities with overall organisation approaches to greening objectives.

### 1.1.2 G-Readiness Framework

#### *1.1.2.1 Practices*

The University support several green user, green procurement and green organisation practices. This aspect is rated well according to the of G-readiness framework. However there is a reliance on external vendors to set the standard with Green IT/IS. These expectations however require assurances that the University needs to make. There is also a strong focus on the bottom line which can become a restraining barrier to Green IT/IS practices within the organisation.

#### *1.1.2.2 Technology*

Green IT/IS initiatives and projects have supported the implementation of a range of commendable technology efforts. These include a free-cooling data center with a PUE of ~1.35, 80% virtualisation and in particular 90% of e-waste is recycled. These directly support the University's energy strategy and reflect an energy efficiency and e-waste focus. Some of the barriers identified in this dimension include lack of senior management support, technology evaluation tools and technology conflicts with current practices.

#### *1.1.2.3 Governance & Policy*

The University's move to incorporate sustainability as a strategic theme is noted as a step in the right direction. As it is new, the policies and resource allocation to support Green IT/IS still needs further development to reflect this strategic stance. There is a need to create a structure to support champions across the University and ensure Green IT/IS is on the agenda at Senior Management level discussion. Memberships in environmental sustainability focuses forums help support reflection and benchmarking of some Green IT aspects within the University.

#### *1.1.2.4 Attitude among key Green IS stakeholders*

The potential of Green IT/IS in supporting environmental sustainability is not fully recognised or understood. There is a myopic focus on efficiency /e-waste that is reflected in senior level attitudes towards Green IT/IS initiatives. There is a difficulty identified in recognising the value of Green IT/IS and there is a demand for the University to be better at 'telling the story'.

#### *1.1.2.5 Eco-Goals*

Green IT/IS efforts focus predominantly on eco-efficiencies and some aspects of eco-effectiveness through their collaboration with various stakeholders during project implementations. In order to complement these approaches greater focus is needed on eco-collaboration to enhance eco-effectiveness.

## 1.2 Recommendations

| | |
|---|---|
| **Practice** | 1. Move from a passive to proactive practice in evaluating and preferring Green suppliers which is supported by a policy with rigorous environmental standards around procurement.<br>2. Reconsider the University's evaluation model of IT procurement. While cost is a valid business consideration it should not be the main constraint for environmental considerations.<br>3. Develop assurances around vendor practices to support environmental sustainability in the procurement lifecycle<br>4. Consider incorporation of ISO 1400 into practices<br>5. Support IT department energy auditing and monitoring as an organisational practice.<br>6. Incorporate Green IT/IS reporting and metrics into overall University Environmental Sustainability Reports. |
| **Technology** | 1. Improve performance in purchasing of gold star EPEAT equipment.<br>2. Fleet Management system is recommended in tandem with the development of green user practices to better leverage environmental sustainability goals.<br>3. Review Total cost of ownership models used in evaluating potential technologies. |
| **Governance** | 1. Develop a Green IT/IS Strategy or incorporate into new IS Strategy.<br>2. Ensure CIOs have co-ownership and responsibility in driving IT-related green initiatives.<br>3. Decentralise environmental sustainability roles and/or create a structure which supports sustainability and Green IT/IS champions across the university community.<br>4. Develop a supporting information system that allows for sharing of information across the University; eg create capabilities for students and faculties to monitor and report on their energy usage<br>5. Ensure Green IT/IS is an agenda item in senior management discussions to reflect the sustainability intention and potential of IT/IS to address environmental sustainability goals<br>6. Developing a funding model to provide more support in terms of funding, human resources and infrastructure for Green IT/IS initiatives across different areas of the University.<br>7. Develop a Green IT/IS policy framework to: * reflect current practices * ensure robustness of policies in this area * and incorporate best practices principles in guiding future activities<br>8. Incorporate into policy a mechanism for assessment and monitoring of Green IT/IS to enhance extent to which these policies are implemented. |
| **Attitude** | 1. Promote an understanding of the potential of Green IT/IS focusing on Green IT/IS potential.<br>2. Develop and implement a change management programme which addresses the impetus to shift the attitudes of the University community towards one which values and actively supports environmental sustainability initiatives and the role Green IT/IS plays. |
| **Eco-goals** | 1. Direct greater focus towards eco-collaboration and eco-effectiveness goals in strategic development.<br>2. Work with relevant marketing and communications section & develop a communications plan to support 'telling of the story' - how Queen's University is supporting environmental sustainability through Green IT/IS initiatives.<br>3. Utilise the brain power within the university to develop and frame messages to have greater impact by highlighting the environment perspective as opposed to the business<br>4. Create innovative and engaging ways to tell the story and send out messages. Visual impactful information proliferated across all internal & external channels.<br>5. Interweave environmental sustainability into University teaching and learning courses.<br>6. Identify opportunities for collaborative projects in Green IT/IS. |

# 2 Case Description

## 2.1 University context

Queen's University[1] is a Higher Education Institution in New Zealand. It caters to a staff and student population of about 30,000 over several campuses within the country. The fleet of technology required to support a community of users this size, coupled with generational technological demands places many Universities in the top league of biggest technology users. From desktops, laptops to infrastructure needs in the form of data centers and servers, the technology kit can add up. For Queen's University, this placed them in the top 100 biggest technology users in the country. Of the Universities ranked, Queen's University placed in the top five (CIO New Zealand, 2015).

The management of such a large fleet of computers and the infrastructure to support it, translated into several different issues and challenges for the University's Chief Information Officer (CIO), Sam Stone and the Environmental Sustainability Manager, Allan Borlaug. Although for Allan, it merely represented one part of the picture; one part in the overall environmental sustainability landscape for the University. It was recognised that the University's technological infrastructure had a carbon footprint in terms of energy consumption and waste but it also created operational efficiencies and insight into better practices.

### 2.1.1 Supporting Environmental Sustainability

Queen's University brought Allan in almost a decade ago as an environmental engineer within their facilities management department. The role had grown from focusing on facilities and operations, the business side of the University, to encompass exploring technological enablers to support better environmentally sustainable practices. He essentially was the University's environmental sustainability champion or as he liked to put it "…here, I'm the linchpin". Allan, had worked in establishing the environmental policy, supported the university's environment committee and reported annually on the environmental action plan and review.

It had seemed a lonely road initially but things had improved and environmental sustainability initiatives were anticipated to garner more support with the explicit commitment to sustainability reflected in the University's latest Strategic Plan. Allan's enthusiasm and hope was shared by the student association's sustainability officer signalling that maybe Allan wasn't alone in his fight after all. The appointment of a senior executive member in the University's governance structure, also nurtured their aspirations for the great environmental sustainability progress to come. The current governance (Figure 1) had three main areas, a) Chancellor (Sustainability) b) Chief Information Officer and c) Environmental Manager. Also included as part of governance structure were support committees which contributed to and/or lead green initiatives for the University.

The University had also become one of the first higher education institutions to divest from fossils fuels. Surely, this was just the beginning of thing to come? With everything that the University had accomplished over the years, Allan was indeed hopeful.

[1] The University's identify has been disguised through use of fictitious details.

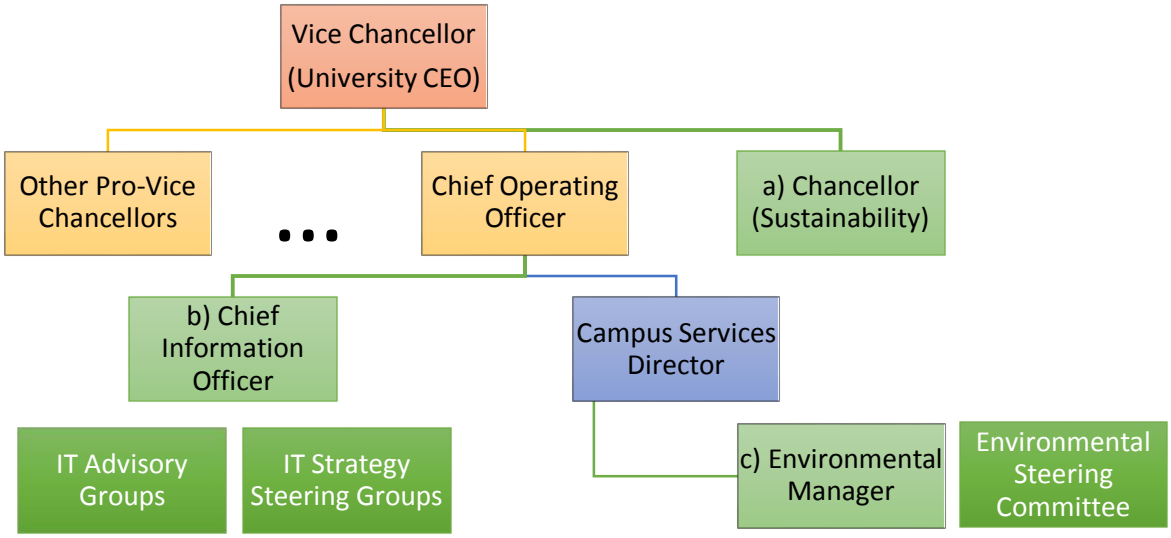


*Figure 1 Green IT/IS governance structure*

## 2.2 Implementing Green Information Technology Initiatives

### 2.2.1 Changing user practices

Not long after he started at the University, Allan instigated a few simple changes. Admittedly a simple measure, defaulting the multi-function device settings to print in duplex (both sides) achieved its objective of minimising paper usage at the University. While printers were still found with unclaimed printing work, since the change had been made, paper consumption had gone from 108-110 thousand reams, in the first year, to 35 thousand reams at current. There was a continual decline but Allan took into account the change in the learning and teaching where there were less print outs with online digital material.

Student and staff population weren't always the most conscientious power users with lights and computers left on in offices. One of Sam's team, noted with chagrin, as he worked late one night:

"I've come in here before, when I've been working late at night, 1, 2, 3 o'clock in the morning and all the student pcs in the library are all on, all the screens are on, and everywhere you look – no one is using that stuff 12 hours at a time – it's ridiculous."

Noting the same thing Allan talked to the IT department and they set up pop up reminder messages on the staff and students computers to remind them to turn off lights and machines when leaving for the day.

### 2.2.2 PC Energy Management Software (PCEMS)

As desktop use grew to 5000 machines in the fleet it became apparent from a money perspective how much energy these machines were consuming. Ten years ago, Sam recalled lining up computers in a row with multi-meters to test for energy efficiency among the models. While it was a big deal back then, vendors had since led the way with energy star ratings, such as EPEAT (Green Electronics Council, 2013) and other energy standards. It had easily become a disqualifying feature in the bidding process if vendors didn't sell from the energy standards perspective particularly as it translated into cost savings for the University. Even with greater energy consideration for the design and manufacture of computers, according to one Green IT consultant, there were still savings (NZ$27 per pc per year) available through better power management software offering the "ability to centrally control and report on the power consumption of computers across an IT network".

PCEMS had been pushed by a vendor and Allan approached IT about its potential to support the University's energy strategy. Initially, the IT department were convinced that the solution would be included in the latest pc operating system and software update but as time went on, nothing really met IT requirements. Allan began exploring off-the-shelf solutions and eventually a project took shape. The project proposed installation of pc energy management software on the University's fleet of desktops to automatically power them down at night when they were idle. The project became rather lengthy and required considerable buy-in from several stakeholders.

Allan recalled, "…it was a very long project. The challenge initially was getting IT across the line with the concept"

From the IT department perspective, the software prevented them from being able to carry out security updates and software patches overnight. The team found a workaround to address this but one IT project staff member noted the initial difficulty with getting buy-in, "My manager had to push it with his manager – we had to push upwards" … "They didn't really care about any benefits perceived or otherwise; they just didn't want to be part of it. There were sit down sessions / rows about it"…" …people thought it was a good initiative from a green aspect, but people like to pay lip service…"

When garnering the buy-in for the project, while the "green aspect" was addressed, it was heavily driven from the money aspect. Even for the University CIO, this value was still questionable:

> "It's more from my point of view when you look at the size of the fleet and then you say – how much are we gonna save – we're gonna save that amount of money in power – but if people come in the morning and 2000 people have to wait 2 minutes to wake their machines and log in – are you really getting a saving or not – that's my concern – it has to be practical…I pushed back..a bit"

Nevertheless, Allan noted that once IT had gotten on board with the project, Facilities Management and the IT Department worked collaboratively to see it through. Stakeholder engagement on the project throughout the schools and faculties had also made a great impact allowing for a pilot system across a number of schools. The project was eventually rolled out over 6 months in 5 phases of deployment. As it got rolled out at the various stages, noticeable changes to energy usage in the building were apparent, illustrating the effectiveness of the software. The University reported an electricity savings of approximately 620,000 kWh/yr which was worth about NZ$60,000 per year. In environmental terms this equated to about 80 tonnes of $CO_2e$.

Along the way, they identified users that didn't care much about the money aspect either and were concerned with how it could interfere with their work.

#### *2.2.2.1 Power management vs Grid computer*

Some of the Faculties employed cycle stealing software to take advantage of machines that were idle to carry out big data crunching activities. Introduction of the PCEMS prevented idle machines and interfered with these activities. Naturally, the staff were less than impressed and represented some very unhappy stakeholders.

This seemed counter intuitive to IT who had gotten on board the project, ". So when that machine is idle, is wasting time and wasting space we shut it down. …there are no cycles and now you want us to wake that thing up and say look it's idle ". However, recognising it was research, their job and area of expertise, IT made it work. IT understood that staff just needed certainty around their needs being addressed.

### 2.2.3 "Fancy pants" Data Center

Allan also worked with the IT department to provide energy tracking of one of the old server rooms to work out how much energy the system was as a whole (server racks and air-conditioning units) were consuming. Ideally, they sought to be only fractionally more than the power demand for the server racks themselves. The golden ratio was to get it below 1.3 and the University had achieved ~1.35. It helped that server virtualisation had over the last 5-6 years been gradually adopted. 80% of the data center was virtualised with one box able to run the equivalent of 40 servers. This had made a huge different in the data center size, power usage, air conditioning and cooling.

As the University CIO, Sam knew how much money the server rooms were eating up in not only running the servers but keeping them cool. A few years ago, Sam set off to create the most energy efficient data centre possible for the University. Recognising the benefits of free air cooling, the IT Department worked with the Environmental Sustainability section, architecture and engineering students and developed a self-contained crate design for a data server. It was built all from an energy perspective and resulted in energy consumption correlating to running fans for the majority of the days of year. The data center used the natural cool air that was characteristic in the region, instead of air conditioning. Sam was thrilled about the massive savings which translated into tens of thousands of dollars of savings for the University. Additionally, as a member of the Australasian Council of CIOs (ACoC) he was looking forward to reporting the power usage effectiveness (PUE) of the data center which had gone from a ratio 1.6 to close to 1.3. This meant an improvement on their rankings from the last benchmarking in 2013.

