An analysis of institutional structures, organisational culture and decision-making processes that affect the sustainability of buildings at the University of Cape Town.

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Submitted by: Jigisha Mandalia

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Supervisor: Dr Andrew Marquard **Co-supervisor:** Dr Amos Madhlopa

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Jigisha Mandalia

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Abstract

Universities globally are realising the potential they have in shaping the future workforce to deal with a variety of environmental issues, such as efficient resource use and sustainable development. The University of Cape Town (UCT) has committed to a number of environmental sustainability goals and is a signatory to international sustainable campus charters. This dissertation analyses the progress of sustainability levels of buildings on campus. A case study of three recently built buildings was undertaken, the last of which attained a 4-star green rating by the Green Building Council of South Africa. A detailed analysis was conducted through semi-structured interviews with key stakeholders at the university and others, including architects and sustainability experts. This study specifically evaluates the institutional structures, organisational culture and decision-making processes that have enabled, promoted or hindered sustainable buildings at UCT. One key policy was established in 2012, which stated that all new buildings at UCT will be constructed to be 4-star rated at a minimum. The decisions leading up to this policy were analysed and they highlight the enabling mechanisms within the university. However, a number of barriers and challenges were found that hindered progress. Many challenges are not unique given the similarity of university structures and governance globally, such as lack of: resources, awareness, motivation and coordination. However, there are local and contextual challenges, especially lack of funding and competing priorities, that need to be addressed before sustainability is fully integrated into UCT. Moreover, inertia of large institutions, difficulty in shifting organisational culture, and complex and lengthy decision-making processes make change difficult at a university. Nevertheless, some strategies are explored that are likely to be effective in promoting increased sustainability levels, especially of buildings on campus.

Keywords: university, environmental sustainability, institutional structures, organisation, decision-making, sustainable buildings, energy efficiency

Contents

i. List of Figures

ii. List of Tables

iii. Acronyms and Abbreviations

ACDI	African Climate and Development Initiative
BREEAM	Building Research Establishment Environmental Assessment Method
CAMP	Campus Access Management Plan
CEB	Chemical Engineering Building
CIDB	Construction Industry Development Board
CO_2	Carbon Dioxide
COP	Conference of Parties
CPI	Consumer Price Index
DHET	Department of Higher Education and Training
DME	Department of Minerals and Energy
DVC	Deputy Vice Chancellor
EBE	Engineering and Built Environment
EGS	Environmental and Geographical Sciences
EMWG	Environmental Management Working Group
ERC	Energy Research Centre
ERC	Energy Research Centre
GBC	Green Building Council
GBCSA	Green Building Council of South Africa
GCAP	Green Campus Action Plan
GCAP	Green Campus Action Plan
GCI	Green Campus Initiative
GCU	Green Campus Unit
GHG	Greenhouse Gas
GOB	General Operating Budget
GSB	Graduate School of Business
GSB	Graduate School of Business
GULF	Global University Leaders Forum
HEI	Higher Educational Institution
HEPI	Higher Education Price Index

HLM	High Level Management
HOD	Head of Department
HVAC	Heating, Ventilation and Air-Conditioning
IDP	Integrated Development Plan
ISCN	the International Sustainable Campus Charter
LCC	Life Cycle Costing
LEED	Leadership in Energy and Environmental Design
NEB	New Engineering Building
NEEA	National Energy Efficiency Agency
NLT	New Lecture Theatre
P&S	Properties and Services
PASE	Partnership for a Sustainable Environment
PCW	Projects and Capital Works
PIC	Project Implementation Committee
PPA	Power Purchase Agreement
PPL	Physical Planning and Landscaping
PV	Photo-Voltaic
REI4P	Renewable Energy Independent Power Producer Procurement Programme
SC	Sustainability Coordinator
SC	Sustainability Coordinator
SHE	Safety, Health & Environment
SRC	Students Representative Council
TLB	Teaching and Learning Building
TOU	Time of Use
UB&DC	University Buildings and Development Committee
UC	User Committee
UCT	University of Cape Town
UFC	University Finance Committee
VC	Vice Chancellor

1. Introduction

The topics of climate change and sustainability are widely spoken about these days. There is much research, data and analysis on the trends and effects of increasing greenhouse gas (GHG) emissions and the resultant anthropogenic climate change. These challenges require a multi-pronged approach and input from various stakeholders. This has resulted in a number of global treaties around sustainability that are negotiated by Conference of Parties (COP). One important treaty relates to climate change, which includes measures to mitigate the effects of climate change. There are also various national and local policies related to ways to reduce emissions, for an increasing number of countries across the world.

The subject of environmental sustainability is large and multifaceted, and requires input and action from various fronts. The focus of this study is on the role of universities in improving their sustainability, especially as universities are institutions that have the potential to influence future leaders and the workforce. Defining a sustainable university is a difficult task, as a university is a complex institution with multiple objectives and stakeholders. The concept of a sustainable university is also a 'moving target' and many universities are continuously exploring new ways to embed sustainability in their various facets. At a high level it can be defined as follows: "A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles" (Velazquez et al., 2006: 3). The focus in this study will be mostly environmental sustainability. The three key sustainability aspects at a university are: improving the level of sustainability in its buildings and operations; integrating sustainability into the various curricula, to adequately prepare students to tackle real-world problems; and transforming the university-wide campus and strategic plans to incorporate sustainability principles. These three aspects together will be referred to as 'general sustainability' in this thesis.

However, the focus of this thesis is one specific aspect: the level of sustainability of buildings at the University of Cape Town (UCT). UCT has made commitments to improve some aspects of sustainability. In 2012 a policy was adopted, stating that all new buildings at UCT will have a minimum 4-star green rating (this is a rating approved by the Green Building Council of South Africa). This policy was effective when the New Lecture Theatre (NLT) attained its rating in 2016. It is only the second university building in South Africa to have achieved this. Besides this there have been instances where UCT has attempted to improve the sustainability of its new buildings, with varying levels of success.

The topic of sustainability and sustainable buildings at UCT is multi-dimensional. Therefore, the focus and research question is: How do the decision-making processes, institutional structures and organisational culture at the university enable, promote or hinder

environmentally sustainable buildings at UCT? Of particular interest are the events that led to the policy and this thesis will analyse the attempts at improving sustainability of buildings – or if there was a lack of attempts, to understand the reasons behind this. To this end, research was conducted using a case study approach, and three recently built buildings at UCT were analysed, by conducting a range of interviews with key stakeholders. The interviews were semi-structured, in order to unpack the details of the research question, and to gain an in-depth understanding of the broader sustainability aspects. The case study also allowed for an exploratory and explanatory understanding of the topic at hand. Three aspects of a university are chosen – university as an institution, its organisational culture and its decision-making processes – to be used as lenses for the analysis, and together they form the conceptual framework. They also provide the tools and dictate the boundaries within which to discuss the factors that influence sustainability buildings at a university.

The detailed structure of this thesis is as follows: firstly, chapters 2 and 3 provide the background and motivation for the study, which led to the defining of the research question. Chapter 4 then describes the research methodology best suited to address the research question. The second part of the thesis is the literature review (chapter 5-7). Chapter 6 explores sustainability in the context of a university – by examining literature from universities across the world. Thereafter, chapter 5 discusses university structures and their components – this includes understanding a university as an institution and organisation, and examining its decision-making processes. Next, chapter 7 shifts the focus to the exploration of sustainable buildings in South Africa – this includes the Green Building Council of South Africa, its rating tools and the market around this. Thereafter, the third section (chapters 8-10) describes the findings, which focus on UCT. Chapter 8 details the background and setting of UCT, by exploring its: history, governance, funding and finance, risk, buildings and electricity usage. Chapter 9 then outlines the history of sustainability plans, policies and initiatives at UCT, together with current transformation themes driving UCT's priorities. Next the focus of the case study, sustainable buildings at UCT, is discussed: firstly, the new building process is outlined, together with how it is funded; secondly, the green-star rating policy is analysed; thirdly, the three buildings of the case study are examined; fourthly, the current status of energy and buildings are broken down; lastly, future capital plans are discussed. The fourth part of the thesis (chapters 11 and 12) is the discussion and analysis of the findings. Chapter 11 is a detailed analysis of the barriers and challenges that exist at UCT. This chapter is segmented according to the three levels of analysis that are relevant to this study – general sustainability, sustainable buildings and energy efficiency. Chapter 12 then discusses three key drivers of change, that are relevant to UCT. Finally, chapter 13 summarises the key findings and analyses, and concludes the thesis.

Note 1: The remainder of this thesis will be referring to environmental sustainability, when sustainability is mentioned, unless otherwise stated.

Note 2: There will be markers (in italics) throughout the thesis to highlight the different sections.

The next section provides the background and motivation leading up to the research question. This is then followed by the methodology applied to best answer it.

2. Background

The evidence for climate change shows that anthropogenic GHG emissions have resulted in a global average temperature increase of 0.85°C over 1880-2012, based on various independent datasets (IPCC, 2014). Figure 1 shows the temperature trends. Figure 2 shows the steep increase in CO_2 levels since 1950, with the IPCC also stating that "It is extremely likely that more than half of the observed increase in global average surface temperature from 1951 to 2010 was caused by the anthropogenic increase in GHG concentrations and other anthropogenic forcings together" (IPCC, 2014: 5).