*Table 1 Queen's University ranking in the 2013 Australasian Council of CIOs (ACoC) Benchmarking Report*

| Key Indicator | Description | Queens University performance indicator | Ranking out of total members |
|---|---|---|---|
| 1) EPEAT Gold Rating | Proportion of PCs, laptops and monitors complying with the Electronic Product Environment Assessment Tool (EPEAT) Gold ratings | 90% | 99th percentile |
| 2) PUE – Data Centre Power Usage Efficiency | (Total Data Centre Facility Power / ICT Equipment power)<br>The lower the PUE value, the greater the efficiency, with 1.2 considered to be world class, 2 optimised and >2 un-optimised. | 1.6 | 42nd percentile |
| 3) Environmental Disposal | percentage of expired PC's and laptops which are recycled, reused or disposed of in an environmentally sound manner | 99% | 63 rd percentile |

#### *2.2.3.1 Data Back-up – Supply Chain*

The University also faced other storage challenges in the form of data back up. Like many other organisations, their library of backed up data were stored on tape and off campus, often miles away. This required manual handling and transportation from and to specialised contracted storage locations. Hosted cloud storage had been far too expensive an option and considering data was seemingly held at ransom with high costs, it was not something the University would be pursuing soon.

## 2.3 Green Information Systems

### 2.3.1 E-Waste System

One of the green initiatives Allan applauded and had been initiated by IT themselves, was the recycling of the University's e-waste. Each year, the University replaced about 1000 pcs as part of

their "refresh-roll out programme". New computers were bought by IT and leased to schools on a monthly fee basis to track, maintain, monitor and dispose of appropriately. The old kit, computers which had usually met its 4-5 year lifecycle, were packaged up on pallets with other e-waste collected from the campuses and picked up and dispose of appropriately by a contracted recycling vendor.

This system worked really well for the University who also made a return on the e-waste collected by the contractor. IT section did its part to maintain records of assets collected by the contractor and the contractor also provided a report on what was done with the e-waste. The vendor serviced several government agencies, banks and organisations and the transparency and financial model used by the company was one which the University preferred.

For each machine collected, the hard drive would be checked for data wipe and operability – 10-15% of the fleet equipment would still be useable. Of these they would be on sold locally or sent to countries where these machines were still good value. For those that did not work, they would be disassembled and parts recycled. The University received a report on this breakdown and a percentage of any sales made; over the last few years it had equated to 150-200 thousand dollars.

The system worked well and it was comforting for Allan to know that the University e-waste wasn't just being sent off to a landfill. Unfortunately, all the packaging that comes with the new kit easily filled up several rubbish skips and that, the University still had to pay for.

### 2.3.2 Fleet Management Software System

The University also managed a fleet of 40-50 vehicles which were independently owned and leased by various university sections. Allan saw an opportunity to centrally manage the fleet with a software system but this remained on his wish list for the time being – even if it did mean the ability to downsize the fleet and use it more effectively.

### 2.3.3 IT Procurement

The IT procurement services oversaw the overall general technology purchases made by the University. They were also a part of the All of Government (AoG) procurement system promoted by the New Zealand government (MBIE, 2015). They also followed the University's procurement policy and environmental procurement guidelines.

It was only recently, that the section had managed to reduce the number of devices per staff member. "We'd only managed not that long ago … to say well you should have one device per staff member not you know 5 because you have a desktop on your desk, and you have a laptop in the bag down there, and you have an iPad here and a phone…what else do you need? So rather than saying you have a desktop and laptop you get a laptop and a docking station."

But there were still challenges in reducing the potential future e-waste with users wanting the latest gadgets. As an IT staff member noted, "It's not the same as a new shirt or whatever. All of these things use some amount of resource obviously taxing the environment in some way".

### 2.3.4 Building Management System

The University had a building management system which had recently moved to a new server. The system provided monitoring at a building by building level across the university tracking heating, ventilation and air conditioning (HVAC). The energy usage tracking had supported several operational and academic activities as part of the university's energy strategy. This system had supported energy tracking for the data centers and the desktop power management software

project. However, a lot of the information had to be drawn out of the system manually and fed into an excel sheet for further analysis and the University's reporting.

While it was time-consuming, Allan appreciated the process of drawing data from the system as it supported understanding the "full depth of the story". Recognising that if you're time poor, an add-on which automated the work could be beneficial but was costly. Allan noted on the other hand that "If the value is there, we would invest the money". At the moment, streaming data was overloading the section with no dedicated human resource to spend the time pouring over all the data. So once a month Allan would spend four hours drawing out the data and getting deep in the full story.

There were aspects of energy initiatives that naturally weren't captured by the system. The University had recently reduced heating in an effort to save costs. One lecturer recalled one foreign student who suffered terribly during the cold winter months and there was nothing that could be done other than to offer the student their own jacket and scarf. Other repercussions included staff finding workarounds and included bringing heaters to the office – counterintuitive to the objective being sought. These reflect some of the human aspects that the building management system does not capture.

### 2.3.5 Student Halls Energy Competition

From a student perspective, the energy data from the building management system while useful wasn't the most effective in illustrating the story. A competition initiated by a student, involved the student halls monitoring their energy consumption to see who could conserve the most. Allan was a strong supporter of student involvement in environmental sustainability initiatives and happily facilitated the data to support the competition and the monthly monitoring. While the students had some challenges in translating the monthly data of each hall's progress into a marketable and informative illustration for their Facebook page, it was the best that could be done.

### 2.3.6 Sustainable Community-based Food System

In addition to the student halls energy competition, the student association executive also worked on a sustainable community-based food system. The 'food coop' as they called it, involved university students, staff and members of the community working together to support the sale of organic food at affordable prices. This was supported by bypassing intermediaries such as retailers. So, essentially all the roles that a retailer would usually undertake, was carried out by the group in a collaborative shared way.

Food coops provide a range of health, environment, social and economic benefits (Sustain, 2015). Students' health and wellness and how it was intertwined with the health of the environment was strongly recognised at Queen's University. The food coop, one of the initiatives undertaken, mirrored this sentiment to support students. Establishing the system involved a lot of trial and error with software and systems. Bucky box (Bucky Box, 2015) and google forms were some of the platforms used to support the ordering system that connected local growers and the group. It wasn't entirely suited for what they were trying to achieve. They needed a system to support the different roles in ordering, tracking and volume payments with a focus on supporting storage and waste.

## 2.4 Monitoring and evaluation

Allan was pacing his floor again. He slumped into his office chair with a frustrated sigh. He had just received the latest bills for utilities and air travels. All the University's utilities were paid for through his office and every now then some of the schools and faculties got a little excessive and as he

noted, "…if one school goes crazy they don't care!". It was frustrating but Allan also knew it was difficult for the University sections to monitor their activities when they didn't have timely visible access to information. "Trying to get to a state where they can have a bit more ownership themselves and responsibility and they will then track their own usage and come up with initiatives themselves. That requires a fairly major shift."

On the plus side, the University community were very passionate about recycling. So passionate, there was an uproar with Allan's emails at an all-time high when the recycling contractor had changed their policy and no longer included glass. This impacted on University practice with staff being advised to take them home to ensure recycling. While not directly IT related, Allan wondered whether the processes and systems were monitored and evaluated well enough to mitigate against such instances.

They were part of the Tertiary Education Facilities Management Association (TEFMA, 2015) and the 2012 survey had benchmarked the University quite well. They had had the lowest emissions per Equivalent Full Time student (EFTS) and lowest emissions overall. They had also achieved the majority of activities outlined in their annual action plan.

Allan didn't know if what they were doing in terms of Green IT/IS was below par or industry leading. They had seen what other Universities were doing and selected initiatives that had been tried and tested to pursue. Nevertheless, as he put it, "Certainly, I'm pretty happy with the initiatives we have done and how they've gone".

## 2.5 Future of Green IT/IS within the University

Allan looked at the timeline, as shown in Figure 2, of some of the University initiatives over the last decade and began thinking about where Green IT/IS could be incorporated in line with environmental sustainability initiatives. There were many considerations from technological opportunities to some major changes in how the University carried out its core business and he alone could only do so much.

Sam was due to review the section's IT strategy and Allan wondered what he might have planned in terms of Green IT/IS. They both had lead their own Green IT/IS initiatives, but were they doing enough? How effective were they and was it sufficient progress? It was some serious thinking and Allan really wanted to create as much impact as possible. With a sigh, he got up to leave. Routinely, Allan switched off his docked laptop and office lights before pausing in the corridor - he wondered what the future held for Queen's University. Where were they to go from here?

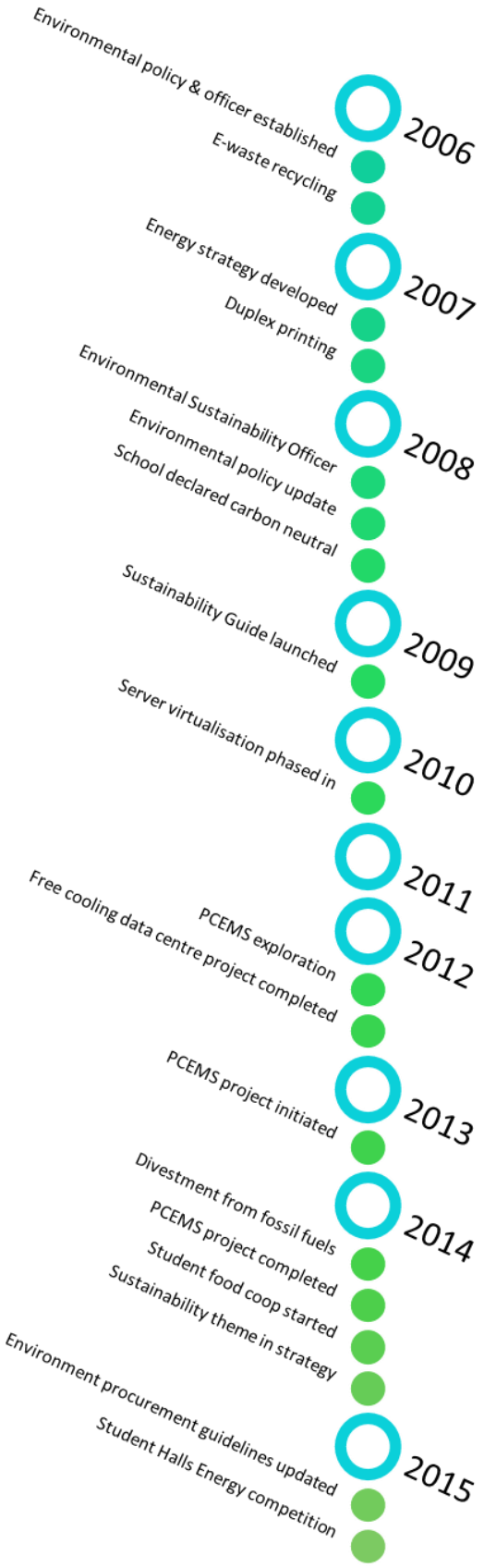


*Figure 2 Timeline of some of the Green IT/IS initiatives*

# 3 Introduction to analysis

This section provides definitions of Green IT and IS and an outline of the methodology and analysis objectives sought. Two frameworks were chosen to analyse the information collated from the case study and are briefly presented.

## 3.1 Setting the scene

Climate change and global warming is a global issue representing a central theme at many international forums (GCGW, 2015; United Nations, 2015). Ongoing concerns continue to grow as slow progress is made in addressing what is happening to the environment, societies and planet as a whole. Climate change represents one of the many dimensions sought to be addressed in environmental sustainability (Moldan, Janoušková, & Hák, 2012).

The world's carbon footprint, largely attributable to global warming and greenhouse gas emissions (GHG), has increased significantly since the 1900s (EPA, 2010). One aspect of greenhouse gas emissions is its recognized link with economic growth, energy consumptions and sources.

Information technology (IT) and systems (IS) have played a large role in supporting economic growth through efficiencies and innovation. As a local example New Zealand's very own ultrafast broadband project is premised on economic growth (Joyce, 2011)

However, with this growth, there is recognition of IT/IS as a contributing factor to the world's carbon footprint both as a problem and as a solution. IT/IS places a cost on the environment giving consideration for enhancing its environmental friendliness. As a solution this is referred to as the 'greening' of IT/IS. However, IT/IS is recognised as a potential to green and is referred to as 'green by' IT/IS.

In defining and understanding Green IT/IS, the linkages with environmental sustainability also become apparent.

### 3.1.1 Green IT (Green IT 1.0, Greening *of* IT)

It is generally accepted that IT contributes about 2-3% to the world's greenhouse gas emission (GHG) (Fujitsu Ltd, 2015; Gartner, 2007; Laitner & Berners-Lee, 2012). The environmental impact of IT spans its lifecycle from IT creation, use to its disposal. Figure 3 provides an overview of the areas where the environmental impact of IT is considered. The pairing of IT and the environment (Molla & Cooper, 2012) with a focus on the greening of IT is referred to as Green IT.

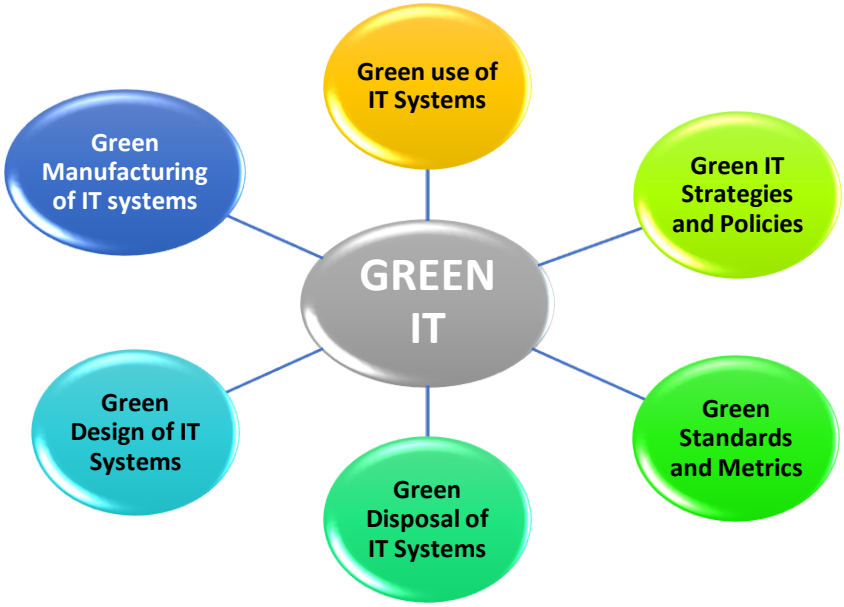


*Figure 3 Holistic multi-pronged approach to greening of IT (S. Murugesan & Gangadharan, 2012)*

Green IT is a systematic application of ecological sustainability criteria (such as pollution prevention, product stewardship, use of clean technologies) to the creation, sourcing, use, and disposal of the IT technical infrastructure, as well as within the human and managerial components of the IT infrastructure.(Molla et al., 2011, p. 29)

### 3.1.2 Green IS (Green IT 2.0, Greening *by* IT)

In contrast, the broader concept of Green IS refers to practices which determine the investment in, deployment, use and management of information systems (IS) in order to minimize the negative environmental impacts of IS, business operations, and IS-enabled products and services (Loeser, 2013). It is the use of information systems to achieve environmental objectives (Dedrick, 2010). From an activities approach it involves re-assessing " what we do and the way we do it as well as understanding the mediating role of information systems in enabling these activities to be sustainable" (Loos et al., 2011, p. 4). It also considers how the IT infrastructure can support changes in organisations processes and practices to improve energy efficiency and reduce the environmental impacts (Brooks et al., 2012, p. 19).

While Green IT focuses on reducing its own environmental impact, Green IS has the anticipated potential to make a significant impact on carbon productivity through system designs which support sustainable business practices (Boudreau, Chen, & Huber, 2008). It has the potential to not only change and transform organisations but also society (Elliot, 2011); the potential to decrease the world's GHG emissions by almost 10 times its own carbon footprint (GeSI, 2015).

## 3.2 Analysis Objectives

The field of Green IS is still relatively new and there is a demand for research (Brooks et al., 2012; Malhotra, Melville, & Watson, 2013). Environmental impact of IT has only recently risen to the agenda of extant literature evolving from green computing to Sustainable ICT which encompass broader social and economic sustainability considerations.

IT industries have led the way with green IT through Green design (eg. Energy efficient machines) and green use (eg. data centers, virtualization) due to the size of the industry these efforts are driven mainly by commercial incentives, regulatory compliance and brand image. The IT industry has sought ways to offset rising costs and reduce their environmental impact.

A recent report illustrated that New Zealand as whole has made a step backwards in ICT sustainability (Stewart, 2014). Universities represent a portion of the largest technology users in the country. With this in mind and considering the context of a university as an institution of higher learning, what were Universities doing in the Green IT/IS space? This case study sought to explore this further.

In assessing what Green IT/IS practices and capabilities were present within a University setting, the case study sought the following objectives:

- Identify and evaluate what Green IT /IS activities were undertaken by the University
- Understand some of the barriers and enablers in such activities
- Provide a measure of how well the University were doing in terms of Green IT/IS
- Understand how these activities align with overarching eco-goals
- Identify opportunities to enhance Green IT/IS activities

Through these objectives the case study also added to extant literature on the topic by providing qualitative perspectives on Green IS/IT activities. It also adds to Green IT/IS maturity literature. From an organizational perspective, benchmarking Green IT/IS can also inform strategy development.

## 3.3 Methodology

Exploration of Green IS/IT within the University context followed a qualitative information gathering approach; a literature review of academic and practitioner resources, organisation research and 7 semi-structured interviews. Organisation research included information obtained from the University website, interviewees and other publicly available information. Identity of the organisation and respondents were kept confidential.

### 3.3.1 Participants

Participants for the interviews were selected based on their involvement or contribution to Green IT/IS initiatives planned/undertaken within the organisation. Profile and number of participants are as follows:

1 x Environmental Sustainability Manager
1 x Chief Information Officer
1 x Environmental Sustainability Student Association member
1 x Procurement Manager
1 x Network Manager
1 x Desktop Services Team Leader
1 x Technical staff member
1 x External Vendor & Green IT Consultant

### 3.3.2 Semi-structured interviews

Questions used to guide the semi-structured interviews can be referenced in appendix 3. The interviews lasted from 30 minutes to an hour and a half with the questions structured according to the frameworks selected. Semi-structured interviews has been chosen to elicit a holistic view of Green IT/IS initiatives within the University context. It has been chosen to provide more detailed

information on the understanding and perspective of Green IT/IS. Also given the variability in the backgrounds of the sample group, this approach allows for greater flexibility.(Diefenbach, 2009; Gummesson, 2000). The interviews were digitally-recorded for more accurate transcription but also supported engagement with the respondent in the interview process. Transcription was carried out manually with the interview dialogues typed up based on review of digital recordings.

### 3.3.3 Thematic coding, rating and categorical grouping

Interview statements were grouped according to themes which were relevant to the areas highlighted within the G-readiness framework. Appendix 2 outlines some of the thematic coding carried out. Additionally, the G-readiness framework provided a template for survey questions which were used to calculate index scores for the different dimensions. A radar graph was produced from the academic literature which applied the G-readiness framework. An adaptation of the survey questions were used to rate the University on these dimensions based on the information gathered. A radar graph was transposed over the academic findings to provide an overview of the University's G-readiness benchmarking. Details on the rating of each dimension can be found in the appendices.

Identification of activities which related to efficiencies, opportunities for collaboration and potentially greater effectiveness were noted during the eco-goals framework analysis. These are presented within section 4.2.

## 3.4 Frameworks

Two frameworks were selected to support the case study. The G-readiness framework by Molla et al. (2011) was selected as it provided a research ready instrument in measuring the maturity of an organisation's efforts towards supporting environmental sustainability. It provided an easy to understand guide on where to explore Green IT/IS practices and capabilities. Use of this framework is also garnered by its striking similarity to the framework utilised by Fujitsu in their renowned global benchmarking report (O'Flynn & Executive, 2010).

The second framework, Brooks et al. (2012) Eco-Goals, was selected as it provided a way to view the Green IT/IS activities identified by the first framework and align them with eco-goals. This supported a holistic view of the University's goals.

Both frameworks presented complementary characteristics that highlighted operational, functional as well as organizational activities and opportunities.

### 3.4.1 G-readiness Benchmarking

The G-readiness framework (Molla et al., 2011) was proposed as a Green IT tool which could be applied to benchmark an organisations readiness or maturity in greening information systems. Bearing a striking similarity to the one used in the Fujitsu global benchmarking report (O'Flynn & Executive, 2010), the framework provided a ready to use instrument. The framework dimensions outlined a focus on practices, technology, policy, governance and attitude which assisted in guiding information gathering activities and represented a clear starting point on areas within an organisation to explore. The framework also support scoring of the different dimensions based on a questionnaire sheet for each dimension.

The diagram and table below provide an overview of this framework.

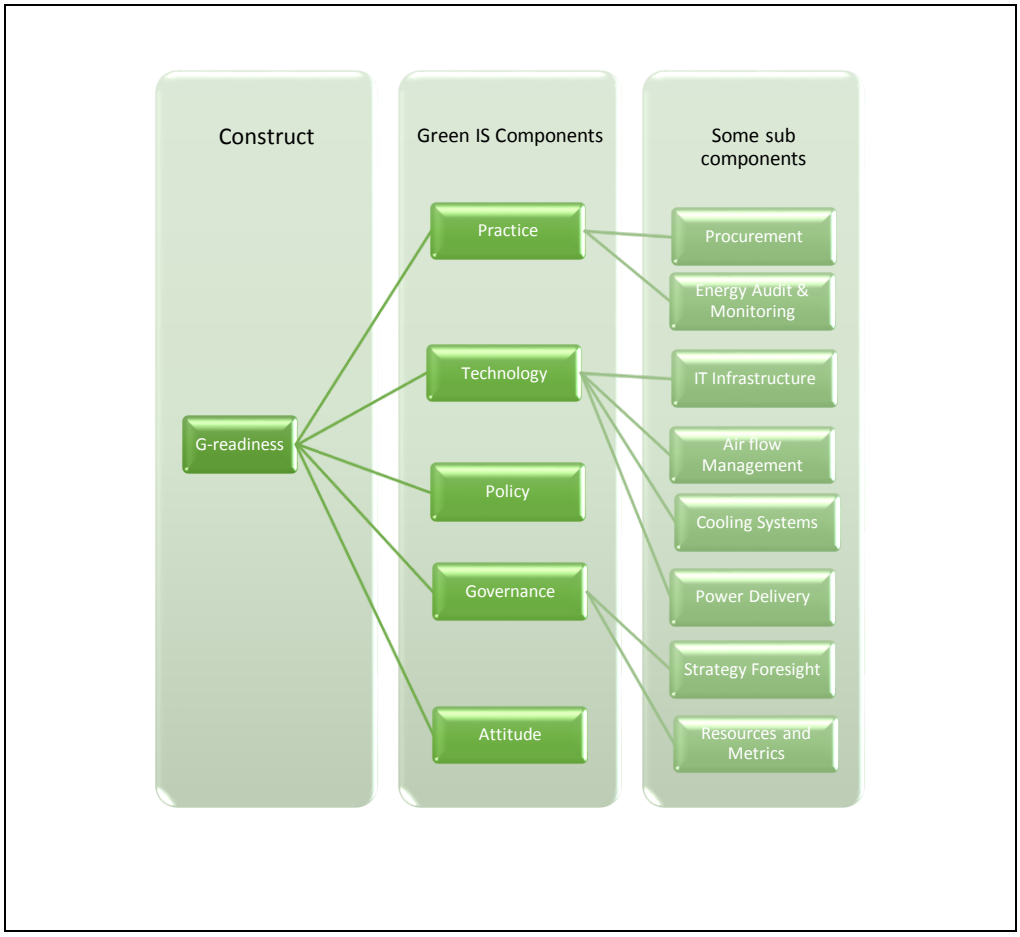


*Figure 4 G-readiness model (Molla et al., 2011, p. 84)*

*Table 2 Description of G-readiness framework components and corresponding case study information sources*

| Green IS Component | Definition | Case study information source |
|---|---|---|
| **Practice** | Pertains to the actual application and realization of eco-sustainability considerations in IT infrastructure sourcing, operation, and disposal | ▪ University website<br>▪ Environmental sustainability annual action plans & reviews,<br>▪ Interviews<br>▪ Articles about University<br>▪ Reporting information provided by University |
| **Technology** | Refers to Information Technologies and Systems for reducing the energy consumption of powering and cooling corporate IT assets, optimizing the energy efficiency of the IT technical infrastructure, reducing IT induced greenhouse gas emissions, supplanting carbon emitting business practices, and analyzing a business's total environmental footprint. | ▪ Interviews<br>▪ Articles about University<br>▪ Benchmark reports provided by University |
| **Policy** | Refers to the environmental criteria and frameworks an organization puts in place to guide the sourcing, use, and disposal of the IT technical infrastructure and the activities of IT people | ▪ University website<br>▪ Interviews |
| **Governance** | Refers to the operating model that defines the administration of Green IT initiatives, the allocation of budget, and other resources and the metrics for assessing impacts. | ▪ University website – organisational structure, committees, advisory groups<br>▪ Interviews<br>▪ University strategic plan |
| **Attitude** | Refers to an organization's IT people sentiment, values, and norms toward climate change and eco-sustainability and IT's role. Measures the extent to which both IT and business are aware and concerned about the impact of IT on eco-sustainability | ▪ Interviews<br>▪ Articles about University<br>▪ University strategic |

### 3.4.2 Eco-Goals

While the Molla G-readiness framework drilled down and focused on various areas within an organisation, the Eco-goals framework was selected as a means to step back and look at all the activities from three types of goal orientation. The framework supported an analysis of Green IS initiatives, which were identified using the G-readiness framework, to determine what type of goals these initiatives were oriented to achieve.

The goals within the framework include eco-efficiency, eco-collaboration and eco-effectiveness. Eco-efficiency deals with reducing the input of resources such as energy, water and water per unit of output. It is also in line with the achievement of organisation activities at lower cost. Eco-effectiveness is reflected by "working on the right things, instead of making the wrong things less bad". It is complementary to eco-efficiency. Eco-collaboration seeks to maximise the benefits of eco-efficiency and eco-effectiveness through partnerships and working together with other stakeholders.

Figure 5 provides the framework and examples of the eco-goals..

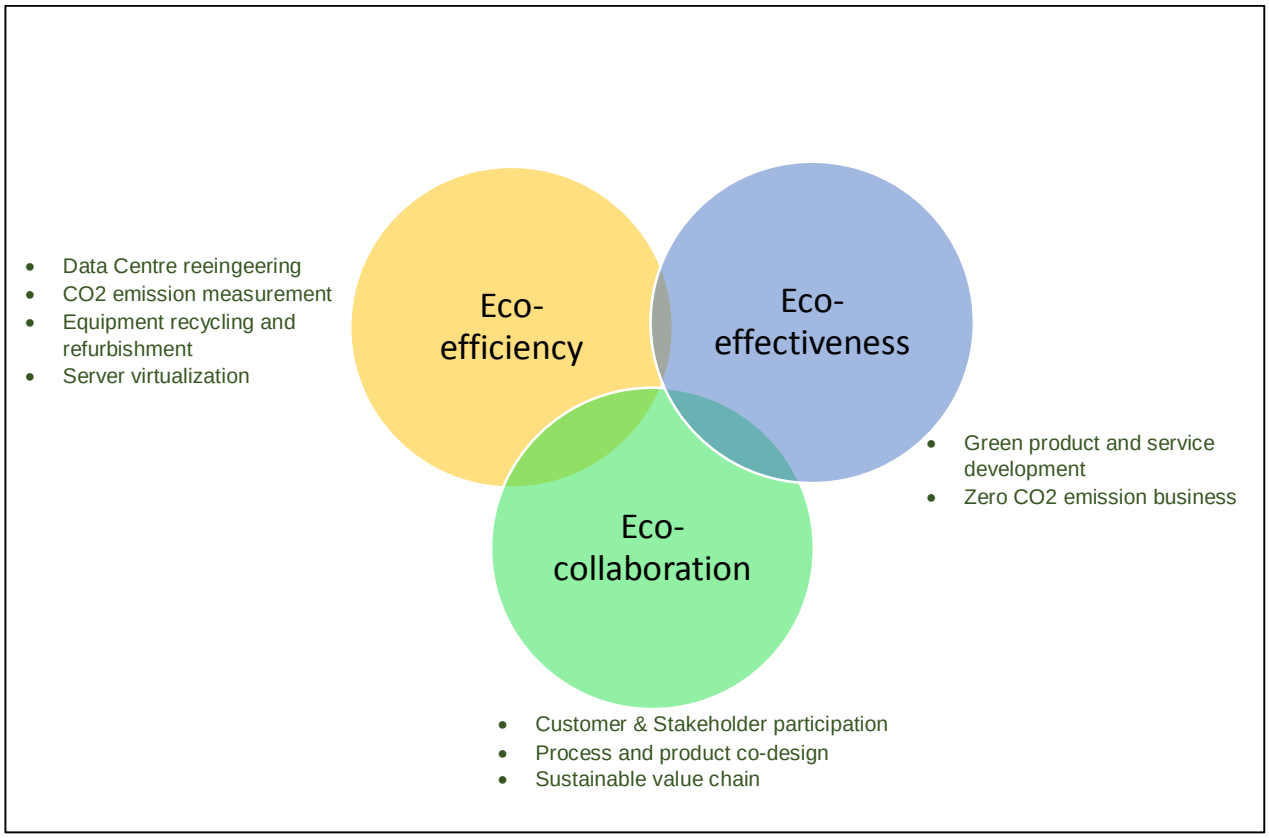


*Figure 5 Eco-goals of Green IS initiatives (Brooks et al., 2012, p. 21)*

#### *3.4.2.1 Eco efficiency*

Eco-efficiency deals with reducing the input of resources such as energy, water and waste per unit of output. It is also in line with the achievement of organisational activities at a lower cost.

#### *3.4.2.2 Eco-effectiveness*

The essence of eco-effectiveness is reflected by "working on the right things—on the right products and services and systems—instead of making the wrong things less bad" (McDonough & Braungart, 2010, p. 76).

#### *3.4.2.3 Eco-collaboration*

Eco-collaboration maximises the benefits of eco-efficiency and eco-effectiveness through partnerships and collaborating with other stakeholders in order to achieve more efficient business than lower total cost. (Brooks et al., 2012, p. 20)

# 4 Analysis

## 4.1 G-Readiness

The findings are arranged according to the components outlined in the Molla et al. (2011) G-readiness framework. Each component is rated according to a scale, to provide an indication of maturity or advancement in this area.

### 4.1.1 Practices

Molla et al. (2011) outlined the dimension of G-readiness practices along procurement and energy auditing and monitoring. It covers product stewardship and pollution strategies. The analysis allows for other organisational practices to be included as they align with these strategies.