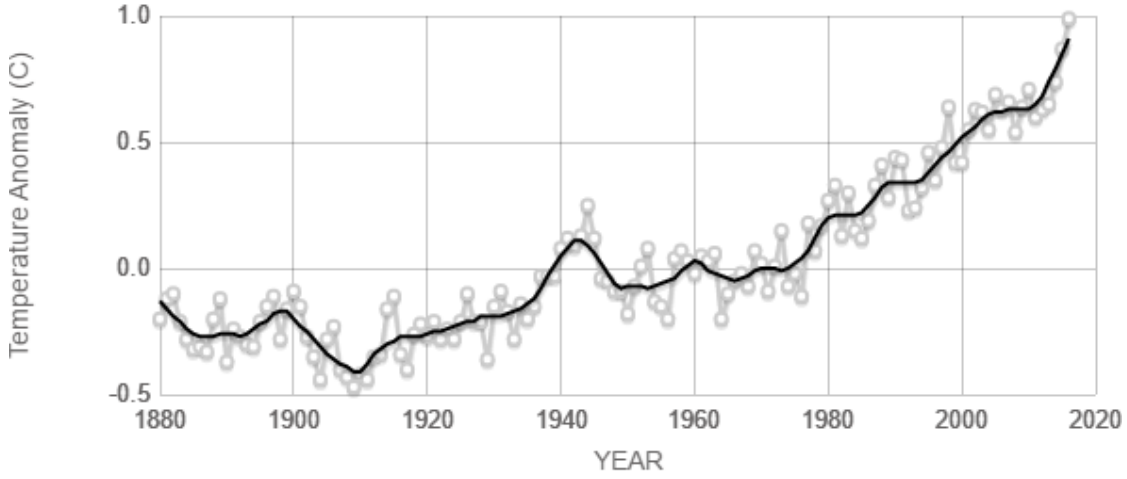

Figure 1 showing Global Land-Ocean Temperature Index from 1880-2020

Source: NASA, 2017a

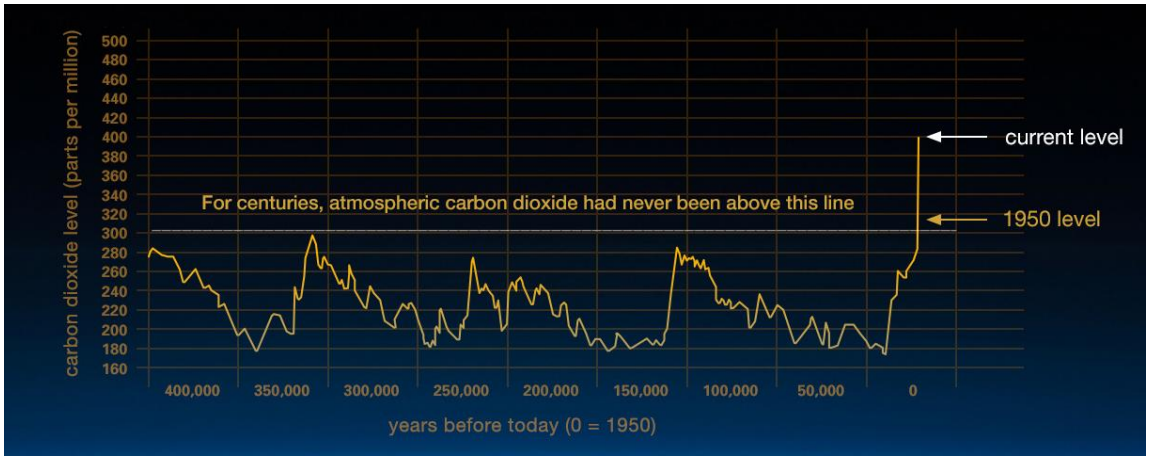

Figure 2 showing CO_2 levels since the Industrial Revolution in 1950

Source: NASA, 2017b

One of the leading causes of the rise in emissions is the use of fossil fuels for energy (NASA, 2017c). The industrial sectors are often the highest consumers of fossil fuels and thus the highest emitters of GHGs. One sector that often does not get enough attention is the built

environment sector. This is partly because it comprises a variety of buildings in different sectors (industrial, commercial and residential). However, it contributes directly and indirectly to emissions. Annually and globally up to 40% of energy use can be attributed to buildings (CSIR, 2015). This translates to 23-40% greenhouse gas (GHG) emissions. These emissions come from both from the operations part of a building (lighting, HVAC, etc.) and embodied energy in the materials used in the construction of the building (concrete, steel, etc.). As per the Construction Industry Development Board (CIDB) the building sector in South Africa emits around 23% of total emissions (DEAT, 2009). A CSIR study states that a further 5% emissions are embodied. Besides the energy use of buildings, the construction of buildings extracts up to 50% of non-renewable materials from the earth. This can lead to more direct degradation of the environment. However, there is limited data and focus on these aspects of buildings in South Africa so far. Thus, more targeted policy is needed to address the embodied emissions from the building sector (CSIR, 2015). Presently the focus is often on operational aspects – mostly energy efficiency measures – for which several international standards and South African codes and regulations have been established.

The electricity generation sector is a high emitter of CO_2 in South Africa. Eskom, which is the national energy generator and supplier of electricity, generates mostly coal based electricity – upwards of 90% of all electricity is fossil-fuel based in South Africa (DoE, 2016). This resulted in per capita emission of 8.9 metric tons CO_2 in 2013. This is above the world average of 5, and the average of upper income category countries of 6.6 (but below the US average of 16.4) (World Bank, 2013). The other sources for electricity generation in South Africa are nuclear and renewable energy – which includes mostly hydro with recent additions of solar and wind. However, renewable energy (net) generation only accounted for 2.6%, in 2014 (Fisher & Downes, 2015).

Historically electricity in South Africa was cheap, given the use of abundant and accessible coal. This meant that there was not much focus on energy efficiency in industries and other sectors. However, there has been a steep increase in the price of electricity, especially in the past decade. Moreover, the real price of electricity is expected to keep increasing (details discussed in following sections). This has thus become a driver for improving energy efficiency.

People are largely dependent on the built environment. Buildings serve a variety of purposes and functions. Besides that, buildings often give a sense of belonging to people – be it their homes, places of study, work, or entertainment. Cities typically include a variety of buildings, some of which are multi-functional. Many cities the world-over are experiencing an increase in the rate of transition of populations to urban areas (United Nations, 2016). This results in an increase in the number of buildings, and with this comes a higher demand for energy. Besides the use of energy in buildings, energy is also needed to move amongst the buildings – that is, the need for larger transport systems. This all

accumulates and results in higher emissions per capita and per square metre in cities across the globe.

Given all the above, there is a need for more sustainable and energy efficient buildings. When it comes to green buildings, the most obvious component is efficient electricity use – with the focus mostly on lighting and Heating, Ventilation and Air-Conditioning (HVAC) systems. However, there is much more to green or sustainable buildings (note the terms 'green' and 'sustainability' will be used interchangeably in this paper when referring to buildings). The Green Building Council of Australia defines a green building as one that "incorporates design, construction and operational practices that significantly reduce or eliminate its negative impact on the environment and its occupants. Building green is an opportunity to use resources efficiently while creating healthier environments for people to live and work in" (GBCA, 2016). The US Green Building Council defines green building as: "the planning, design, construction, and operations of buildings with several central, foremost considerations: energy use, water use, indoor environmental quality, material section and the building's effects on its site" (USGBC, 2016). The focus of this paper is on accredited green buildings, hence the Green Building Council of South Africa (GBCSA) and its tools for grading a sustainable building will be discussed.

This research is based on university buildings and universities often have multi-purpose buildings which house students, academic staff, administrative staff and managerial staff. All these groups have different needs and wants, yet space is often limited on university campuses (beyond this there are residences – however they will not be considered in this paper). Universities are sometimes referred to as 'micro-cities' (Brinkhurst et al., 2011). As can be expected, these micro-cities also consume many resources, use large amounts of electricity and thus can be large carbon emitters. There is a growing need for sustainable buildings on campus. This will be discussed further in the next section.

3. Motivation and Research Question

A university is a place of learning and plays an integral part in the life of those that can pursue tertiary education. Universities are important places of teaching, research and innovation where many students accomplish much growth in their development.

Universities are expected to meet the needs and wants of a large number and variety of students and staff. At the same time, universities are facing many challenges and constraints: decreasing funds, higher student enrolment, increasing staff employment, greater competition, rising expenses and so on (Bates, 2011). Yet they produce the future work force and leaders for a range of industries and sectors. Therefore, they are (increasingly) expected to address various social and societal issues.

Given the unique position of universities as places of knowledge, teaching, learning, research and innovation, it is important that they also take part in discussions around sustainability. The Association of University Leaders for a Sustainable Future (ULFS) recognises that "universities educate most of the people who develop and manage society's institutions. For this reason, universities bear profound responsibilities to increase the awareness, knowledge, technologies, and tools to create an environmentally sustainable future" (ULSF, 2008a).

UCT's mission is to "be an outstanding teaching and research university, educating for life and addressing the challenges facing our society" (UCT, 2010a). Thus, it is important to ensure that students are equipped with the necessary skills to tackle real world problems once they graduate. There is much literature on climate change and the science reflects the urgency in combating climate change and its effects, through mitigation and adaptation.

Furthermore, the university needs to be able to adapt to the changing environment – that is, to the implications of climate change, and to the changing economic environment. A university should also be able to adapt its physical spaces to these changes. One way of doing this is through incorporating environmental sustainability elements into its operations. It is important for a university to ensure its campus and buildings are sustainable, as firstly, they consume a lot of resources and energy and thus contribute to national emissions. Secondly, by improving energy efficiency of existing buildings and constructing new buildings sustainably, the university can save money by reducing electricity expense. Thirdly, by having (accredited) green buildings, the university publicly shows its commitment to sustainability – in other words it can be symbolic. Lastly, sustainable buildings on campus allows for a living lab experience and can be used as case study material for departments such as Environmental and Geographical Sciences, Architecture, Engineering and others.

More broadly, there is great potential in enhancing the efficiency and sustainability aspects of existing and new buildings in South Africa. There is still 'low-hanging fruit' available for

picking, such as reducing and phasing out incandescent bulbs. The market around green buildings has shown good progress in recent years, but it is still developing and maturing. The GBCSA has played a vital role in helping to create and sustain this market. However, there needs to be increased awareness and demand for green buildings to reduce emissions from the built environment in South Africa. The tertiary education sector could potentially be a leader and driver for this change of mindset and improvement to the conventionally understood built environment.

This section will outline what the focus of this study is. The question of UCT's progress regarding environmental sustainability is in the foreground. However, this is a very broad research question – as can be expected the two main topics, of environmental sustainability and universities, are complex and can be explored in a myriad of ways. Furthermore, there are four major parts when it comes to describing a university's sustainability progress, namely: teaching and learning; research and development; campus operations; and more broadly its social responsiveness activities. From here onwards, the term 'general sustainability' will be used to encompass these parts. Each is a large topic of analysis on its own. Therefore, one aspect is chosen as the focus in this thesis – namely, campus operations, and specifically that of (sustainable) buildings. Therefore, one could consider a narrower and more directed question: What factors lend themselves to improved sustainability levels for university buildings? However, this question can also be approached in a number of ways. In order to narrow the scope, and to add value to the literature, one can explore the environment in which university decisions are made. This is likely influenced by the university as an institution. Related to this would be the people that exist within the institution and make the decisions – which is related to the organisation and its culture. This then leads to the final and more focused research question: How do the decision-making processes, institutional structures and organisational culture at the university enable, promote or hinder environmentally sustainable buildings at UCT?

The focused part here is 'sustainable buildings' – which for the purposes of this thesis refers to a building that has achieved a green star rating by the GBCSA and/or a building that has explicitly incorporated energy efficiency measures during or post construction. This research question will be unpacked through a case study analysis of three recently built buildings at UCT, namely:

- New Engineering Building (NEB),
- Teaching and Learning Building (TLB), more commonly referred to as Snape, and
- New Lecture Theatre (NLT)

NEB and TLB have some energy efficient measures in place, while NLT has been accredited with a 4-star green rating.

Whilst one focus of the thesis is to unpack the decision-making processes that led to the 2012 policy for all new buildings to be rated 4-star (at a minimum), the study will also

consider energy efficiency, retrofits and maintenance plans of existing buildings. To do this effectively, UCT's broader sustainability policies, documentation, plans, incentives, views, and priorities are analysed. This is mostly done through a desktop analysis, but resources provided by some interviewees is also used.

Throughout the analysis of the topic it is important to keep in mind the broader research contexts mentioned above. This is because level of sustainability of buildings at UCT is related to the general level and advancement of environmental sustainability at the institution as a whole. Therefore, this thesis will analyse the relationship between factors that enable or hinder sustainable buildings, and the factors that advance or limit sustainability. This will be elaborated upon in the findings and analysis chapters (10-12). The next chapter discusses the methodology best suited to answer the research question.

4. Methodology

This research is qualitative in nature and explores various dimensions of: universities, sustainability and sustainable buildings. It is important to highlight the differences between quantitative and qualitative research, as seen in the figure below:

Quantitative	Qualitative
Objective	Subjective
Research questions: how many, strength of association	Research question: What, Why?
'Hard' science	'soft' science
Literature review must be done early in study	Literature review may be done as study progress or afterwards
Tests theory	Develops theory
One reality: focus is concise and narrow	Multiple realities: focus is complex and broad
Facts are value free and unbiased	Facts are value laden and biased
Reduction, control, precision	Discovery, description, understanding, shared interpretation
Measureable	Interpretative
Mechanistic: parts equal whole	Organismic: whole is greater than parts
Report statistical analysis Basic elements of analysis on numbers	Reports rich narrative, individual interpretation Basic element of analysis is words/ideas

Figure 3 showing the Difference between quantitative and qualitative research methods

Source: Sanghera, 2009

The previous chapter outlined the following research question: How do the institutional structures, organisational culture and decision-making processes at the university enable, hinder or promote environmentally sustainable buildings at UCT?

A case study methodology was deemed most suited to addressing this research question. Firstly, a case study is valuable when examining 'why', 'how' and 'who' types of questions. Yin (1994) states that this is useful as it allows one to examine the: decisions, thinking behind the decisions, processes leading up to the decisions, and results of those decisions. Therefore, this study is both exploratory and explanatory in nature.

Secondly, Yin (1994: 15) states five applications of a case study methodology; this thesis has two relevant applications: "describe an intervention and the real-life context in which it occurred" and "illustrate certain topics within an evaluation, again in a descriptive mode". In this case the 'intervention' is the 2012 green building policy, and the 'certain topics' include the factors that lend themselves to improved sustainability levels in buildings (enablers), what factors limit such advancement (hindrance) or what allows for proactive enhancement of sustainable buildings (promoting).

As can be seen the three lenses of analysis that will be used, and which form the conceptual framework, are:

- Institutional structures
- Organisational culture
- Decision-making processes

These three specific lenses are used as they are quite prevalent in the literature (this will be elaborated on in the next chapter). Even though the lenses are listed one after the other, it is important to note that the decision-making processes will be mapped and unpacked within the organisational and institutional context of the university.

Furthermore, these three lenses, together with the description and analysis of the three recently built buildings (mentioned previously), are the focus and anchoring point for the analysis of this thesis as a whole. However, the broader context of university structures, systems and progress of general sustainability will also be discussed, especially as sometimes there are no clear boundaries or distinctions between the factors that influence sustainable buildings and those affecting general sustainability (also the former is mostly a subset of the latter).

Yin (1994: 13) explains this well: "A case study is an empirical inquiry that:

- investigates a contemporary phenomenon within its real-life context, especially when
- the boundaries between phenomenon and context are not clearly evident

In other words, you would use the case study method because you deliberately wanted to cover contextual conditions-believing that they might be highly pertinent to your phenomenon of study". Therefore, even though the focus is on the operational side of the university (that is, the buildings); the case study will shed light on the way in which sustainability is implemented at UCT, and will have relevance for the broader literature on sustainability at universities.

The main method used to gather information was through semi-structured interviews. Open-ended questions allow the interviewer to explore new ideas and gain a deeper understanding, and also allows the interviewee to dictate the direction of the interview. This

can be useful if a narrative is required to further understand the research question and the context surrounding it. These interviews specifically helped to: examine three recently constructed buildings at UCT, understand the processes of design, construction and sustainability integration, and identify the actors involved in decision making. The interviews also helped to understand the views of key decision makers and what aspects of the processes they believe works well or not – which is very useful primary information.

Thereafter, it was necessary to conduct a detailed analysis of UCT's policies, documents, reports and articles related to sustainability – some of which were recommended by certain interviewees. It was also important to understand the history and timelines of the various sustainability initiatives undertaken by UCT, especially to ensure that the research context was better understood (that is, the broader research questions discussed above).

The interviews were conducted with the following: key stakeholders at UCT (High-level management, Properties and Services, Finance, academics, student); architects of buildings in case study; others involved in planning and decision-making processes; and those involved in sustainability at UCT (including external people). Initially a short list of relevant contact persons was drafted, however with time this grew as interviewees often made suggestions about other relevant people to interview. Where necessary, follow up interviews were also conducted.

In total, for this case study, 30 interviews were conducted with 26 research participants (this includes 2 interviews with two people present and 5 follow-up interviews). Each interview was done in person, and lasted between 40 and 120 minutes. The interviews were not recorded or transcribed; instead notes were taken during the interview, and the interviewee had opportunities to clarify or edit what they had said.

Ethics clearance was applied for and granted by the EBE Faculty's Ethics in Research Committee. All interviewees were aware of the research context and provided consent. The interviewees were also informed that even though their names would not be used in the thesis, their positions would be used. Since it is easy to identify some interviewees by their position or title, each interviewee was given the option of how they preferred to be identified, that is either by: their full title, department they worked in, a generic title or anonymously. Therefore, there are variations in the way interviewees are referred to, depending on how they preferred to be referred to as – however, for the most part, interviewees allowed their full position or title to be used. The signed ethics clearance form can be seen in Appendix A.

Table 1 lists the interviewees, together with their codes, which allows for easy reference throughout the paper.

Table 1: Interviewee codes and their positions

Interviewee Code	Position
SC&A	Previous Sustainability Coordinator, Architect, Environmental Management Professional, and current consultant to Properties & Services (P&S)
ED-P&S	Executive Director of Properties & Services (P&S)
ED-F	Executive Director of Finance
H-PCW	Head of Projects & Capital Works
H-M&O	Head of Maintenance & Operations
H-PPL	Head of Physical Planning and Landscaping
H-F	Head of Finance at P&S
S-F	Staff member of Finance at P&S
S-HLM1	Staff – High Level Management 1
S-HLM2	Staff – High Level Management 2
S-HLM3	Staff – High Level Management 3
A-EBE1	Academic in Engineering and Built Environment (EBE) faculty 1
A-EBE-Ch	Academic in Engineering and Built Environment (EBE) faculty (Chemical)
A-EBE-En	Academic in Engineering and Built Environment (EBE) faculty (Energy)
A-EGS1	Academic in Environmental and Geographical Sciences (EGS) department 1
A-EGS2	Academic in Environmental and Geographical Sciences (EGS) department 2
A-L&E	Academic in Law and Environment
A&HLM	Academic and High Level Management
A-F	Academic in Finance department
E-A1	External – Architect 1
E-A2	External – Architect 2
E-QS	External – Quantity Surveyor
E-ES	External – Energy Specialist
E-GBC	External – Green Building Consultant
PSS	Professional & Support Staff
S-IT	Staff – IT
St-GCI	Student – GCI

What follows is the literature review for the three main topics: universities, sustainability and sustainable buildings.

5. Sustainability at universities

This chapter discusses the motivation, relevance and advancement of sustainability at HEIs, as documented by literature.

The need for climate change mitigation and adaptation is urgent. There are measures that are being taken at various levels by various individuals, government officials, NGOs and other institutions. However, there is still much to be done to ensure emissions do not lead to a world with temperatures higher than 2°C. This target has been set to prevent dangerous effects of climate change, such as extreme weather events (IPCC, 2014). Some countries are calling for a more stringent target of 1.5°C, especially at the fairly recent COP21 in Paris, as they are more vulnerable to climate change effects (UNFCCC, 2017). To address climate change effectively, a multi-disciplinary approach is necessary – this is an issue that has a number of causes, and thus needs to be tackled on various fronts.

However, the first step is awareness of the causes, effects and possible solutions. Closely tied to awareness is knowledge and education. This is where HEIs come in. They are well suited to raise awareness and moreover, offer courses and degrees related to climate change and sustainability. Besides education and raising awareness, universities can improve the sustainability of their campuses, which includes its operations and buildings. This thesis will focus on sustainable buildings and their related operations; the topics of curriculum and education will be discussed only briefly.