#### *4.1.1.1 IT & Service Procurement*

IT Hardware Procurement

As part of the all-of-government (AoG) procurement, the University are limited to set of pre-approved suppliers. University environmental sustainability procurement guidelines then guide selection. As illustrated in case study some external pressures seem to influence or dictate organisation practice. The example of the change in policy by the recycling vendor for glass recycling resulted in a change in University practice. As part of the AoG procurement, organisation practice is reliant on government; what assurances are there for suppliers' environmental sustainability practices, when the NZ government performance on the environmental sustainability front has been questioned (Morton, 2014; Shelton, 2015; Stewart, 2014). While the University could wait for external pressures for change (Coffey, Tate, & Toland, 2013) it is recommended that they take a more proactive and independent approach holding supply chain partners to the same green standards that the University aspires to (Brooks et al., 2012).

| | |
|---|---|
| **Practice R01:** | Move from a passive to proactive practice in evaluating and preferring Green suppliers supported by a policy with rigorous environmental standards around procurement (Stewart, 2014). |

At current, the University purchases IT through Dell, and as the procurement manager noted:

> *"Despite all the efforts that people make in buying the right and all that – they're [Dell] cheap! They're the best price. "*

Based solely on cost, how can the University ensure that Dell is the best product in terms of environmental sustainability? Products need to be evaluated on other dimensions that factor in long term environmental and other benefits.

| | |
|---|---|
| **Practice R02:** | Reconsider the University's evaluation model of IT procurement. While cost is a valid business consideration it should not be the main constraint for environmental considerations. |

E-waste recycling services

The University moved from a Green IT "take-back" option of returning IT to hardware vendors to e-waste recycling services. Additional revenue and audit reporting represented strong incentive to maintain e-waste recycling services which have been in operation close to 10 years. Audited reporting from the vendor provided a measure of transparency and value for money that the University preferred:

> *"[another vendor] do a retrieval service, you buy a pc from them and you call them and they will collect it again and take it away – that takes [current vendor] out of the cycle for them but it also deprives us of the money… In the last few years, I've brought back between 150-200 thousand dollars of this second hand market...There are other companies that do similar things and they do contact us from time to time but most of them work in a slightly different way. They want to buy all the stuff off you for their price and then they will profit at their end. They will just make an offer – 1000 pcs at this price – but we tend to get a lot more money [with current vendor]" (Interviewee #3)*

There is a strong element of trust in the vendor, in that they will dispose of the equipment in an environmentally responsible manner. However there is recognition that this is not necessarily guaranteed.

> *"There's obviously a certain amount of trust relationship there…I sort of don't feel that the containers will land in India and a bunch of 5 year olds have to crawl amongst them to dissemble them… we don't know for sure, you can only go with your gut feeling" (Interviewee #3)*

The University can play its part in supporting environmental sustainability by raising standards and expectations of suppliers. It is an ethical and social responsibility to take greater measures to mitigate the negative impact created at the end of the procurement lifecycle. Additionally applying and encouraging this expectation also in turn creates a form of pressure that could enhance greener practices externally.

| | |
|---|---|
| **Practice R03:** | Develop assurances around vendor practices to support environmental sustainability in the procurement lifecycle. eg request an e-waste certificate of destruction (E.-stewards, 2015) |
| **Practice R04:** | Consider incorporation of ISO 1400 into practices. (ISO, 2015) |

#### *4.1.1.2 Energy Audit & Monitoring*

University energy reporting and evaluation is carried out annually as mandated by the University's Energy strategy. This includes Environmental Sustainability Action plans and annual reviews. As a member of TEFMA there are also annual benchmarking requirements that covers energy and water consumption. The University did very well in 2013 as reported on the website however this has not been updated since.

Visibility of energy consumption is centralised within the campus services section.

> *"…we have energy monitoring at a building by building level for all buildings across the university...We do track energy usage quite closely." (Interviewee #1)*

Ad hoc measures are employed to support analysis of IT's energy consumption particularly during the data centre and PCEMS projects. However, there is no established practice of monitoring and reporting IT energy consumption.

> *"Talking to our chief architect this morning and he was saying they've got no monitoring at all and no way of knowing what the data centre was using. Presumably, facilities Management who looks after the power, if we wanted them to, I'm sure they could meter how much was going in there …it would be smart if the University thought about that. It is a fairly huge use of electricity." (IT staff member)*

Monitoring and reporting provide many benefits including an awareness which can support decision-making, evaluation and performance. IT's ability to measure and create awareness of their energy consumption as organisational practice directly supports the improvement of practices.

Green IT assessments and reporting is carried out in response to external pressures such as the requirement of membership in ACoC and the request by an external Green IT consultant. Other assessments were triggered by a project such as the data center. Moving from an adhoc approach to organisational practice, not only ensure the Green IT is on the agenda but it also highlights performance and efforts in this area.

| | |
|---|---|
| **Practice R05:** | Move from adhoc Green IT reporting and support IT department energy auditing and monitoring as an organisational practice. |

E-waste audit information does not feed into the University's environmental sustainability reporting to show visibility of how much of this e-waste is being recycled annually.

| | |
|---|---|
| **Practice R06:** | Incorporate Green IT/IS reporting and metrics into overall University Environmental Sustainability Reports. |

#### *4.1.1.3 Other Organisational Practices:*

The University explores and implements cloud computing opportunities with consideration for feasibility and appropriateness. Examples include migration of University blackboard system and staff email servers to the cloud. Summary of practices identified are categorised in Table 3.

*Table 3 Summary of University Green IT/IS practices*

| Area | Green IT/IS Practice |
|---|---|
| **Green Use practices/ end user behaviour** | Duplex printing<br>Audio & Video conferencing<br>Remote IT services (dashboard for network system functionality, virtualisation of pcs, remote desktop troubleshooting etc.)<br>Green use guide & information on website<br>Light censoring in offices and buildings<br>Energy efficiency consideration in new building designs |
| **Green Procurement Practices** | Consideration of Energy Star Rating in computers<br>Exploring alternative technologies (VDI, Cloud computing)<br>Limit number of devices per staff member |
| **Green Disposal Practices** | E-waste recycling system<br>E-waste auditing<br>Extend life of equipment |
| **Green Organisation Practices** | Environmental sustainability monitoring & reporting (includes energy efficiency)<br>Energy carbon footprint benchmarking in TEFMA<br>Green IT benchmarking through ACoC<br>Environmental Sustainability certifications and membership |

**Overall Practice Component Rating: 5.1 out of 7**

(refer to Practice Component in the appendices on page 40)

**Summary of Green Practice drivers and barriers as shown in Figure 6**

Practices reflect a strong focus on the bottom line which can be limiting potential opportunities for greater impact supporting environmental sustainability. However, the industry practices adopted by suppliers have a flow on benefit for the University in their procurement lifecycle. External

membership (ACoC, TEFMA) also have positive effects triggering important opportunities for reflection and assessment in the area of Green IT.


*Figure 7 Identified drivers and barriers for Green IT/IS practices*

### 4.1.2 Technology

Technology used by the University, which is also supported with external funding, not surprisingly, has a strong focus on energy efficiency. Energy efficiency translates into cost-savings. Some of the technology implementations have been led by the IT department and by the Environmental Sustainability section as shown in Table 4.

*Table 4 Summary of IT/IS supporting environmentally sustainable practices*

| Technology / System | Leads | Areas targeted |
|---|---|---|
| **Free Cooling Data Centre** | IT Department | Energy efficiency |
| **Building Management System** | Environmental Sustainability section | Energy efficiency<br>Cooling |
| **PC energy management software (PCEMS)** | Environmental Sustainability section | Energy efficiency |
| **Server Virtualisation** | IT Department | Optimising<br>Energy efficiency |
| **E-waste system** | IT Department | E-waste |
| **Cycle stealing Software** | Faculty | Optimising |

As identified in the Green IT assessment reports carried out for ACoC, the University is doing extremely well with aspects of their technological infrastructure. Their data centre has a PUE of ~1.35, 90% of e-waste is recycled and 80% of their serves are virtualised. However, there are improvements to be made in their purchase of gold star EPEAT equipment, when compared with other organisations. (refer to Table 1 on page 6)

**Technology R01:** Improve performance in purchasing of gold star EPEAT equipment.

#### *4.1.2.1 Future technology considerations*

The University has considerations for the use of future technology. These are sometimes limiting with the shortage of specialised IT staff. However, a viable technology considered is the use of fleet vehicle technology to better manage and optimise the use of vehicles throughout the University. While fleet vehicle management contributes directly to environmental sustainability (Watson, Boudreau, Chen, & Sepúlveda, 2011) it can be enhanced with green user practices (Rutty, Matthews, Scott, & Matto, 2013).

| | |
|---|---|
| **Technology R02:** | Fleet Management system is recommended in tandem with the development of green user practices to better leverage environmental sustainability goals. |

Also from an energy consumption perspective, Virtual Desktop Infrastructure (VDI) was explored. While considered too expensive compared to a desktop machine, the total cost of ownership of VDI did not include cost of energy consumption during the life of the product. VDI is considered an industry game changer with the potential to provide 80% savings in desktop energy consumption (Stewart, 2014).

| | |
|---|---|
| **Technology R03:** | Review Total cost of ownership models used in evaluating potential technologies. |

**Overall Technology Component Rating: 5.5 out of 7**

(refer to Technology Component in the appendices on page 41)

**Summary of Technology identified drivers and barriers are shown in Figure 8.**

Much like the Green IS practices drivers, external Green IT practices within the IT industry have a positive effective particularly in the procurement of Greener technology. This is also complemented by the energy strategy which naturally favours cost-efficient equipment. As cost continues to be a factor external funding and support directly supports the procurement of green technology. Some of the barriers identified however include evaluation tools for new technology, conflicts with current infrastructure and human resource issues in the form of skilled specialty IT staff availability to implement new green technologies.s

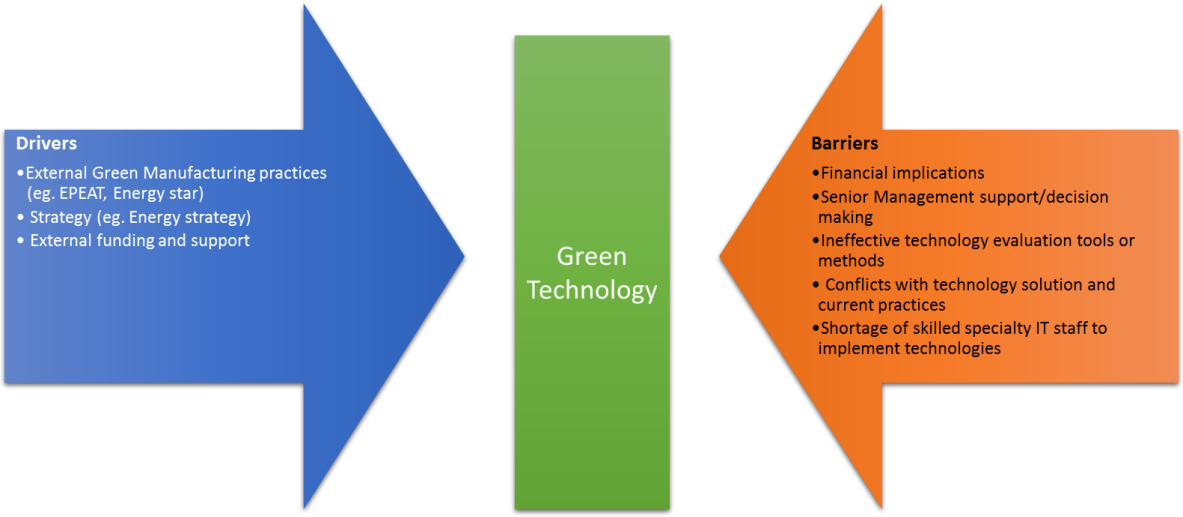


*Figure 8 Identified drivers and barriers for Green Technology*

### 4.1.3 Governance & Policy

Governance refers to senior management commitment and general oversight established. This can be expressed through organisational structure and the roles allocated to support Green IT/IS as well resource allocation, project management and benefit tracking of Green IT/IS activities (Johnstone, Huff, & Hope, 2006; Molla et al., 2011). The policy section will consider the maturity of the policy framework and how it supports Green IT practices and strategies. An established policy framework reflects organisational governance and intent. As such these components are considered together (Molla et al., 2011).

#### *4.1.3.1 Strategic Foresight*

The newly established strategic focus of the University on sustainability brings to the forefront the role of Green IT/IS in supporting this area. In recent years the University's Green IT/IS-related initiatives have focused on energy efficiency and cost savings. Largely driven by the Energy Strategy these initiatives reflect clearly a Green IS for efficiency approach (Loeser, Erek, & Zarnekow, 2012). The recognition of technology and information systems in supporting environmental sustainability is implicit in the Energy strategy. The purview for strategic and IT/IS related direction in supporting these initiatives should arguably lie with the ICT section of the University.

The latest IS Strategy, which is due to be renewed, does not include environmental sustainability or greening considerations other than a focus on cost reductions and efficiencies in their suite of projects planned. This is concerning as a strategy focused solely on the bottom line can obscure opportunities to pursue innovation and create value (McDonough & Braungart, 2002).

There is no Green IT/IS Strategy and explicitly recognising a greening by IS dimension should naturally feed into operational strategies of the University sections.

| | |
|---|---|
| **Governance 01:** | Develop a Green IT/IS Strategy or incorporate into new IS Strategy. |

Project management practices within IT place the ownership and responsibility of driving IT projects with the business owner. The business owner is identified as also owning the budget for the project. This seems a reasonable practice until considering the difficulty encountered by the ES Manager in driving the PCEMS project as the owner and budget holder. While information security and user resistance were valid concerns they became restraining forces the ES Manager had to combat. This scenario provides an example for why IT leaders are recommended to lead IT-related green initiatives (Stewart, 2014).

| | |
|---|---|
| **Governance 02:** | Ensure CIOs have co-ownership and responsibility in driving IT-related green initiatives. |

#### *4.1.3.2 Role and Responsibilities*

There are various established roles and committees to support Green IT/IS initiatives as illustrated in Figure 1Green IT/IS governance structure. The main roles driving Green IT/IS are the ES Manager, CIO and some from students. The centralisation in these areas does not support the pervasion of Green IT/IS across the University.

The ES Manager noted the LIFE tool that could be useful for the University, but could not be used given the current governance structure and centralisation of roles and responsibilities within the University. To be effective it requires a whole of institution approach.

| | |
|---|---|
| **Governance 03:** | Decentralise environmental sustainability roles and/or create a structure which supports sustainability and Green IT/IS champions across the university community. |

*"Trying to get to a state where they can have a bit more ownership themselves and responsibility and they will then track their own usage and come up with initiatives themselves. That requires a fairly major shift…It hard to get people all on the same page. Here, I'm the linchpin essentially… ideally, the big next step for the University to take if we*

*want to really push sustainability is for individual separate service units to take on a bit more ownership for themselves" (Interviewee #1)*

In the centralised structure, access to information is within the Campus Services section. This access and sharing of information has been difficult. To support an institution approach with sustainability initiatives, an information system is needed to support this.

| | |
|---|---|
| **Governance 04:** | Implement a supporting information system that allows for sharing of information across the University; eg create capabilities for students and faculties to monitor and report on their energy usage |

Green IT/IS as an agenda item does not feature in Senior Management discussion.

*"I think it should be important to [University] but I don't know if it is at a senior management level. I think that ITS could do more[Green IT/IS] but there hasn't really been a push along those lines. I wouldn't say they're not open to it but I haven't heard anybody at meetings say lets look at this or lets do this" (Interviewee #2)*

| | |
|---|---|
| **Governance 05:** | Ensure Green IT/IS is an agenda item in senior management discussions to reflect the sustainability intention and potential of IT/IS to address environmental sustainability goals |

#### *4.1.3.3 Resources & metrics*

Some of the constraints and barriers identified relate to resourcing. There are human resource needs within various areas.

##### ES Manager Support

The ES Manager formulates, drives and reports on environmental sustainability initiatives with the support of the environment sustainability committee. However the ES Manager has noted difficulty in finding time to monitor thoroughly and report on the amount of data produced by the BMS.

*"It's starting to overload us at the moment…Like I say we have this half hourly data available to us and we're not using it really. We don't have the resources in house to be able to have someone dedicated to spend the time pouring over all the data"*

Other activities including updating the website with the latest information can also be delayed. The sustainability guideline for users hasn't been updated since 2009 and the TEFMA benchmarking metrics have not been updated on the University website since 2013.

##### IT Support

While the IT section recognises that Green IT/IS is an important issue, it doesn't prioritise well in the scheme of everyday operations.

*"I think it's the work load. Keeping the lights on. Fulfilling requests for people. General day to day running of stuff. I don't think anybody has the time. It takes time…. It just hasn't come across the radar because there's all this day to day stuff – it just gets in the way." (Interviewee #5)*

*"We also got work to do that is mission critical. We need to focus in on what needs to be done but we're confident that we're doing the best we can in that regard. "(Interviewee #4)*

Human resources are needed to support IT to allow more innovation as opposed to just everyday operational activity.

Student Association

Students recognise their transient nature in the University community but are still enthusiastic about supporting projects around sustainability. They provide what time and input what effort they can but need more support from the University; support that other Universities have adopted in supporting sustainability initiatives.

> *" If the uni had a position, a staff position which oversaw student sustainability initiatives and had a budget to employ students to do a whole bunch of things. There's models for that around the world. Glasgow university employs 20 students within its sustainability...running a whole lot of different projects." (*Interviewee #7*)*

| | |
|---|---|
| **Governance 06:** | Develop a funding model to provide more support in terms of funding, human resources and infrastructure for Green IT/IS initiatives across different areas of the University. |

#### *4.1.3.4 Policies*

The University has made commendable achievements in their Green IT/IS activities. However, much of these are not supported by policy. Policies and guidelines supporting and driving these initiatives include the Environmental Sustainability Policy and Environmental procurement guidelines. There is no Green IT policy, Corporate social responsibility policy or Green data centers policy (Molla et al., 2011). The practices are there but need to be made more robust by establishing the corresponding Green policy framework.

**Overall Governance Component Rating:** **4.4** **out of 7**

**Overall Policy Component Rating:** **3.17** **out of 7**

(refer to Governance and Policy Components in the appendices on page 41)

**Summary of identified Governance and Policy drivers and barriers in Figure 9**

The Energy Strategy within the University has naturally reproduced several initiatives that have translated in cost savings. Similarly having Greening by IT/IS as a strategic focus could garner some similar results. Unfortunately, the lack of this Green IS focus represents a barrier for the University. Another includes the lack of fiscal and human resources.

Green IT initiatives driven outside of the purview of the CIO represents a barrier and recommendations to have the CIO as a co-owner of these activities could enhance success or progress in this area.

A lot of support is needed in various areas to enable better Green IT/IS governance and policy. This includes discussion of this agenda at senior management levels supported by evaluation, monitoring and reporting. A greater driver would also be the decentralisation of champions across the University.

While there are laudable Green IT/IS practices this needs to be ratified in a University Green Policy framework to guide consistency in this area.

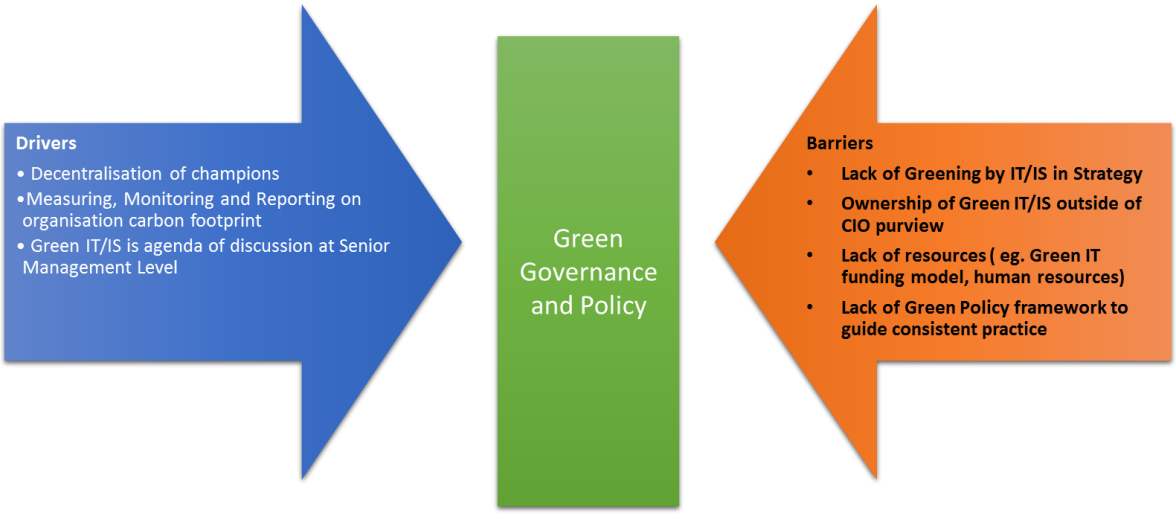


*Figure 10 identified drivers and barriers for Green IT/IS Governance and Policies*

### 4.1.4 Attitude

The Attitude component captures the dynamics of stakeholder attitudes and beliefs regarding IT and IS in supporting environmental sustainability objectives. This component is considered as important as management commitment and resource allocation and can be harnessed to identify and encourage green innovations. (Molla et al., 2011, p. 86)

#### *4.1.4.1 Understanding of Green IT/IS*

Understanding of Green IT/IS among the interviewees covered concepts of energy consumption, IT carbon footprint, Green IT lifecycle, e-waste and environmental sustainability. For the majority of interviews, focus predominantly remained on energy consumption, e-waste and cost efficiencies (refer to Table 6 Thematic Analysis of Green IT/IS Definition statements on page 43). Very few managed to recognise the encompassing potential of Green IS to support a range of sustainability initiatives. This represented a limiting factor as much focus is placed on the 2% aspect, Greening of IT and very little on the larger potential of IT/IS to 'green'. Diffusing Green IT/IS concepts and information across the enterprise supports these initiatives (Molla et al., 2011).

| | |
|---|---|
| **Attitude R01:** | Promote an understanding of the potential Green IT/IS with a particular focus on its greening by IT/IS potential. |

#### *4.1.4.2 Potential and value of Green IT/IS*

At the CIO level, Green IT is considered to be part of Business as Usual operations. Its value is again its ability to find savings:

> *"I know at the time, there were some people that were really into. They spent a lot of time and a lot of money complying – at other Universities at other IT Director levels...And whether all the work that they were doing was really adding value? I know a number of them brought in external consultants…to tell them stuff that was available from all the vendors. We didn't need a consultant to tell us that we should be buying energy star rated machines – but I know some people did. We didn't make as big a deal – but when we knew there could be some possible savings we definitely jumped on board. "*

At the ES Manager level it is noted:

> *"…those systems cost a lot of money. If the value is there we would invest the money."*

Value consideration for Green IT/IS, while understandably constrained by the cost aspect, again cannot and should not be based solely on money. It automatically limits innovation and outside the box thinking to enable opportunities. A greater awareness and understanding of the potential and value of Green IT is needed. (Chou & Chou, 2012)

#### *4.1.4.3 Student Attitudes*

There is a sense of helplessness identified with students regarding their ability to create impact in the area of environmental sustainability. However, the potential value of Green IS is recognised.

> *"It's a helplessness. We're in a crisis but what can I do as an individual – any effort I make is so meaningless in the scheme of things and its essentially out of our hands… Use the information technology to show people their effort alongside efforts of hundreds and thousands of other people – alone its not significant but if you can show them all these other people are doing it." (Interviewee #7)*

#### 4.1.4.4 Senior Level Support & Leading IT

There were challenges in implementing Green IT/IS initiatives suggesting a lack of recognition or belief in the value of Green IT/IS. PCEMS project was initiated externally of the IT department. As stated in the case study, IT technical staff had to push upwards and get manager buy in. Also as the Green IT consultant noted:

> *"I even sent [CIO] a questionnaire around [University] on all those different areas at one point. He wasn't interested. I don't think he was that impressed…I interviewed…quite a few people around the business and rate them - and said you're about 20% out from what you should be. He was good enough to say yes you can have access to all my people, go and interview them, but he wasn't really interested in the response."*

#### 4.1.4.5 IT/IS User Values

University IT/IS users understand the environmental impetus to recycle despite it having little impact. This belief pushes practices:

> *"people make a big song and dance about recycling but in the overall scheme of things the amount of environmental impact that that makes I would argue is fairly small compared to the other things we could do. But people are passionate about recycling and we need to address it" (Interviewee #1)*

The same environmental impetus regarding Green IT/IS is needed with users still paying what many interviewees call "lip service".

> *"It's not quite there, as I said, there's a lot of lip service, when it comes down to it, I love the environment if its inconveniencing me then I'm sorry bugger the environment."*
>
> *"…but people like to pay lip service "Ooo it's green that's good". There was a lot of buy in from that aspect as long as it didn't interfere with people's work. The users didn't care so much about the money aspect."*
>
> *"… it's also you know the more senior people get, the less they care about – they want everything because I'm important because someone said so and I'm getting a big salary so I must be important. They have it. "*

User attitudes play a significant part in green IT/IS measures and can require consultation and education in enhancing these efforts.(San Murugesan, 2008) As noted by one interviewee:

> *"… don't upset people. …Pretty much what the user wants." (Interviewee #4)*

| | |
|---|---|
| **Attitude R02:** | Develop and implement a change management programme which addresses the impetus to shift the attitudes of the University community towards one which values and actively supports environmental sustainability initiatives and the role Green IT/IS plays. |

**Overall Attitude Component Rating:** **5** **out of 7**

(refer to Attitude Component in the appendices on page42)

**Summary of identified barriers and drivers to Green Attitudes is provided in Figure 11**

One of the key drivers for green attitude relates to awareness, visibility and information. These support an understanding for the impetus for change; impetus for better practices and technology. Inversely a lack of understanding of Green IT/IS potential, lack of senior level support and myopic focus on efficiency/e-waste represent barriers in this area.

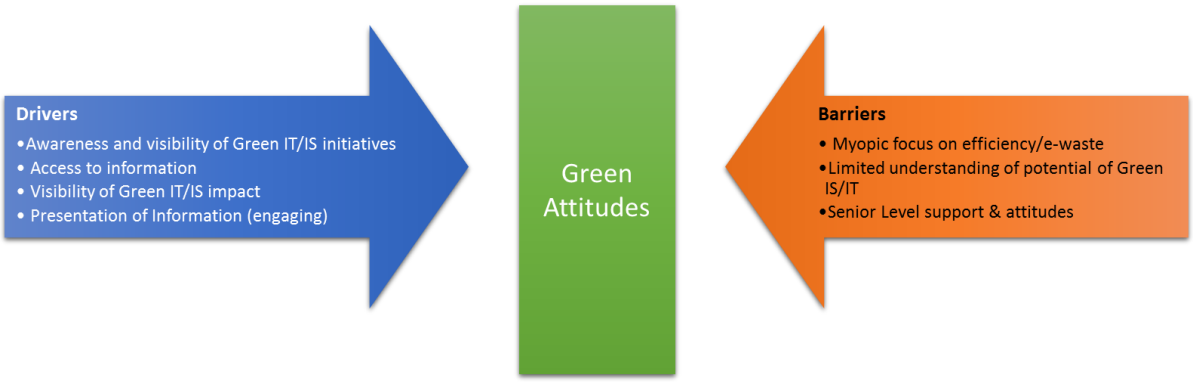


*Figure 11 Identified barriers and drivers to Green attitudes*

### 4.1.5 Overall G-Readiness

Utilising the G-Readiness framework, information collected from the case study was aligned according to the Practice, Technology, Attitude, Governance and Policy components. The preceding sections rated these components with more detail provided in the appendices. Consolidating these ratings and transposing over the G-Readiness maturity data plotted by Molla et al. (2011, p. 86), we can see where Queen's University's maturity compares in Figure 12.

Not surprisingly, given the temporal comparison of where Queen's University is now with geographical progress made in 2009, the University has made strides in technology, practice and governance. However, policy and attitude are areas identified for further development. It may be noted that governance maturity is not aligned with policy, as may be expected. However, this could account for the recent and new change in structure and strategy and insufficient time has elapsed for the policy aspect to reflect these changes.

A summary of identified barriers and drivers to the University's G-readiness in represented in Figure 11.