As can be expected much of the literature and research focus is on the education dimension of a university – that is the teaching, learning and curriculum. Some studies also focus on curriculum development; and there has been some focus on sustainable development in education – for example, the UN decade of Education for Sustainable Development 2005-2014 (UNESCO, 2005). There are also studies related to policy reform and changing governance structures. This study refers to only a few of these topics and relevant papers where necessary, as this is beyond the scope of this research.

There has been an increase in literature available on sustainability in HEIs – in fact, there is an International Journal on Sustainability in Higher Education. Much of the literature found was from universities in America and from certain European countries, and only three relevant papers from developing countries (India, Mexico and Singapore) were found. This shows a gap in the literature, and therefore this is a useful study to do for UCT in South Africa.

According to Wooltorton et al. (2015) and Sharp (2002) there is no university that can be considered as completely sustainable (that is, a 'role model'). Instead there are varying methods that different institutions are using and there is scope to share knowledge and learn from different HEI's experiences – after all, universities are places of learning and application (Wooltorton et al., 2015). Filho (2000: 4) states that sustainability is both a

process and a goal. Also, universities are different in size and scope (what they teach, offer and specialise in) which makes comparisons harder.

It is important to firstly define what sustainability at a university means. Shriberg (2002) analyses how sustainability advancements are measured at universities. The author quotes Orr (2000) which listed five criteria to determine the progress of sustainability at the institution:

(1) What quantity of material goods does the college/university consume on a per capita basis?
(2) What are the university/college management policies for materials, waste, recycling, purchasing, landscaping, energy use, and building?
(3) Does the curriculum engender ecological literacy?
(4) Do university/college finances help build sustainable regional economies?
(5) What do the graduates do in the world?

As can be seen questions (1) and (2) are related, and so are (3) and (5). If (4) is adjusted, to be broader and not just include finances, one can think of it as the main, underlying question. Shriberg (2002) and Jain & Pant (2010) emphasises that sustainability is continuous process rather than a fixed end-goal, and thus it needs to be monitored and tracked over time. Two other important points to note are that: firstly, the motivation behind improving sustainability needs to be known (and not just the actions or initiatives taken) and secondly, besides environmental sustainability, social and economic sustainability must also be considered. This is a vital point for UCT – as will be seen in other chapters, other social issues are often seen as competing priorities, however they are important to consider and integrated into the university.

There are different types and levels of sustainability at HEIs. The ISCN-GULF breaks them down into three major categories (which is also comparable to the above list), listed as follows:

- Principle 1: To demonstrate respect for nature and society, sustainability considerations should be an integral part of planning, construction, renovation, and operation of buildings on campus.
- Principle 2: To ensure long-term sustainable campus development, campus-wide master planning and target-setting should include environmental and social goals.
- Principle 3: To align the organization's core mission with sustainable development, facilities, research, and education should be linked to create a "living laboratory" for sustainability.

Source: ISCN-GULF, N.d.

As can be seen principle 1 is most closely related to the title of this paper. However, it is placed within a wider setting (principles 2 & 3) that is necessary to transform to an environmentally sustainable university (which correlates to the research questions).

Rauch & Newman (2009) also state that incorporating sustainability into an institution requires all three types: environmental, economic and social intervention; and that it is a system-wide, recurring process which takes time. Petratos & Damaskou (2015) also echo these views, while adding two more important factors: technical and individual. They highlight the necessity of including all relevant university stakeholders to ensure wide and comprehensive planning.

In practice, environmental sustainability projects are confronted by certain obstacles. Filho (2000) lists five reasons why sustainability as a process is a hard notion for some to grasp and implement. Sustainability is seen as too broad, theoretical, and no one group or department is seen as responsible for it. This makes it difficult to implement in practice and also to prioritise. A quote by Annan (2001) is still applicable 15 years later: "the biggest challenge in this century is to transform sustainable development from abstract to real for all the people in the planet" (Velazquez, Munguia & Sanchez, 2005: 2). Filho (2000) also states that these reasons are sometimes used as excuses and therefore, these points need to be clarified, to progress. Conversely Rauch & Newman (2009) state that the many features inherent in sustainability allow for more opportunities to set targets (which would be dependent on the local context and resources available).

Jones, Selby & Sterling (2010) from Plymouth University have suggested a model called '4'C', where the C's stand for: Curriculum, Campus, Community and Culture. They describe the first 3 Cs as overlapping concepts embedded in the Culture of the university. They state:

> "the idea is that the culture of a university (e.g. is it a culture of opportunity, of equality, of commitment to positive action and impact) is reflected in how it manages its estates (campus), how it treats its stakeholders (community – students and staff but also neighbours and partners) and what it prioritises within its curriculum and what it sees as the purpose of its curriculum (e.g. to develop students as lifelong learners able to contribute to society, or as a means to high earnings upon graduation). Achieving harmony and balance between the 4C's is a step towards sustainability" (Speight, 2016).

Another C that could be added to the model is: commitment. This is relevant to all the C's, because when there is greater commitment, the culture of the university can better adapt and incorporate environmental sustainability (Speight, 2016).

The above two paragraphs reflect the need for holistic, campus-wide planning. And given that the context is a university, it is also important to ensure that there is inter- and trans-disciplinary teaching, learning and research (Ferrer-Balas et al., 2008). Furthermore, system-

wide thinking and planning are necessary to truly transform to a sustainable university. Even though the focus of this study is on the physical aspects of a university, sustainable buildings do not happen in isolation; therefore, it is important to mention the wider drivers and barriers to transforming the entire university to be sustainable. Conversely (or in parallel), if a university has reduced its ecological or carbon footprint; it can incorporate this into its teaching and research, and provide a living lab experience for its students. Moreover, it can be a model for society (Jain & Pant, 2010).

There are various studies that document the advantages of having green buildings on campus: reduce energy and water usage; cost savings; investment in better monitoring and management systems; improve air quality which is beneficial to staff and students; and the educational benefits through living lab experience (James & Card, 2011).

There are also arguments for the moral imperative as universities can be seen as obligated to ensure sustainability by revisiting their operations, and transforming their curricula to include environmental issues. Wooltorton et al. (2015) speak about the greater context in which a university is situated, and how the drive for economic advancement has allowed the environment to be treated as a commodity for use and abuse. This is also mostly due to Western philosophies and ideas (including increasing consumerism) and now even the climate crisis and ways to fix are coming from the West (Wooltorton et al. 2015). However, the concept of environmental sustainability has not yet been fully acknowledged as important in universities the world-over. This is firstly due to a lack of awareness about sustainability, and secondly because it is not embedded in the university culture. Sharp (2002) suggested this could be the next major reform that is required for universities to survive in the coming decades. This is partly evident given the expansion and quality of literature available regarding sustainability in higher education institutes – nevertheless, there is still much scope for improvement, and different universities are on different levels and advancing at varying paces (Finlay & Massey, 2011).

It is vital to ensure that the local context is taken into account. There is no "universal tool" for sustainability (Shriberg, 2002). As mentioned at the beginning of this chapter, there is no single model for sustainability at universities; instead it is still a developing concept in some universities (especially in developing countries). Given the unique history of South Africa – its apartheid era and resulting socio-economic problems, it is important to contextualise topics like environmental sustainability. This is quite topical at UCT currently: students have recently argued for the 'decolonisation of the curriculum'. This is about reducing the impact of Western and colonial thinking; and rather incorporating more indigenous knowledge and also changing the way the information is taught. These competing, parallel ideas and priorities that are present at UCT are important to consider, when finding holistic solutions.

Another trend that is relevant is the rise of entrepreneurial universities and the links to the corporate world. This is partly a result of the autonomy of departments (Arnaboldi &

Azzone, 2005). There are arguments for and against this: some prefer the more traditional models of education and do not support the commodification of knowledge and education (Levin & Greenwood, 2008 in Wooltorton et al., 2015); while others think that this makes knowledge and degrees more relevant and applicable if the university has ties with the corporate and industry sectors (which will later employ graduates). Another argument in favour, is the increased funding opportunities that can become available for the university. This could eventually change the funding model of universities, especially given budget constraints (discussed in latter chapters).

There are many papers that refer to organisational structures when analysing the barriers and changes needed, to transition to a sustainable university (Filho, 2000; Dahle & Neumayer, 2001; Arnaboldi & Azzone, 2005; Velazquez, Munguia & Sanchez, 2005; Kothari & Handscombe, 2007; Rauch & Newman, 2009; Kurland, 2011; James & Card, 2011; Barth, 2013).

Richardson & Lynes (2007) conducted a detailed study at the University of Waterloo titled: Institutional motivations and barriers to the construction of green buildings on campus. The two key themes they identified were: organisational and financial. The key drivers for change are summarised in the figure 4 below, and parallel barriers can be derived from this.

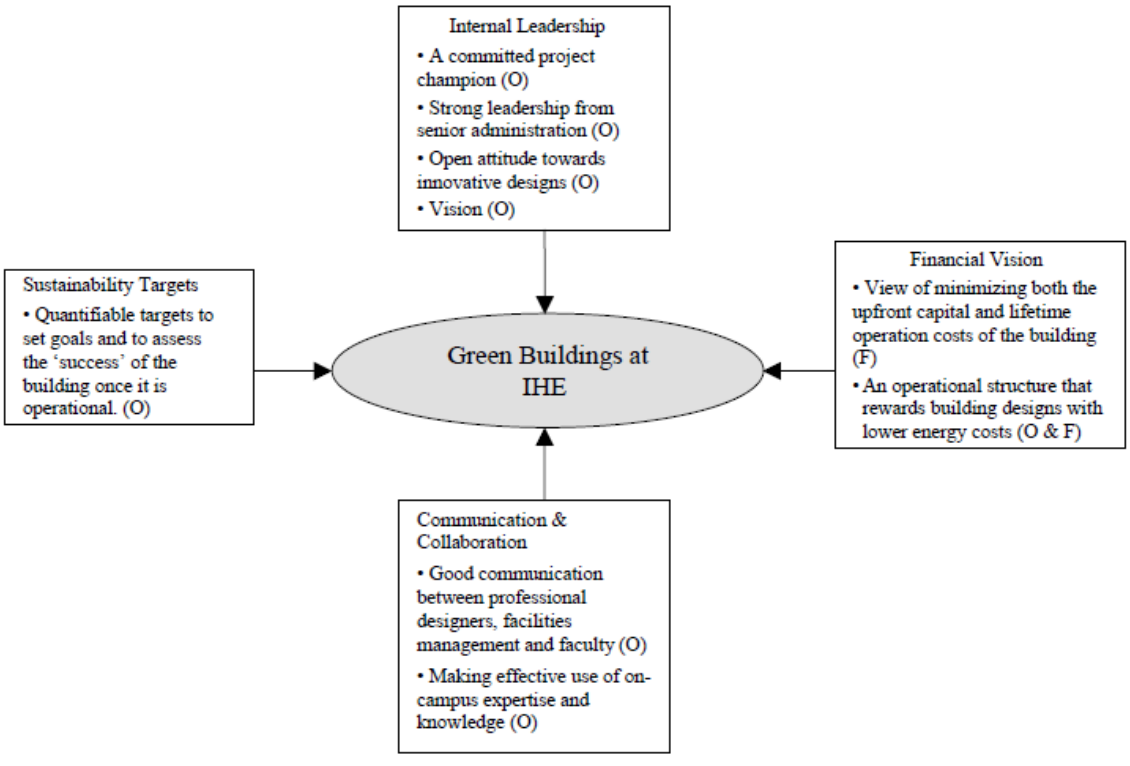

Figure 4 showing Ingredients for success for constructing green buildings at Institutes of Higher Education (IHE)

Source: Richardson & Lynes 2007: 5

Bekessy, Samson & Clarkson (2007) also conducted a case study of Royal Melbourne Institute of Technology (RMIT) to determine the lack of sustainability progress. One imposing issue they identify is that "the highly resistant patterns of unsustainable behaviour ingrained in society are largely caused by institutional arrangements; such as customs, laws, underlying rules, and even the way individual and collective behaviour is shaped" (Dover 2011 in Bekessy, Samson & Clarkson, 2007: 14). This is a key point that will be discussed in detail in the next chapter.

Finlay & Massey (2011: 5) succinctly identify the major barrier common to many universities: "the process of changing the institutional landscape is often slow, complex, and contested. The concept of a "sustainable university" has faced political setbacks, bureaucratic roadblocks and general unawareness and disinterest". These, and other barriers and challenges, will be unpacked in chapter 11. Above the specificities, Sharp (2002) states that one of biggest challenge is for the university to become more adept at change and regeneration. This need for being adaptive will be discussed in section 12.1.

Lastly, it is important to note that sustainability at universities is an evolving topic. It has certainly progressed and improved with time – which is reflected by: the greater number of universities that are aware of and concerned about climate change issues; more research coming out of universities on both climate change and sustainability issues; it is explicitly mentioned when setting university targets; and more resources are dedicated to improving it on different campuses (Velazquez et al., 2006 & Wooltorton et al., 2015). However, there are endearing themes and barriers that exist for many universities still, and some are as relevant today, as they were a years ago (as can be seen from the range of above-mentioned sources). Also, some barriers are more prevalent in the developing world context, and even though there is limited literature from these countries, this thesis hopes to contribute to the discussion. Nevertheless, there is increased general awareness of the environmental sustainability and its nuances, and each university seems to be making progress at its own pace. The next chapter examines the three lenses that will be used to address the research question.

6. University governance and structures

The first part of the literature review established the prevailing literature, relevant to the research question. It also provided justification for the use of the three lenses mentioned under Methodology. In this next part of the literature review, the following aspects will be unpacked: how a university is structured, who the key role players are, what frameworks they sit within and how decisions are made. This section will aid in unpacking the progress (or lack thereof) to sustainability and sustainable buildings – which will be discussed throughout the study.

Sporn (2001) highlights the main themes that help define university structures: "Governance refers to the structure and processes of decision-making. Management refers to the structure and processes for implementing or executing these broad decisions. Leadership refers to the structure (positions, offices, and formal roles) and processes through which individuals seek to influence decisions".

Governance is a key aspect of any university's operations. Altbach (1973: 32) defines governance as: "ways in which universities are managed and organized. Such factors as the structures of decision-making within an academic institution, the roles of various participants in the academic community (faculty, administrators, and occasionally students) have in its functioning, and the general effectiveness of these structures in the way in which the institution works are included under the theme of governance."

Throughout this section the above two authors' definitions and comments will be broken up and its parts will be discussed further. The three main lenses have already been stated in the research question. Once these components are analysed, one can determine the ways in which change does or does not occur at a university and also how to ensure that change is effective.

6.1 Background and history

The university is in fact one of the oldest and most resilient type of institution globally. According to Meyer et al. (2005) despite the diversity in cultures and socio-economic circumstances; universities have developed and evolved in a similar fashion throughout the world. This is noteworthy given that this research is focused on a university in a developing country; yet UCT is easily comparable to universities elsewhere in the world.

This point is well summarised by Pusser & Loss (N.d): "The degree of uniformity in private and public college and university organizational structures has been shaped by the nature of demands on the postsecondary system since the mid-twentieth century. Although the key governance structures of colleges and universities were present prior to the turn of the twentieth century, the full scope of the university's multifaceted organizational structure, most scholars agree, was not realized until after the rise of the research university, in the

wake of World War II. In 1963 then-president of the University of California system, Clark Kerr, described the post-war American university as a multiversity. The term captured the increasingly complex organizational and governance structures required to negotiate its ever-expanding task environment".

According to the Webometrics site there are estimated to be over 40000 Higher Education Institutions (HEIs) world-wide (which includes colleges and Technicons), and excludes some universities in developing countries which are not listed due to a limited web presence. One UNESCO estimate is that there are at least 17000 universities (Webometrics, 2012). Furthermore, most HEIs have an internal growth rate each year, and a growing proportion of the population attends and values HEIs. This reflects the vast growth and importance of HEIs throughout the world, independent of geographic, cultural, political, economic and social differences (Meyer et al., 2005).

The similarity of university structures is partly due to and a result of, university rankings. In 2016 more than 26000 universities from 206 countries were ranked (Webometrics, 2016). This method of ranking, together with the institutional structure of universities – with similar governance mechanisms, rules, staff, degrees, curricula and ways of teaching – has led to fairly homogenous universities across the world. This allows universities to be easily comparable and ranked. The differences that are present are due to varying locations, student and staff numbers, resources and types of degrees offered.

6.2. Universities as an institution

Firstly, it is important to define an institution. A simple dictionary definition is: "an organisation, establishment, foundation, society, or the like, devoted to the promotion of a particular cause or program, especially one of a public, educational, or charitable character" (Dictionary.com, 2017). Hodgson (2006) speaks of the long history of the use of the word institution, by various disciplines (for example, sociology and politics); but there does not seem to be a standard definition. On a very basic level, institutions are structures that help govern our (social) lives. This implies that there are formal and informal rules that guide people's behaviour. Thus Hodgson (2006: 2) defines institutions "as systems of established and prevalent social rules that structure social interactions… [and they] enable ordered thought, expectation, and action by imposing form and consistency on human activities". Given the presence of rules, they can either be enabling or a barrier to achieve certain outcomes.

One key subset of rules at a university, that is discussed in this study, is its policies. There are different policies for different divisions of the university. This study focuses mostly on polices which affect the operations side of the university and then other broad policies that deal with sustainability. As will be illustrated further in the text, there are a limited number of policies, rules or guidelines for enhancing sustainability at UCT. Another important concept is that of 'norms'. These can be defined as implicitly or explicitly accepted

behaviours and beliefs amongst a group of individuals. An example of a common norm in South Africa is most businesses are open from 8 or 9 am to 5 pm; versus in some countries, like India, there is a later opening time, a long lunch break and then closing is between 7-9 pm. Meyer (2007) states that sometimes norms can become internalised such that they become rules. Hodgson (2006) also goes into detail discussing 'habits' – both of individuals and of collectives. These habits (of thought and action) then get translated into either positive transformation or can become a hindrance to change. Therefore, there is continuous interaction between habits, norms, rules and also conventions which mould an institution from the inside.

Some of the reasons institutions were formed, and still exist, are to help keep order, to lessen uncertainty and risk, and to guide accepted forms of behaviour (North, 1991). Institutions provide structured frameworks which aid actors in advancing their mandates, and the primary mandates of a university are to: produce graduates and advance research in various fields.

There are various branches of institutionalism and theories around the formation, structure and development of institutions. Universities would fall under the 'social institutional' category. Thoenig (2011) speaks of how sociological institutionalism includes public institutions and organisations which are there to support a society's values and interests and not merely to attain fixed goals. This fits well with the mandate of a HEI. This point is reiterated by Amenta (2005) in Schofer et al. (n.d.) which mentions that institutions "generally, shift attention away from individual social actors and toward the social context or environment in which actors are embedded". It is not necessary for an institution to be efficient. In fact, given changing social and internal environments, the institution has to adapt with time. Meyer (2007) mentions that there are four aspects to an institution: cultural, discursive, structural and organisational. Given the nature and flexibility of these aspects, an institution can be effective and efficient. Furthermore, it is vital to consider these aspects holistically in order to understand the university as an institution, in all its complexity. The next section focuses on the concept of an organisation, which can also be multifaceted, however it deals more directly with stakeholders within a university.

6.3 Organisational structure and culture

The organisational structure of the university is dependent on the institutional structure and vice-versa. Each is not fixed and influences are bi-directional. Universities as a whole are complex and multi-layered, with a diverse range of staff and students. It is also a dynamic and changing entity. This all makes it difficult to observe or to generalise. However, there are certain characteristics of universities, that make it easier to study, analyse, categorise and compare.

North (1994) draws a comparison between institutions and organisations: "it is the interaction between institutions and organizations that shapes the institutional evolution of

an economy. If institutions are the rules of the game, organizations and their entrepreneurs are the players. Organizations are made up of groups of individuals bound together by some common purpose to achieve certain objectives." Thus, an institution can be seen as the framework (with rules) which houses an organisation (with actors) that has a common goal or purpose. Each organisation also has its unique internal processes that enable it to achieve those goals. North (1994) also mentions that organisations can be seen as different types of 'bodies' and a university would be an educational body.