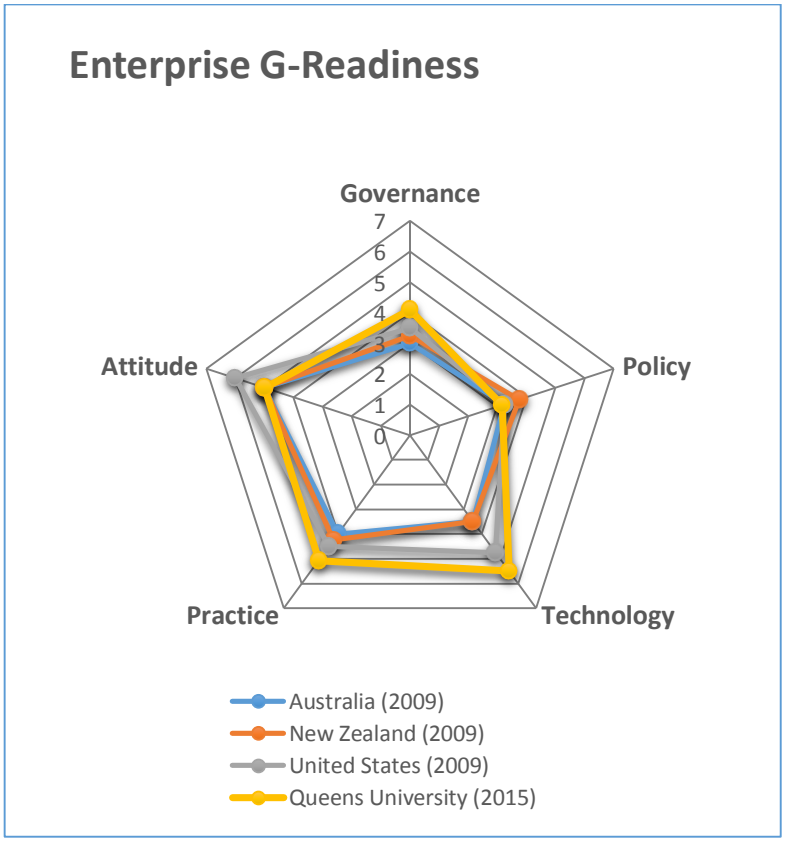


*Figure 12 Queen's University overall G-Readiness maturity*

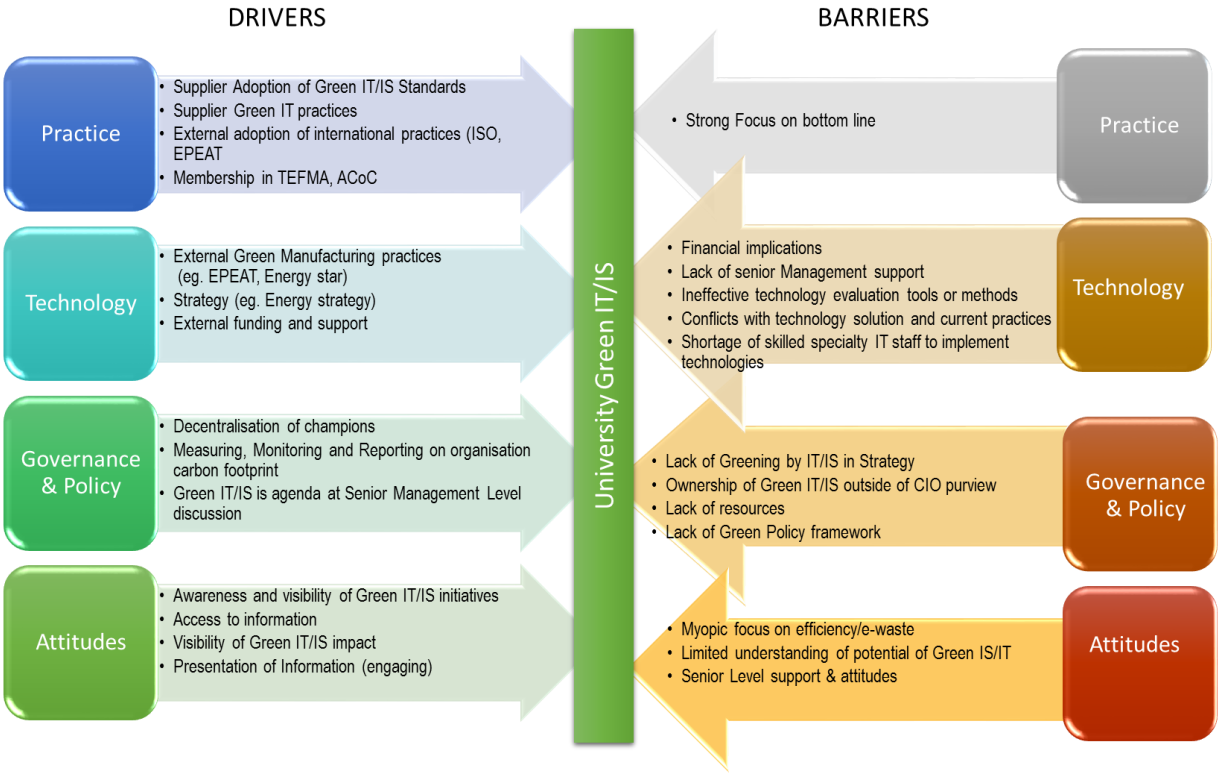


*Figure 13 Drivers and barriers to University G-readiness*

## 4.2 Supporting Eco-Goals

In looking at all the Green IT/IS initiatives undertaken by the University, this section analyses how these align with eco-efficiency, eco-effectiveness ad eco-collaboration. These goals can inter link and as such eco-effectiveness and eco-collaboration are considered together due to the strong complementary characteristics identified between these areas.

### 4.2.1 Eco-Efficiency

Driven by their Energy Strategy, many of the initiatives undertaken mirror the University's general understanding of Green IT/IS ; that it is about energy consumption and e-waste. This lends to Green IS/IT goals heavily focused on eco-efficiency.

- Organisational CO2 emissions measurement, monitoring and annual reporting
- Server virtualisation
- Data centers - free cooling data center
- Power management software
- Building management software - monitoring energy, heating etc.
- Student hall energy competition – promoting greener practices

These measures however can be seen as tactical. Watson et al. (2011) advocates a strategic move from eco-efficiency to eco-effectiveness recommending strategic breakouts rather than tactical improvements. The preceding section will highlight the focus on this area.

> **Eco-goal R01:** Direct greater focus towards eco-collaboration and eco-effectiveness goals in strategic development to enhance Green IT/IS maturity and performance within the University.

### 4.2.2 Eco-Effectiveness and Eco-Collaboration

#### *4.2.2.1 Customer & Stakeholder participation*

Queen's University has done well involving others in its various initiatives as illustrated by the table below.

*Table 5 Summary of Eco-effectiveness and eco-collaboration in Green IT/IS activitis*

| Green IT/IS Activity | Involved collaboration with | Effectiveness acquired |
|---|---|---|
| **Data Center Project** | Student Engineers | Design informed by research, experience |
| | Environment section | Provided energy measuring benchmark to test design |
| **PCEMS Project** | University faculties | Mitigated user resistance<br>Informed current practice conflicts |
| **Student Hall Energy competition** | Environment Section | Enabled energy data |
| **All of Government Procurement** | Government Ministry | Cost reduction<br>Streamlined procurement process |
| **Environmental Sustainability Section Support of Research & Projects** | University courses (staff, students) | Provides insight of operational practices while supporting learning & teaching |
| **Memberships in Environmental Sustainability forums** | ACoC<br>TEFMA<br>Other Universities | Triggers reflection on organisation practice and benchmarks relative to others<br>Promotes use of benchmarking tools |

#### *4.2.2.2 Telling the Story*

The activities and level of collaboration provide superficial effectiveness with the interviews highlighting greater potential through 'Telling the story'.

*". So there's not enough chest beating or rah rah rah to say how amazing we are. Lots of people don't know what we're doing" (Interviewee #1)*

*"It's doing some things well… But in terms of telling the story they didn't do it that well… So it's one thing to do the outward comms and then have the conversation outside campus but then also walking the work outside campus" (Interviewee #7)*

| | |
|---|---|
| **Eco-goal R02:** | Work with relevant marketing and communications section & develop a communications plan with activities to support ongoing 'telling of the story' - how Queen's University is supporting environmental sustainability through Green IT/IS initiatives. Must include an internal and external focus due to the nature of the University as an organisation. |
| **Eco-goal R03:** | Utilise the brain power within the university to develop and frame messages to have greater impact by highlighting the environment perspective as opposed to the business |

Telling the story supports sharing of information and engagement of University community stakeholders in these initiatives. Other ways includes the access to and presentation of information.

*"it would be really good to pursue the display of information in foyer on progress and performance of environmental sustainability initiatives – energy, water …"(Interviewee #2)*

Visibility and presentation of information can be critical to promoting and influencing environmentally conscious behaviour. (Malhotra et al., 2013) While it is recognised as a challenge, informational systems has a role to play in changing individual and organisational behaviours towards more environmentally sustainable practices. (Watson et al., 2011). As one of the University stakeholder recognised, the potential for Green IS impacting behaviour is there:

*"If you can develop ways that are 1) exciting 2) engaging and 3) which is what green IT has an ability to do is, demonstrate the collective action. Use the information technology to show people their effort alongside efforts of hundreds and thousands of other people – alone its not significant but if you can show them all these other people are doing it…"*

| | |
|---|---|
| **Eco-goal R04:** | Create innovative and engaging ways to tell the story and send out messages. Visual impactful information proliferated across all internal & external channels. |

#### *4.2.2.3 Interweaving environmental sustainability into the fabric of the University*

The Environmental Sustainability section have made efforts to incorporate the teaching and learning into an aspect of their operations. This effort reflects an efficacy in collaboration that needs to be embraced more throughout the University.

*"It is a sustainable approach with far reaching implications for making an impact in this area. environmental sustainability or sustainability generally often gets pigeon-holed… We want to be encouraging more sustainability into teaching. There's always been a reticence…it's not relevant to particular schools." (Interviewee #1)*

There is a transformative potential in this approach that is recognised by extant literature, and indeed interdisciplinary and practitioner partnering is encouraged.(Brocke, Watson, Dwyer, Elliot, & Melville, 2013; Malhotra et al., 2013)

*"For a long time I have been beating my drum. As a University, our contribution to the world of sustainability and how we're going to ensure that this planet is still liveable for future generations, we can offer so much more to that through teaching and research than what we can do on the operational side." (Interviewee #1)*

| | |
|---|---|
| **Eco-goal R05:** | Interweave environmental sustainability into University teaching and learning courses, projects, partnerships… |

The ES Manager has worked in linking operations with the teaching and learning environment; it sets an opportunity to also bridge the gap often encountered with research feeding into practice. One of many potential opportunities may include research feeding into the consultancy branch of the university with niche expertise in Green IS.

| | |
|---|---|
| **Eco-goal R06:** | Identify opportunities for collaborative projects in Green IT/IS;eg students and operations, between universities, external organisations to investigate and study Green IT/IS. |

As a New Zealand University, Queen's University accepts a role as critic and conscience of society, enhancing society through their contribution to the understanding of social issues and the achievement of social, economic and physical well-being (UNZ, 2015). There is arguably no issue greater than addressing climate change at this hour.

Eco-effective and eco-collaborative measures have greater potential to enhance Green IT/IS activities and support Queen's University in this role. Queen's university can work towards Green IT/IS initiatives that effectively and collaboratively contribute to our achievement of social, economic and physical well-being.

As Allan put it, "Sustainability is a pan University theme, get on board people"

# 5 Summary of Recommendations and Conclusion

While many studies have carried out research based on surveys, the semi-structured interview adopted provides rich information on the various perspectives of stakeholders involved in Green IT/IS activities. These perspectives reflect many views identified in extant practitioner and academic literature. Recommendations made are aligned with practitioner and academic literature and are provided below according to the areas explored in the case study.

## 5.1 Practices

These recommendations for practices seek to address the approach and focus taken by the University in some areas. This includes a reliance on external pressures to trigger/inform/influence internal practices as well as a focus on bottom line evaluation. There are also some adhoc activities which are recommended to be incorporated as organisational practice and into overall University reporting.

*Practice R01:* *Move from a passive to proactive practice in evaluating and preferring Green suppliers supported by a policy with rigorous environmental standards around procurement (Stewart, 2014).*

*Practice R02:* *Reconsider the University's evaluation model of IT procurement. While cost is a valid business consideration it should not be the main constraint for environmental considerations.*

*Practice R03:* *Develop assurances around vendor practices to support environmental sustainability in the procurement lifecycle. eg request an e-waste certificate of destruction (E.-stewards, 2015)*

*Practice R04:* *Consider incorporation of ISO 1400 into practices. (ISO, 2015)*

*Practice R05:* *Move from adhoc Green IT reporting and support IT department energy auditing and monitoring as an organisational practice.*

*Practice R06:* *Incorporate Green IT/IS reporting and metrics into overall University Environmental Sustainability Reports.*

## 5.2 Technology

The University has done some great work in the area of technology. Recommendations in this area focus on minor way to improve or enhance activities in this area.

*Technology R01:* *Improve performance in purchasing of gold star EPEAT equipment.*

*Technology R02:* *Fleet Management system is recommended in tandem with the development of green user practices to better leverage environmental sustainability goals.*

*Technology R03:* *Review Total cost of ownership models used in evaluating potential technologies.*

## 5.3 Governance & Policies

Incorporating sustainability into the strategic direction of the University signals a start in the right direction for Queen's University. Recommendations in this area build upon this direction addressing roles, responsibilities, resources and policy considerations.

***Governance 01:*** *Develop a Green IT/IS Strategy or incorporate into new IS Strategy.*

***Governance 02:*** *Ensure CIOs have co-ownership and responsibility in driving IT-related green initiatives.*

***Governance 03:*** *Decentralise environmental sustainability roles and/or create a structure which supports sustainability and Green IT/IS champions across the university community.*

***Governance 04:*** *Implement a supporting information system that allows for sharing of information across the University; eg create capabilities for students and faculties to monitor and report on their energy usage*

***Governance 05:*** *Ensure Green IT/IS is an agenda item in senior management discussions to reflect the sustainability intention and potential of IT/IS to address environmental sustainability goals*

***Governance 06:*** *Develop a funding model to provide more support in terms of funding, human resources and infrastructure for Green IT/IS initiatives across different areas of the University.*

## 5.4 Attitude

Recommendations for attitude provide an overall approach to address some of the perspectives identified as barriers to Green IT/IS initiatives. This includes a lack of understanding of the potential of Green IT/IS as well as the impact of current unsustainable practices. These have been identified at senior management and user level.

*Attitude R01:* *Promote an understanding of Green IT/IS with a particular focus on its greening by IT/IS potential.*

*Attitude R02:* *Develop and implement a change management programme which addresses the impetus to shift the attitudes of the University community towards one which values and actively supports environmental sustainability initiatives and the role Green IT/IS plays.*

Implicit in the change management programme is the need for an education component to shift users attitudes from not caring to understanding why they need to care and more importantly change.

## 5.5 Supporting Eco-collaborations & Eco-effectiveness

The University has incorporated a collaborative approach in its projects. These recommendations build on these approaches and show where eco-collaboration can create eco-effectiveness in other areas or activities. Some of these recommendations go hand in hand with enhancing recommendations in practices, governance and attitude.

***Eco-goal R01:*** *Direct greater focus towards eco-collaboration and eco-effectiveness goals in strategic development to enhance Green IT/IS maturity and performance within the University.*

***Eco-goal R02:*** *Work with relevant marketing and communications section & develop a communications plan with activities to support ongoing 'telling of the story' - how Queen's University is supporting environmental sustainability through Green IT/IS initiatives. Must include an internal and external focus due to the nature of the University as an organisation.*

***Eco-goal R03:*** *Utilise the brain power within the university to develop and frame messages to have greater impact by highlighting the environment perspective as opposed to the business*

***Eco-goal R04:*** *Create innovative and engaging ways to tell the story and send out messages. Visual impactful information proliferated across all internal & external channels.*

***Eco-goal R05:*** *Interweave environmental sustainability into University teaching and learning courses, projects, partnerships…*

***Eco-goal R06:*** *Identify opportunities for collaborative projects in Green IT/IS;eg students and operations, between universities, external organisations to investigate and study Green IT/IS.*

Overall Queen's University has made great progress with a laudable benchmark in its G-readiness. Areas for improvement focus on improving the governance structure and support around these activities and looking at how they can become more effective through collaborative efforts.

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# 7 Appendices

## Appendix 1: Subjective assessment of Queen's University G-Readiness

The author openly acknowledges interpretation in the use of this tool is subjective. However, commentary is provided as insight into the thought process and reasoning behind the rating given for each of the dimensions. These perspectives are informed by statements from the interviews and may not necessarily reflect accurately the University's true G-readiness state. Nevertheless the subjective assessment itself represents an interesting exercise in consideration of benchmarking and can provide indication of the areas to check for improvement or opportunities.

All scales are adapted from Molla (2011, pp. 91-92) with the average of ratings incorporated into the G-Readiness Spider chart.