The organisational culture can be broken down further into three parts: values, norms and beliefs. Both norms and beliefs was discussed briefly in the previous section; however, these are also important concepts when discussing the organisation (which again shows the interrelation between the two). One key part that was not discussed before, but is core when discussing the organisational culture, is its values. The values that individuals, groups, and the institution as a whole hold true, help define the vision, goals and processes for achieving them (Fumasoli & Stensaker, 2013). It is ultimately the people that shape the direction in which the organisation moves forward. There need to be certain values, which form part of the foundation, that do not shift easily. Sustainability seems to be a new goal that has yet to embed itself into university institutions and organisational cultures.

There are a number of organisational structures or networks which dictate the type of interactions actors have. These structures allow for university members to identify paths and processes to follow to perform their daily actions, complete their tasks and achieve their goals. Typically, a university has a bureaucratic structure. This is related to the hierarchies present in the institution and there are clear top-down procedures and decision makers can be distinctly identified. In other words, it is seems to be a vertical structure. However, given the complexity of a university, there is no one organisational structure. Firstly, there are nuances in the bureaucratic structure and there are also other types of structures which better describe different parts of the university – mostly horizontal structures.

At the top, there are three different categories of staff: managerial, operational, and academic. Thereafter, there are distinctive divisions within a university: operations, finances, administrative, etc. These are further divided into departments (and faculties for the academic category). This shows the wide range of sub-structures – both vertical and horizontal – within a university organisation. A university can also be seen has having a cross-institutional structure (Keeling, Underhile & Wall, 2007). This allows for dialogue and discussion across the university in order to achieve its various goals (this will be discussed further, in detail, in the context of sustainability). Arnaboldi & Azzone (2005: 6) define universities as "a professional bureaucracy where two different configurations overlap: the teaching staff structure and the support staff hierarchy". This is depicted in figure 5. The administrative staff structure has a few centres and more departments that oversee specific aspects of the university. Sometimes the administrative duties are merged into

departmental activities. The teaching staff structure is characterised by a few faculties, and each has various departments below it. Usually there is no overlap between different departments across faculties, instead each is a block or unit, with its own resources. Overall the university is a multi-dimensional organisation whose functions vary depending on the sub-structures and its goals.

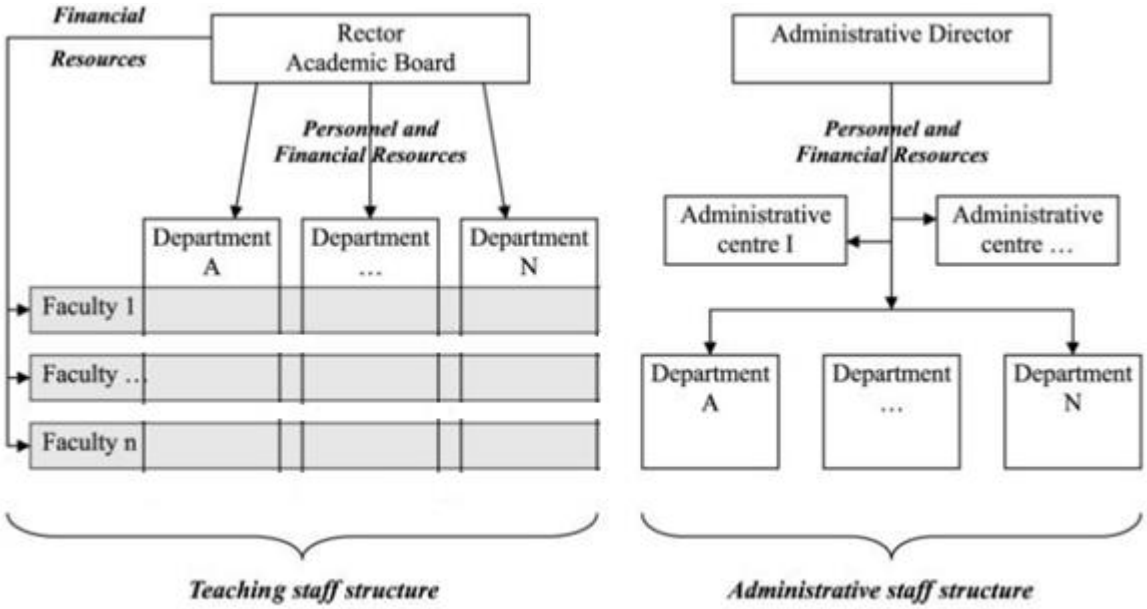

Figure 5 showing organisational structure of a typical university

Source: Arnaboldi & Azzone (2005)

The operational part of the university is depicted on the right-hand side of figure 5. There is one executive director, followed by departmental heads (such as finance, property management, maintenance, human resources, etc.) and a team under each department. There is a clearer line of accountability and reporting. On the left side is the academic structure. Here there is more autonomous decision making as each department is a distinct entity. However, it is important to note that financial and personnel resources filter down from the top and so this does impose some restrictions. On the other hand, given academic autonomy, funding can be sourced directly by individual academics (including deans). This will be discussed further in chapters 8, 10 and 11.

Lawless (1982) mentions that it is in the nature of complex organisations to have a bureaucratic structure, due to the range of coordination that is required over multiple departments with their unique purposes. As will be illustrated later, some universities have seen increasing participation from a range of decision-makers, and this can lead to longer and more complex decision-making processes. This is partly a result of criticism that university departments operate in silos – both amongst academic departments and across the wider university organisation. However, this is due to the vertical and parallel structures of the university; with each department or group wanting to achieve its own goals, that can

create an illusion of competition which can in turn negatively affect broader institutional goals (Kuh, 1996 in Keeling, Underhile & Wall, 2007).

Cohen, March & Olsen (1972) examine a specific type of organisational choice and base their analysis on university organisations. They characterise them by three general properties, namely that organisations:

- have inconsistent and changing preferences. They are not always chosen a priori; instead are discovered through actions and decisions taken by members
- do not have clear processes – they are sometimes unknown or unclear to its own members – and so there can be much trial-and-error
- have fluid participation – members' time and effort dedicated to particular issues fluctuates over time, therefore there is uncertainty about the organisation's boundaries, goals, processes and decision-making.

These are all important elements of a university organisation, which often lend themselves to challenges, however this will be further explored in the analysis of the thesis topic.

6.4 Decision making processes

The last major component that is discussed are the decision-making processes that take place within a university. These are largely affected by the institution (its rules and governance processes) and the organisation (the people that make the decisions). A university is known to be a hierarchical organisation. There is a fairly clear top-down tier of decision makers and the processes that need to be followed in order to get something done. It is important to note that this is more applicable to the operational parts of the university; the academic side usually has more autonomy to make decisions – however, this is in the context of academic decisions (such as deciding on the content of courses) and not necessarily operational decisions (e.g. deciding to install its own meters at each level of the building). There are also more informal ways decisions are made and this is unique to each university. Again, this will be dependent on the organisational culture and how flexible it is. Given the range of stakeholders and structures at a university, one can expect varied styles of decision making. Once again, changing times with changing priorities lead to different decisions and decision-making processes.

One aspect that is unique to universities, is the use and number of committees. This is discussed later in detail for UCT in section 8.3. These are often the formal structures that are set up to aid decision making, with the idea to have logical groupings that enable efficient problem solving and smooth operation of the institution. However, it is often the everyday decision that are made which determine the culture of the organisation, the goals which are prioritised and the strategy that the university is actually following. As mentioned previously the university as an organisation is fluid and thus it is continuous work-in-progress, moulded by the decisions made every day (Kothari & Handscombe, 2007). In contrast, there are the

more deliberated, long-thought out and discussed decisions that are taken in, for example, a formal committee setting. These feed into the everyday decisions and vice-versa. Given the large and complex nature of a university that has many faculties, it is important to ensure that there are opportunities for different stakeholders and faculty representatives to meet and discuss the overall direction of the university. This is both enabled and complicated by the cross-institutional nature of universities, as discussed above. As will be discussed later, these meetings affect the funding decisions that are taken which in turn determine short, medium and long-term priorities.

Kothari & Handscombe (2007) mention an important distinction between deliberate planning when strategizing, and change that happens incrementally that then becomes an important part of strategy. Both have a place in decision making and are necessary to ensure wide-spread integration of sustainability at all levels of a university.

6.4.1 Management

The typical structure of a university's management is as follows: there is a Chancellor or President at the top who oversees the university as a whole; Vice-chancellor or Vice-president who oversees and manages a number of activities and takes a more active role in decision making; a number of Deputy vice-chancellors or vice-presidents who are in charge of specific key areas of the university, such as research, development, finance, student affairs, etc.; Deans for each faculty; department heads; and then various other staff that help with the day-to-day functioning of the university such as administrative (academic, housing and institutional), operations, IT, facilities, residences, cleaning and other support staff. The operational past of the university has a clearer management structure and delineation of duties (as discussed under figure 5). Other key parts of the structure are: Council (to which the vice-chancellor is accountable to, and thus has much power), the board of directors, treasurers and trustees.

All these members of the university are important to ensure that it fulfils its mandate, mission and goals. Sometimes the structure will vary with time and priorities, however the core, high-level executive remains fixed. Each university is always within a local context which will affect and lead to nuances at lower levels of the structure.

6.4.2 Stakeholders

The study also discusses the various stakeholders at a university. Most of them were mentioned under the organisational section. To reiterate, four key groups will be analysed in the context of UCT – note that these are internal stakeholders that are involved in the functioning of the unviersity. These influence sustainability in different ways: high level management (HLM) staff; academic staff, of which there are sub-groups; operational staff; and students. Given the subject of analysis, namely sustainable buildings, the focus will be on operational staff and how they make decisions; but it is necessary to consider higher

levels of management, whose decisions affect many parts of the institution. Thereafter, academic staff are core to the university, hence their input is vital. It is noteworthy that there are different rankings in academia and it is important to analyse their (micro) organisational culture and the level and type of influence departments and faculties have on other aspects of the university; especially as academics are often active members on several committees. Lastly, students, which are a large group, can also influence and sometimes dictate the priorities of a university. Historically they have mostly been involved in governance issues through the Students Representative Council (SRC), however this has expanded and there are various student leaders, from faculty councils to many society heads, and more student representation on various committees and groups that traditionally only had staff members. Over time both the academic and student groups have been given greater autonomy and thus they are important to consider when analysing how change happens at an institution like a university (Pusser & Loss, n.d.).

Government is an external influencer, that is not directly involved, but is a key stakeholder – both since they partly fund public universities, and the Department of Higher Education has a mandate to increase graduate rates and ensure quality education is taught and research fields are advancing. As will be seen in further chapters, the external influencers such as government can be a key driver in advancing sustainability at universities.

Other stakeholders include alumni and funders of the university. Alumni are a network of graduated university students and some wish to remain aware of key university activities and sometimes engage with the university – for example being invited as guest speakers. They sometimes also make donations to the university (with or without conditions attached). Other funders also contribute to the university and therefore take interest in the broad workings and decisions of the university.

6.4.3 Leadership

Leadership is closely related to the above two sections. Given the structure of the university, there is a (top-down) hierarchy and many (horizontal) departments. There are parts of the university that are autonomous and there are others that are carefully controlled and managed. However, given the nature of a university with the presence of many academics and researchers, there is room for independent decision making (the most obvious is at the faculty and departmental level, but it can go all the way down to individual professors). This implies that there is much room for leadership.

A university is dynamic and can reflect the issues in society. In fact, it can be considered a micro-city, given the various structures, many role-players and multitude of goals discussed thus far. Therefore, it is important for the university to be aware of global, national and local issues so that it can ensure its teaching and research are on par. More so, it can be a leader in tackling these societal problems given the accessibility of academic expertise and pursuance of knowledge.

Related to this are the institution's values – which can originate from leader(s). A university in the US states it: "attributes … success in energy conservation to four factors: a shared vision, a correct understanding of financing, research linked to practice, and a pride in collective work. These factors all stem from leaders' strong values" (Kurland, 2011: 15). Typically, leadership is viewed at coming from the top; but HLM should also consider bottom-up initiatives and incorporate them into high-level planning (Barth, 2013). This also allows leaders to develop in different parts of the organisation.

7. Sustainable Buildings

This last chapter of the literature review will briefly discuss aspects related to sustainable buildings, especially within a national context. The first part will look at the national policies and measures to promote energy efficiency, the second part will focus on the GBCSA and the impact it has made thus far, and the last part will examine a key shortage when it comes to incorporating sustainability in the built environment and thereby help reduce carbon emissions.

7.1 Energy efficiency

Given the high carbon intensity of electricity in South Africa, there is a focus on improving energy efficiency in buildings. There are a number of energy efficiency policies at a national and regional level that have been developed since the early 2000s. The National Energy Efficiency Strategy (NEES) was published in 2005, by the Department of Minerals and Energy (DME). It included a target of improving energy efficiency by 15%, by 2015, for both public and commercial buildings.

The national electricity provider, Eskom, also focused on Demand Side Management (DSM) and energy efficiency, mostly given supply constraints. During the periods 2007-8 and 2012-14, there were electricity blackouts across South Africa, termed 'load shedding'. This was a result of under-supply, a number of technical problems, power plant maintenance issues and mismanagement of resources at Eskom. There was some emphasis on getting industrial companies to install energy efficient equipment and optimising their processes to reduce demand. However, the focus was often on reducing peak load demands and encouraging large industrial users to shift their loads away from the peak (Martin, 2011).

In 2006, the National Energy Efficiency Agency (NEEA) was established. One of its key mandates was to oversee the implementation and funding of DSM. It would also raise awareness around energy efficiency and DSM, together with identifying strategies around increasing energy demand (DME, 2008). However, this agency has been dormant for the past few years.

There are also national SANS codes that must be adhered to in South Africa. SANS 0204 titled Energy Efficiency in Buildings was published in 2011, and SANS 10400 has two parts: Part X for Environmental Sustainability and Part XA for Energy Usage in Building, the last of which was initiated in 2008 and published in 2011. These are mandatory for all new buildings within the scope of the National Building regulations. Thereafter, SANS 1544 titled Energy Performance Certificates for Buildings was initiated in 2012 and published in 2015 (SABS, 2017).

In 2013, DoE published a regulation: 12L Income Tax Allowance on Energy Efficiency Savings. This incentivises companies to invest in energy saving measures; however, this is after

Measurement and Verification of the energy savings (GreenCape, 2014). The initial tax rebate was at 45c/kWh, however this was increased to 95 c/kWh in 2015 (SANEDI, 2016).

There are no regulations related to green buildings directly, but the energy efficiency policies do lead to more businesses considering other sustainability and cost saving as pects. Nevertheless, more governmental support and incentives (in line with the rating tools) could help drive the market in South Africa further (WGBC, 2013).

7.2 GBCSA and rating system

The Background section discussed the contribution of buildings to emissions and resource extraction. Given the relatively large impact of the built environment on the natural environment and people, measures to reduce negative effects are becoming vital. This is reflected by the number of Green Building Councils (GBC) that exist in many countries across the world. The most notable councils are from the USA, UK, and Australia which have developed their own rating tools and standards, which are: Leadership in Energy and Environmental Design (LEED), Building Research Establishment Environmental Assessment Method (BREEAM), and the Green Star rating system respectively. The South African GBC is based on the Australian one. All these councils – of which there are more than 100 – are part of the global network, the World Green Building Council (WGBC). The WGBC provides support for new and existing councils, helps develop tools, and fosters collaboration across countries. It aims to have a "comprehensive strategy to deliver carbon emission reductions" (WGBC, 2016). They also help transform the market around (green) buildings and all of this ultimately leads to greener cities.

Figure 6 shows the relative green building shares for 13 countries. The average green share across all countries is 24%, with South Africa having the highest at 41%. The Dodge Data & Analytics report goes on to state that developing countries are expected to show the highest growth in green building development. This is reflected in figure 7, with South Africa once again showing the highest percentage of respondents whose firms have done more than 60% green projects. According to the GBCSA's website more than 260 green buildings have been certified as of October 2017 (GBCSA, 2017).

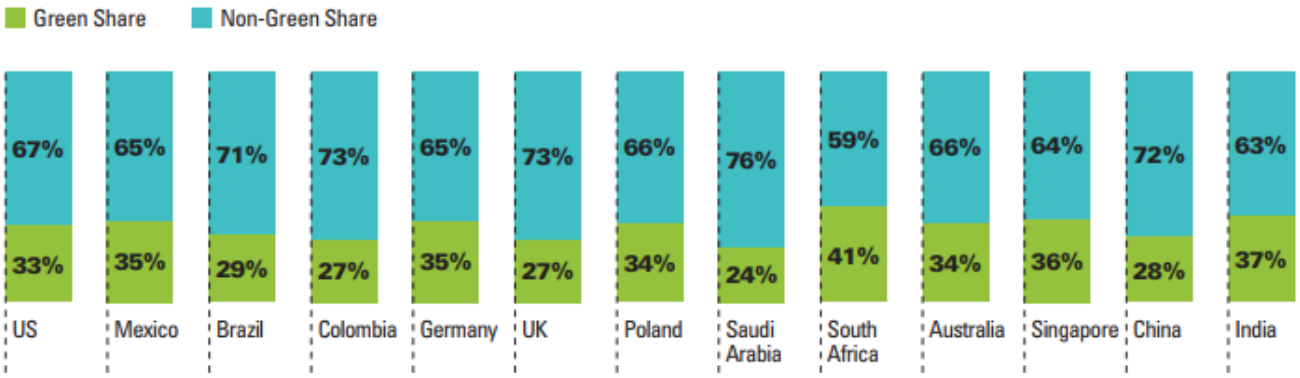

Figure 6 showing Average 2015 green share of building project activity (by country)

Source: Dodge Data & Analytics, 2016

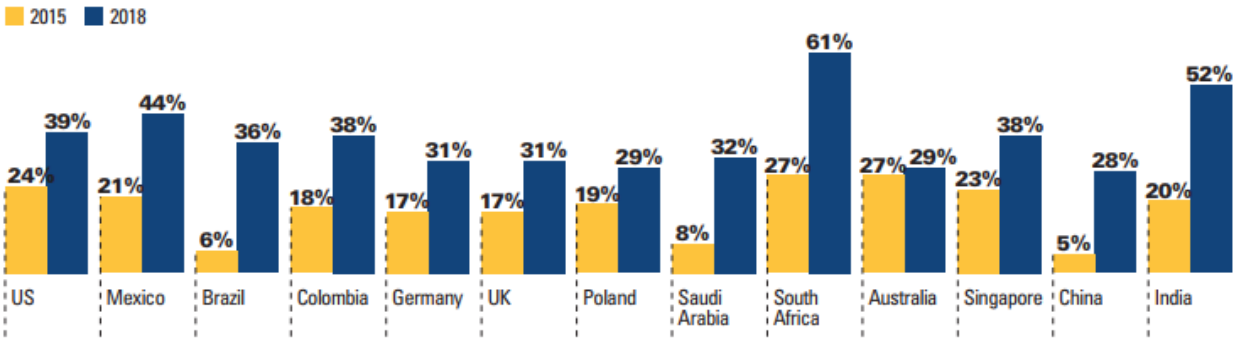

Figure 7 showing Percentage of respondents whose firms have done more than 60% green projects

Source: Dodge Data & Analytics, 2016

It is interesting to note the key drivers of increased green buildings in South Africa. As seen in figure 8, the main current factor is that it is the 'Right thing to do', whereas the main factor across all countries is 'Client Demands'. These are somewhat overlapping, but the increase in client and market demand (since 2013) reflects the expanding understanding and awareness of the benefits of green buildings in South Africa (Dodge Data & Analytics, 2016).