### Practice Component

*To what extent are these aspects practiced?*

Rating is given on a scale of 1**- Strongly disagree** to **7-Strongly agree**.: Avg – 5.1

| Practice aspect | Rating | Comments |
|---|---|---|
| Preference of IT suppliers that have a green track record | 2 | *IT procurement guided by All-of-government procurement; cost is seems a greater preference in consideration; while environmental guidelines are available and environmental sustainability action plan requested an evaluation of suppliers, within IT there seems a reliance and expectation on the industry to be green. Yet to develop a preference.* |
| Gives weight to environmental considerations in IT procurement | 5 | *Consideration given to EPEAT ratings with gold buying as much as possible; extending life of equipment* |
| Shortens IT equipment refresh periods to gain access to more energy efficient equipment | 7 | |
| Considers environmental factors in the design of the site infrastructure (lighting, power delivery, cooling systems) and IT infrastructure (servers, storage and network) of data centers | 7 | *Fancy pants data centre project reflects a high degree of consideration of environmental factors from an energy and cost perspective* |
| Audits the power efficiency of existing IT systems and technologies | 3 | *Audit carried out adhoc to meet external reporting or information requirements. Enterprise architecture commented that to do so would consistently involve the assistance of Campus services* |
| Switches off data center lights and equipment when not needed | 7 | |
| Operates existing IT systems in an energy efficient manner | 6 | *Energy efficiency equates to cost savings and* |
| Enforces PC power management | 5 | *Enforces PC power management but not the total pc fleet* |
| Implements IT projects to monitor the enterprise's carbon footprint | 3 | *Some efforts are made to accommodate reporting /analysis requirements* |
| Prints double-sided on paper | 7 | |
| Analyses IT's energy bill separately from the overall corporate bill | 3 | *Some analysis is done for the computers and the data centre but more as a measure to benchmark at the start of a project and again at the end. Not an ongoing practice and more to support business cases for initiatives eg. PCE* |
| Relocation of its data center near clean sources of energy | 7 | *Relocation carried out to support free cooling, wind and air as opposed to expending energy to cool with air conditioning* |
| Recycles consumable equipment (e.g., batteries, ink cartridges, and paper) | 7 | *Contractor on board manages this aspect* |
| Disposes of IT equipment in an environmentally friendly manner | 6 | *E-waste system reflects this but IT procurement acknowledges there are no guarantees at the destruction point – based on trust* |
| Engages the service of a professional service provider regarding Green IT | 1 | *CIO does not recognise any value in this and perceived that Green IT/IS considerations have become BAU practices* |
| Prefers hardware vendors that offer end of IT life —take-back options | 7 | *Previous practice reflected this before moving to e-waste auditing and recycling system* |

## Technology Component

Extent of technology measures - Seven point scale anchored by 1=Not at all and 7=Great Extent Average – 5.5

| Technology aspect | Rating | Comments |
|---|---|---|
| Desktop virtualisation | 2 | *VDI is being explored but desktop virtualisation is used as part of IT troubleshooting services* |
| Install more energy efficient lights | 5 | *Progressively deploying energy efficient lights and joining programmes* |
| High efficiency stand-by power systems | 5 | |
| Retire energy inefficient systems | 5 | *Systems in the old server is slowly being phased out* |
| Print optimisation | 5 | *Duplex printing but still paper in printers – could be at 7 with follow-me-printing* |
| Computers that have functions to monitor workloads and to shut down components when unused | 5 | *PC energy management software on most of fleet but not all.* |
| Server consolidation and virtualisation | 6 | *80% servers virtualised* |
| Data center airflow management | 7 | *Free cooling data centre, airflow management in older server* |
| Free cooling in large scale data centers | 6 | *Old server being retired* |
| Hot aisle/cool aisle data center layout Info | 7 | *Measures employed* |

## Governance Component

*To what extent are these aspects true?* Seven point scale anchored by 1= Strongly Disagree and 7=Strongly Agree. Average – 4.4

| Technology aspect | Rating | Comments |
|---|---|---|
| Our business has set C02 targets to reduce our corporate carbon footprint. | 7 | *Targets are set annually and monitored and reported in Environmental Sustainability Report* |
| We have defined a role for coordinating our business‘s green initiatives | 7 | *New role established to oversee strategic sustainability and environmental sustainability officer.* |
| Top management discuss Green IT issues as a priority | 3 | *Environmental sustainability features heavily on* |
| Responsibilities are clearly defined within each Green IT initiative | 7 | *Project management principles and practices are adopted and support this aspect* |
| Our CIO (or equivalent) plays a leading role in all green (IT and non-IT) initiatives | 3 | *Data centre was lead by CIO and PCEMS by ES Manager. Also CIO was initially against PCEM project.* |
| We have earmarked a budget and other resources for Green IT | 4 | *ES Manager has considerations for some systems add-ons to enhance BMS* |
| We have established metrics for assessing the impact of Green IT initiatives | 3 | *Some metrics are assessed in response to external reporting requirements* |
| Our organization has mechanisms for monitoring IT suppliers‘ green performance | 1 | |
| IT is responsible for its own electricity costs | 1 | *Electricity costs are centralised within the Campus Services section* |
| Our organization demonstrates adequate readiness for Green IT | 5 | |

## Policy Component

To what extent are these policies developed – Scale: 1- not at all developed – 7 (extremely developed). Average: 3.17

| Technology aspect | Rating | Comments |
|---|---|---|
| **Corporate social responsibility policy** | 4 | There is no corporate social responsibility policy but some aspects of this are covered implicitly in the environmental sustainability policy and some of the University’s actions |
| **Green supply chain management policy** | 5 | Environmental sustainability policy and guidelines touch on this |
| **Green IT Procurement policy** | 4 | Save as above |
| **Green data center policy** | 1 | None, but practice is there, relies on external vendor |
| **Green IS policy** | 1 | None, but practice is there |
| **Policy on employee Green IT use** | 4 | Practices are there, sustainability guidelines are there |

## Attitude Component

*Are these concerns?* – Scale: 1- Strongly disagree – 7 Strongly agree. Average: 3.17

| Technology aspect | Rating | Comments |
|---|---|---|
| Managerial attitudes | 3 | Green IT/IS is not an immediate concern or priority; CIO considers business |
| Beliefs regarding IT energy utilization | 7 | Energy strategy drives this to the top of the agenda |
| Organisational action towards current energy consumption | 7 | Every effort made |
| Efficiency of powering IT infrastructure | 6 | Efforts are made but old equipment is there that they're soon retiring |
| Concerns about IT's contribution to green house gas emmissions | 4 | There is concern from an energy perspective but room for further development |
| Concerns about suppliers enviornmental footprint | 3 | Reliance and expectation that suppliers are leading the way in addressing environmental footprint with their products and services but no measure to check other than environmental procurement guidelines |
| Concerns about environmental impact in discarding IT at the end of its life | 6 | No full guarantee or assurances made that IT is disposed off at the end of life –eg. certificate of destruction needed |

## Table Summary of Enterprise G-Readiness Maturity Rating

| | Governance | Policy | Technology | Practice | Attitude |
|---|---|---|---|---|---|
| **Australia (2009)** | 3 | 3.25 | 3.5 | 4 | 5 |
| **New Zealand (2009)** | 3.25 | 3.75 | 3.5 | 4.25 | 5 |
| **United States (2009)** | 3.5 | 3.25 | 4.75 | 4.5 | 6 |
| **Queens University (2015)** | 4.4 | 3.2 | 5.5 | 5.1 | 5.1 |

# Appendix 2: Interview Statements Analysis and categorisation

## Definition and Understanding of Green IT

*Table 6 Thematic Analysis of Green IT/IS Definition statements*

| Statements | Themes |
|---|---|
| We have this immense resource for us, at a stage in terms suddenly we've got access to these information systems that can enable us to do crazy things that would be really useful. Essentially my approach is how can we create inventive systems that enable engagement and environmental issues and enable coops | Potential of Green IT/IS as a solution |
| about running green ITS, around being more sustainable with your IT decisions..procurement, making decisions around organisation that adhere to sustainable policies…energy efficiency…EPEAT…standards…it about understanding, around what solutions…could reduce your footprint. It's looking at technology as a whole and how you can actually be more sustainable. It's quite broad in its sense, it's about the purchasing, the use the lifecycle – it also can be about technology increasing the sustainability of your enterprise overall. | Procurement<br>Energy efficiency<br>E-waste<br>Sustainability |
| Green information systems to me is about reducing the carbon footprint of the organisation and using IT systems to lessen that impact on the environment. It's also about from an electricity point of view, but you can also say it's about the whole lifecycle of IT and how you can use IT to decrease that footprint across the IT | Potential of Green IT/IS as a solution<br>Energy efficiency<br>Life cycle of IT |
| Obviously, for an organisation like ours any power savings is enormously important. It does make a huge difference. We've extended the life of all our desktop equipment by an extra year | Energy efficiency<br>E-waste |
| So for me, from my job point of view, it'd have to be power the machines use, and packaging for new and stuff that's going out | Energy efficiency<br>E-waste |
| our IT kit has got an environmental impact; whether you'd say it's big or not…I guess it's pretty big in terms of the energy demand it requires and all the materials that go into the kit<br>...E-waste is a big issue so we're not just sending it to landfill... | E-waste<br>Environmental Impact of IT<br>Energy efficiency<br>Lifecycle |
| what green IT has an ability to do is demonstrate the collective action. Use the information technology to show people their effort alongside efforts of hundreds and thousands of other people | Potential of Green IT/IS as a solution |
| I guess I would be looking at it from a power consumption perspective<br>we would be looking to our vendors,<br>to make sure they produce hardware that uses the lowest power consumption possible<br>ensure that stuff can be recycled | Energy efficiency<br>E-waste |

## Attitude

*Table 7 Thematic Analysis of Select Statements reflecting Attitude*

| Statements | Themes |
|---|---|
| 1. On one hand it can seem like students aren't as engaged in these issues as you'd think they'd be but there's hundreds – thousands of students that even if we don't see it, that they're not engaged in environmental studies and courses – the interest is there and this generation of students at Victoria there's very real understanding of the environmental crisis that we're in and what the situation is – in order to make that engagement happen it's about coming across in inventive and exciting ways for people to participate in sustainability and environmental issues. I think what characterises people's views of the environmental crisis. It's a helplessness. We're in a crisis but what can I do as an individual – any effort I make is so meaningless in the scheme of things and its essentially out of our hands. If you can develop ways that are 1) exciting 2) engaging and 3) which is what green IT has an ability to do is demonstrate the collective action. Use the information technology to show people their effort alongside efforts of hundreds and thousands of other people – alone its not significant but if you can show them all these other people are doing it. | Green IS Potential<br>Visibility of impact<br>Collective efforts<br>Engagement |
| 2. The University has put it in the strategic plan it's a priority with academic emphasis. Reflecting on that it's something that needs to be intertwined into the very fabric of teaching and research and operations. In terms of academic departments there can be more courses in more department | Intertwine with core functions<br>Eco-effectiveness<br>Eco-collaboration |
| 3. – our waste system on campus is absolutely embarrassing. To be having aspirations as a world leading university in sustainability and not having not dealing with your own waste properly is very hypocritical. Ground level stuff – establishing good waste systems. Establishing – investing in student led centers, organisations on campus to run sustainability initiatives – food gardens. | Lead by example<br>Resourcing<br>Eco-effectiveness |
| 4. I want to do stuff around waste around the University and I'm trying to think of ways you could integrate IT into that. I think it would primarily be around education because when you're setting up a system like that 1) structure 2) education which are equally important so when a waste system is rolled out it would be great to partner up with an IT system that acted like a tool for education for students. | Green IS value<br>Intertwine with core functions |

| Statements | Themes |
|---|---|
| 5. But I got extremely demoralised about this business because I had so many opportunities but getting it across the line was so god-damned difficult – it was " yea yea we understand yea it's a great idea but here's where all our priorities". | Green IS not as priority |
| 6. There had to be a directive in that environment about an energy reduction because if there wasn't who cares. There had to be payoff, there had to be the ability for us to measure that – we needed a baseline – it was important for the enterprise to have a baseline to understand what their footprint is – what their current usage was. Trying to build those measurement capabilities and I think [Allan] had gone so far down that track of getting a feel for where his energy use was so they already had reduction initiatives going on. So it was how do we squeeze in a couple of percent it'll help us towards our targets | Green IS Value |
| 7. But no one is really interested to be honest. I'd say you'd need senior level people with large IT infrastructures or a lot of infrastructures that have a lot of IT – that say that 1) we're procuring using and disposing of our IT in the most sustainable ethical manner and 2) we're using technology to ensure that we are preventing or using less CO2 and the least energy we could possibly. | Green IS value<br>Senior level support |
| 8. When they make technology decisions, are they [University] asking how sustainable is this? I think they are. Their data center…it's pretty good. | Green IS Value |
| 9. I pitched to him years ago and it wasn't him [IT Director] that got it across the line. It seemed like years ago that we did this. | Green IS Value |
| 10. Take it slowly and test it out, try it out and don't upset people. If people asks for it to be taken off, take it off. Pretty much what the user wants. | Implementation approach |
| 11. I know at the time, there were some people that were really into. They spent a lot of time and a lot of money complying – at other Universities at other IT Director levels...And whether all the work that they were doing was really adding value? I know a number of them brought in external consultants…to tell them stuff that was available from all the vendors. We didn't need a consultant to tell us that we should be buying energy star rated machines – but I know some people did.<br>We didn't make as big a deal – but when we knew there could be some possible savings we definitely jumped on board. | Implementation approach<br>Cost focus |
| 12. You do [have to manage a lot of people's expectations]. Unfortunately sometimes, it's also you know the more senior people get, the less they care about – they want everything because I'm important because someone said so and I'm getting a big salary so I must be important. They have it. | Environmental impact recognition |
| 13. Most people do accept it but some it just doesn't work. That is in some sense, where it becomes a bit tricky when people say, "aw I'm an environmentalist I'm really concerned about the environment" but when it comes to their own consumption they have no concept whatsoever that every time every laptop you buy that's another [environmental impact] | Environmental impact recognition |
| 14. There's obviously a certain amount of trust relationship there. We have a good system here we know exactly what goes there. [recycling vendor]...they do all the same kind of work for lots of government departments, they do it for banks – they are a trusted partner of a many organisations. That's no guarantee. | Environmental Sustainability assurances |
| 15. I think if I went to the University in General or my boss in particular. We need to buy these green pcs, they're $200 more but you know we really need them otherwise we're destroying the planet – they're probably say, ok um nah | Green IS value<br>Economic consideration |
| 16. HP do a retrieval service, you buy a pc from them and you call them and they will collect it again and take it away – that takes [recycling vendor] out of the cycle for them but it also deprives us of the money. | Economic consideration |
| 17. I sort of don't feel that the containers will land in India and a bunch of 5 year olds have to crawl amongst them to dissemble them. The images we seen…you don't know.<br>As I say we don't know for sure, you can only go with your gutt feeling… | Environmental Sustainability assurances |
| 18. It's not quite there, as I said, there's a lot of lip service, when it comes down to it, I love the environment if its inconveniencing me then I'm sorry bugger the environment. | Environmental impact recognition |
| 19. It ends up, there is a critical mass that's pushing the suppliers to do what they can, the best they can do in terms of being green. | External |
| 20. My manager had to push it with his manager – we had to push upwards. There's been a little bit of push back from staff, clients because they think they need to have their machine on every night all the time. We had to push back with them as well. It's just a matter of managing user expectations.<br>We're not being draconian about it, we're just trying to save power where it can be saved.<br>If someone's research dictates that they need to crunch numbers for 20 hours straight, then that's what has to happen. | Senior level support<br>Green IS value<br>Environmental impact recognition<br>User needs |
| 21. The feedback that I got, and the feedback that [Ana] and [Allan] got as well was people thought it was a good initiative from a green aspect; but people like to pay lip service "Ooo it's green that's good". There was a lot of buy in from that aspect as long as it didn't interfere with people's work. The users didn't care so much about the money aspect. | Environmental impact recognition<br>User needs |

| Statements | Themes |
|---|---|
| 22. I think it should be important to [University] but I don't know if it is at a senior management level. I think that ITS could do more but there hasn't really been a push along those lines. If Allan hadn't put this night-watchman in place or started the project himself, pretty much single-handedly, I don't think we would have done that – just judging from the push back I got from parts of IT – I don't think it would've have been initiated from us – we would've done nothing at all. | Senior Level support<br>Green IS Value |
| 23. I wouldn't say they're not open to it but I haven't heard anybody at meetings say lets look at this or lets do this | Implementation approach |
| 24. After several years of trying to woo IT on that, we got them across the line on that. And then the challenge became working with all the users that they comfortable and that we were capturing their themes; | User needs |
| 25. We need to be walking the talk. | Lead by example |

## Appendix 2: Semi-structured questions used in interviews

**General/Role**

1. Describe your role(s) in the organisation?
    a. What is it and what it entails
    b. How long have you held this role?

**Attitude**

2. What is your understanding of Green Information Systems and Technology?

3. Please describe where your role/position fit in with Green IS/IT initiatives which have been undertaken or are planned for the organisation?
    a. What are the Green IS/IT initiatives/activities?
    b. How did it evolve?
    c. What was your involvement?
    d. What were some of the challenges or lessons you identified from these implementations?
    e. Where and what support did you identify for these initiatives?

**Practice/Policy/Governance**

4. What internal and external resources do you draw from to guide/inform Green IS/IT initiatives or practices?
    a. Standards
    b. Internal Policies
    c. External Consultants
    d. Vendors/Suppliers
5. What resources have been developed or are available to guide more environmentally sustainable practices?
    - Workshops
    - Toolkits
    - Policies?
6. Please describe the different ways the organisation monitors and evaluates its progress or performance with regard to Green IS/IT?
    a. What systems or information are used?
    b. Reporting practices/processes?
    c. Where do you think these could be improved?
7. Please describe, from your perspective what your assessment of Green IS/IT practice is within the organisation?
    a. How important is Green IT/IS
    b. What are the organisational challenges?
8. Please describe any Green IS/IT opportunities you have identified in your role or involvement in such initiatives?
    a. What could the organisation do differently or in addition to what it is already doing now?
    b. Ways to collaborate better?

# Appendix 3: Green IT/IS Frameworks

## Green IT Consultant framework

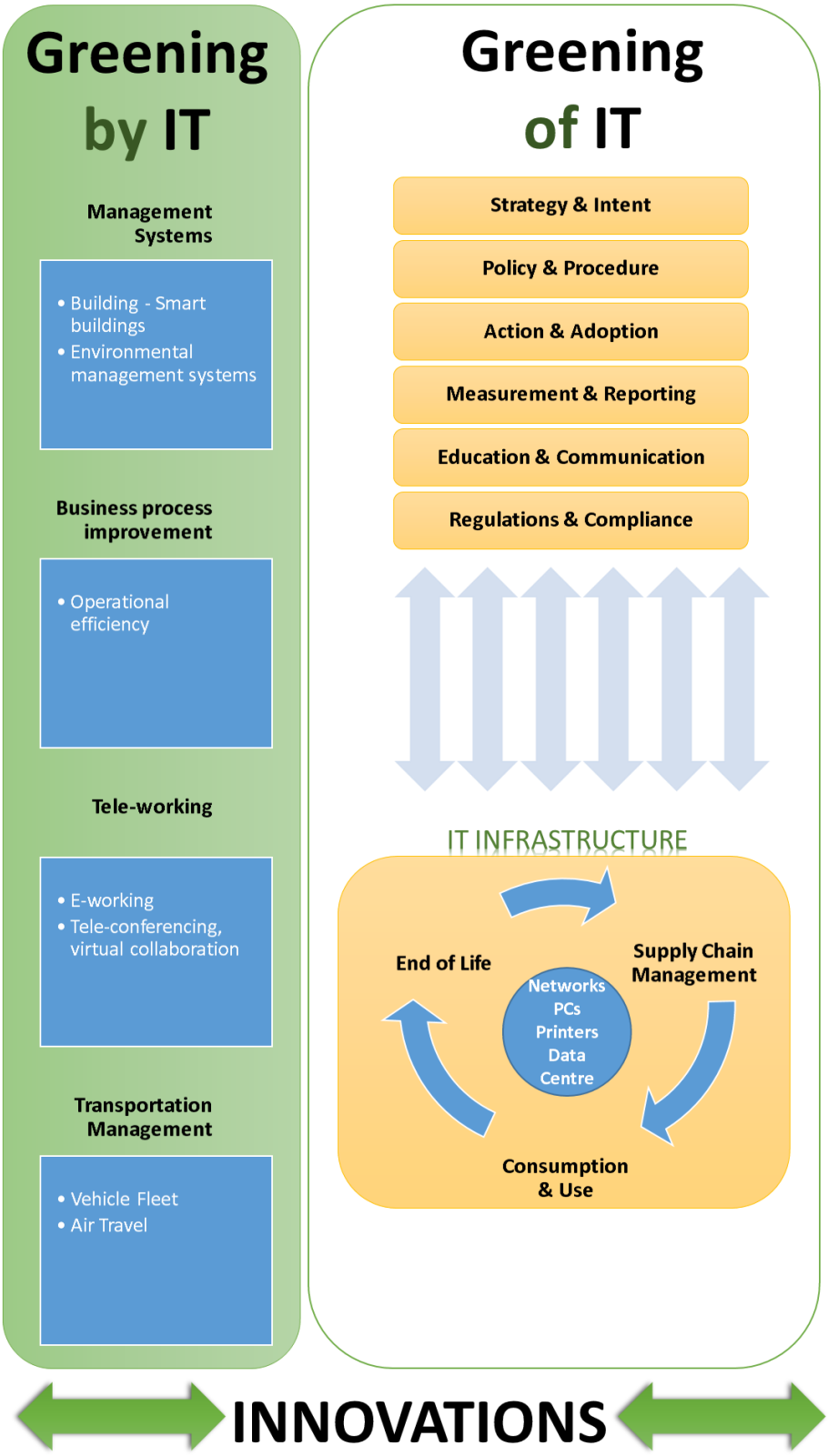


*Figure 14 NZ Green IT Consultant Framework*

## Fujitsu Sustainable ICT framework

The following diagram represents the framework used in benchmarking New Zealand and other countries' ICT sustainability

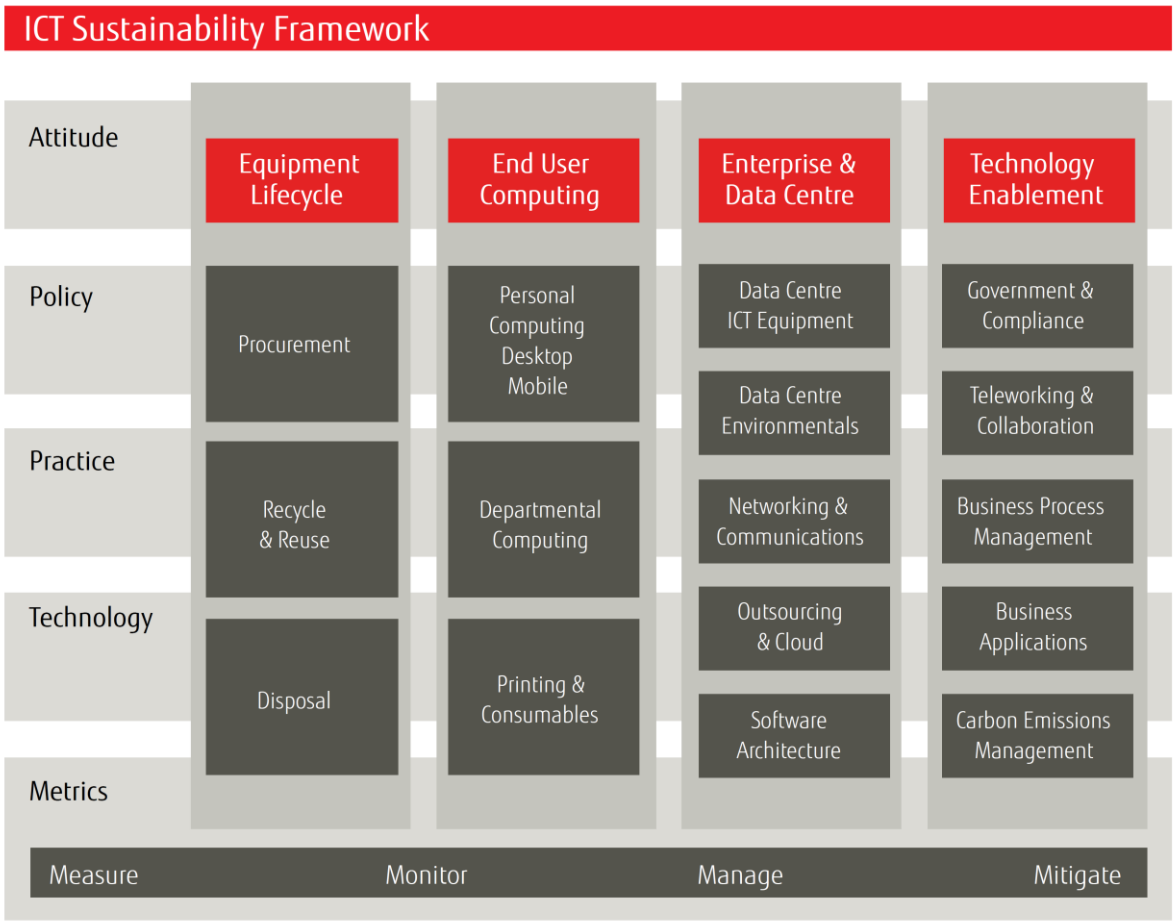


*Figure 15 Fujitsu ICT Sustainability framework (Stewart, 2014, p. 18)*

## Appendix 4: Supporting Catalogue of Green IT Measures and List of Green IS Initiatives

The following tables from Loeser (2013) were used to further support analysis of data collected during the case study.

| Process | Scope | Focus | Measures and initiatives | |
|---|---|---|---|---|
| IT Sourcing | Supplier relationships | | • Collaborate with suppliers and share knowledge<br>• Define environmental requirements for suppliers | • Encourage suppliers to decrease their footprint<br>• Conduct environmental supplier audits |
| | Sourcing of IT products and services | | • Consider eco-labels when purchasing hardware<br>• Conduct total-cost-of-ownership (TCO) and lifecycle analyses (LCA)<br>• Buy eco-friendly paper and cartridges | • Centralize sourcing of IT equipment<br>• Purchase renewable energy<br>• Purchase energy-efficient cloud services |
| IT Operations | General IT management | | • Develop a Green IT/IS action plan<br>• Develop a Green product and service portfolio<br>• Create an inventory of IT hardware<br>• Consolidate applications<br>• Manage lifecycle of stored data | • Monitor energy consumption<br>• Measure and analyze environmental KPIs<br>• Implement IT performance measurement systems<br>• Detailed energy monitoring of all devices |
| | Data center | Servers and Storage | • Consolidate servers<br>• Virtualize servers and storage<br>• Deploy blade servers<br>• Deploy energy-efficient processors<br>• Install energy-saving hard disk drives<br>• Install dynamically adjustable fans | • Deploy energy-efficient server power supplies<br>• Right-sizing of server and storage capacities<br>• Activate energy-management functions<br>• Apply scheduling and workload management<br>• Shut down servers dynamically<br>• Monitor energy consumption of servers |
| | | Network | • Install intelligent switches | • Virtualize network |
| | | Cooling | • Install dynamically adjustable cooling systems<br>• Install modern CRAC systems<br>• Install in-row chillers<br>• Utilize liquid refrigerants for server cooling<br>• Deploy free cooling system<br>• Separation of hot and cold aisles<br>• Containment of hot and cold aisles | • Detailed monitoring of air temperatures<br>• Optimize air flows<br>• Eliminate hot spots and air circulation short cuts<br>• Increase data center temperature<br>• Consider energy flows in data center architecture<br>• Reuse data center heat |
| | | Energy Supply | • Optimize energy supply<br>• Install modern and efficient UPS<br>• Increase UPS utilization rates | • Install UPS flywheel instead of batteries<br>• Reduce power conversion steps to decrease power losses |
| | Office environment | | • Use notebooks instead of desktop computers<br>• Utilize energy-efficient desktop PCs<br>• Install thin clients<br>• Deploy LED displays<br>• Activate power management functions of PCs | • Install power management software<br>• Inform and educate end users<br>• Install network multifunction printers<br>• Double sided black & white printing as default |
| IT Disposal | | | • Holistic end of IT life management<br>• Reuse computers<br>• Refurbish computers<br>• Extend life of IT equipment<br>• Manage e-waste<br>• Recycle hardware | • Track toxic materials<br>• E-waste policies and rules<br>• Engage in recycling initiatives<br>• Cooperate with suppliers and strive for takeback programs and recycling initiatives |

**Table 5: Catalogue of Green IT measures.**

(Loeser, 2013, p. 7)

| Area | Category | Green IS initiatives |
|---|---|---|
| IT department | IT Governance | • Explicitly formulate a Green IS strategy<br>• Align Green IS with corporate sustainability<br>• Regular meetings between IS and management executives to identify synergies<br>• Organizational integration of Green IS through specific roles and responsibilities<br>• Establish measurable environmental targets<br>• Track IT-related environmental KPIs<br>• Integrate environmental criteria into IT resource management<br>• Internal allocation of IT-related energy costs<br>• Deploy an energy management system<br>• Implement an environmental management system<br>• Strive for certification of the EMS<br>• Analyze customer demand for green products<br>• Green IT service and product portfolio<br>• Create incentives for employees to go green<br>• In-house and external communication of Green IS initiatives<br>• Establish a dialogue with relevant stakeholders<br>• Issue a public IS sustainability report<br>• Engage in NGOs and industry consortiums<br>• Publish technical papers and best practices<br>• Use Green IS initiatives for marketing<br>• Consider environmental aspects in Make-or-Buy decisions |
| Organization | Information and transparency | • Track and analyze corporate waste and emissions<br>• Measure resource consumption and report the firm's environmental footprint<br>• Provide aggregated information regarding environmental sustainability aspects to consumers<br>• Implement firm-wide environmental management systems |
| | Process optimization | • Smart manufacturing (monitor, manage, and optimize production processes)<br>• Track and optimize resource and material flows<br>• Advanced automation technologies<br>• Use simulations in the product design phase<br>• Dynamic vehicle routing and advanced logistic systems<br>• Supply chain optimization<br>• Virtual meetings and remote working practices (reduce individual travel) |
| External market | Innovative end products and infrastructure solutions | • Product lifecycle assessment (tracking of product-related resource demands and emissions)<br>• Building automation (integrated management of light, heating, and cooling systems)<br>• Smart grid technologies (measurement, management, and prediction of electricity demands)<br>• Fuel-saving car technologies (start/stop function, smart engine control units)<br>• Intelligent traffic management systems<br>• Dematerialization initiatives (digital services instead of physical products)<br>• Waste analysis and waste management systems<br>• Environmental innovations through modern technologies<br>• Smart sensors to control and optimize energy flows |

**Table 6: List of Green IS initiatives.**

(Loeser, 2013, p. 8)