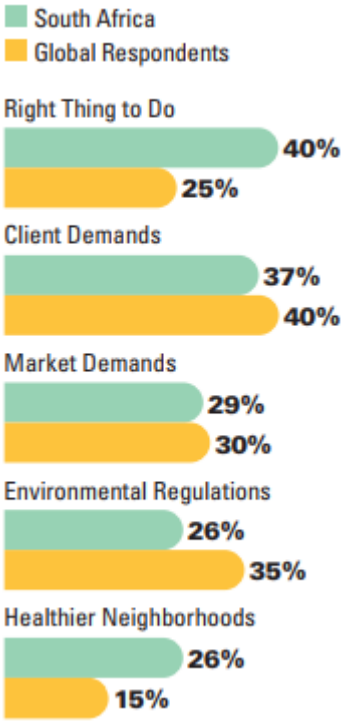

Figure 8 showing Top triggers driving future green building activity in South Africa

Source: Dodge Data & Analytics, 2016

The GBCSA was established in 2007 and the first rating tool for offices was launched in 2008. This was followed by separate tools for retail and residential buildings (GBCSA, 2016). The rating tool for public and education buildings was only developed in 2011 and launched in 2012 (Green Times, 2011). The tools are driven, in part, by those sectors that show an interest in green buildings (SC&A).

The most obvious, and often prioritised, issue when it comes to green buildings and reducing emissions is the reduction of energy consumption of the buildings. However, there are other important aspects to buildings that need to be considered and they are explicitly accounted for in the rating tools for green buildings. The categories in the GBCSA's typical rating tool are: Management, Indoor Environmental Quality, Energy, Transport, Water, Materials, Land Use and Ecology, Emissions, and Innovation. As can be seen this is broader and all-encompassing, and includes elements related to people, health, the surrounding space and its use, and there is room for innovation. Depending on the sector (e.g. retail or public building), the tool weighs each category accordingly (GBCSA, 2016).

There are three categories of achievement when it comes to GBCSA's rating system, namely: 4, 5 or 6 star. The higher the rating, the more sustainable the building is considered to be. Furthermore, there are two distinctions to the accreditation: a building can either get a 'As Design' or 'As Built' certification. The former can be achieved at the end of the design phase of the building, whereas the latter means that the building has been measured and monitored (post construction) and then verified that it performs according to the specific star rating.

There are number of reasons for building sustainably. The more obvious reasons are related to the climate change and reducing emissions through lower energy use. However, as stated previously sustainable buildings and the rating tool has more elements. A key component is improving the health and well-being of its occupants. A study published by WGBC found that 55% of businesses state that this is the key reason for building green – after energy and other cost savings (WGBC, 2013). This can be done by paying attention to air-flow, having enough lighting, providing uninterrupted views, and providing spaces for collaboration and teamwork. All these elements are said to improve productivity of staff in office spaces. Detailed studies are yet to be conducted for public or educational buildings.

7.3 Skills for green building

Given the advancement of the GBCSA and the more stringent energy standards; there is a need for more skilled professionals in the building sector. It is required that amongst those working on a green-rated building, there is at least one professional accredited by the GBCSA. This is often the architect, but it can be a consultant working on the project (SC&A). It is also important for managers on-site to be aware of sustainability principles and methods and it is their responsibility to ensure that contractors are also aware. It is

necessary for the range of people that are part of a building project to be on the same page. This is the philosophy of at least two of the architects interviewed.

GBCSA is aware of the skills gap and has developed educational programmes and run courses throughout South Africa. The attendees are not just architects and engineers, but others that are involved in decision-making (GBCSA, 2012). An article published in Engineering News specifically mentioned that there is a lack of degrees offered for students to enrol in to construct green buildings. Instead the industry itself trains and develops the necessary skills. Further, South Africa is at a stage where more in-depth solutions are being considered, and people are starting to incorporate environmental and social factors when building (Slater, 2014).

However, there is a lack of people that can measure, monitor and verify the various standards, codes and regulations that are present on paper. Government and municipalities should invest in developing these skills and competencies. The Dodge Data & Analytics (2016) report highlighted that one major challenge is the lack of trained green building professionals – if this is corrected, South Africa could become a leader in green buildings.

That is the end of the literature review section. The next section (chapters 8-10) explores aspects specific to UCT and describe the findings from the case study.

8. University of Cape Town: background and setting

8.1 General

The University of Cape Town (UCT) was founded in 1829 and was originally known as the South African College. It is the oldest university in South Africa (Times Higher Education, 2017) and the highest ranked in 2017 (uniRank, 2017). From 1880 to 1990 UCT received more funding from both the private and public sector and this allowed it to expand. In 1918 it was renamed to UCT and was given the status of a university (UCT, 2017c). Prior to 1928, UCT was based in the current central part of Cape Town. After 1928 UCT established most of its buildings along the slopes of Devil's Peak, on the property previously owned (and then donated) by Cecil John Rhodes, where it is still located. UCT is situated on one of the most scenic locations, both locally and internationally. It has the mountains and a Heritage Park as a backdrop in the west, and one has a large, undisturbed view of the city towards the east.

UCT is split into several campuses, namely: Upper, Middle, Lower, Medical School, Hiddingh, and Graduate School of Business (GSB) campuses. More than 20 residences are scattered across the campuses and parts of the city. The buildings that are discussed in this study are all on Upper Campus.

8.2 Student and staff numbers

UCT has six faculties, with various courses and degrees on offer. More than 27000 students (including international) are enrolled at UCT, together with over 5000 employed staff (UCT, 2016). Over the periods 2010-2014, UCT had an annual growth rate between 1-2% in student enrolments, whereas, over the period 2014-2015, UCT experienced a rate of 5.5% (UCT, 2016). This can be seen in table 2. This reflects the need for infrastructure and services to expand.

Table 2: Headcount Enrolments 2010-2015 showing percentage growth on base

	2010	2011	2012	2013	2014	2015	% Change
SA African	5323	5744	6012	6256	6247	6341	19.1%
SA Coloured	3653	3687	3530	3608	3620	3619	-0.9%
SA Indian	1681	1671	1701	1731	1819	1845	9.8%
SA White	9183	8992	8814	8483	8141	8148	-11.3%
International	4171	4268	4802	4290	4686	5028	20.5%
Unknown	1003	1146	1191	1962	1820	2809	180.1%
Total	25014	25508	26050	26330	26333	27790	11.1%

Source: UCT, 2015: 32

8.3 Governance

One aspect that is unique to universities, is the use and number of committees. There are different groupings of staff and students – called committees, working groups, task teams, project groups and advisory groups – that meet regularly with agendas. They all invite different people (management, operational, academic, PASS staff and students, and sometimes industry experts and consultants) depending on its mandate. And they have different levels and types of powers when it comes to decision making.

Two of the highest-ranking groups are Council and Senate. The latter deals with all academic issues, while the former oversees the "mission, objectives, goals, strategies and policies for the progress of the institution. It must also ensure an environment conducive to efficient, effective, economical and ethical attainment of these goals" (UCT, 2017a). Council must also ensure the university is stable financially, has a "healthy and viable environment" (UCT, 2017a) and must ensure proper accounting and reporting is done to the Department of Higher Education and Training (DHET). Council is mandated to have representatives outside of the university as well.

The University Finance Committee is a committee under Council and reports directly to it. It oversees the spending of the entire university. Funding related to UCT is discussed in the next section. Then there are a number of other committees which often have key decision makers (including deans and HODs) with the power to influence. One key committee that will be discussed, especially as part of the case study, will be the University Buildings and Development Committee (UB&DC). This committee has the major say in capital projects, funds available for the project and oversees the construction and development of new buildings.

The UCT website (2017b) mentions that committee structures are in place to allow for "logical hierarchy" which in turn allows for "simplicity, accountability and defined responsibilities". This statement will be unpacked in the context of sustainable buildings later. The other key category is loosely termed as 'groups'. These range from Project Groups or Task Teams (such as the Waste Task Team which aims to improve recycling on campus), to Working Groups which are formed more quickly and loosely, to deal with a specific issue, a recent example of one is the Transformations working group. These workings groups often do not have much decision-making power – this will be illustrated further on when discussing the Environmental Management Working Group (EMWG). Lastly, there are Management Advisory Groups that can be formed by high level management to solve more generic managerial issues (UCT, 2017b).

8.4 Funding and Finances

One key theme that is explored in this study is the funding of universities. There are three main sources of funding: government subsidies (unless if it is a private university), student

fees, and the universities' endowments (which earn interest). Another source could be reserve or surplus money from previous years. Lastly, various members of the university community can seek sponsorships or donations from external and private companies or organisations – this can be for the university in general or by an academic for their department or project. The ratio of the sources and the absolute and relative sources of income play a role in the functioning of a university as an institution, and the resources available for various activities and initiatives that the university needs to or wants to take part in.

Government is an important source of funding and is also involved in high-level policy reform. There has been a renewed focus on state funding, given the recent student protests for free tertiary education (this is discussed in detail in chapter 12). There has been a decline in government subsidies over the past few years and this has led to universities increasing their fees. This has become unaffordable for many South African students, who then protested, firstly for a no fee increase, and thereafter for free tertiary education. This decline in government grants, loss of fee income and rise in expenses from insourcing has placed increased strain on UCT's financial management. This has and is likely to continue having a negative effect on increasing sustainability at UCT. This will be discussed at length under the Barriers and Challenges chapter.

According to UCT's 2015 financial report, their financial policy is "to provide for sustainable operations and the ability to invest in educational initiatives consistent with our mission. We practise conservative financial management, by striving for efficient recurrent operations which generate funds to support strategic initiatives" (UCT, 2016: 73).

The funds that are available to UCT can be split into three categories: council controlled; designated; and agency. The first one is further broken down for: educational purposes; housing; and other council specific spending. Designated funds are usually grants and donations provided by other companies or parties for a specific (research) purpose. And the third category is when the university becomes an agent for a third party to transfer funds to (usually) students (UCT, 2010b).

From the financial statements of the university, one can see it has four sources of recurrent income: state subsidies and grants; tuition and other fee income; sale of goods and services; and private gifts and grants. Thereafter, it has interest and dividend income. Its four recurrent expenditure categories are: personnel; other operating expenses; bursaries; and depreciation and minor capital expensed. There is also some interest on internal borrowings expense. The General Operating Budget (GOB) is derived from fee income and government grants; whereas capital expenditure (capex) is derived from reserves, investment income and infrastructure grants. Operating expenses (opex) are part of GOB, and thus there is a disparity between opex and capex. The management of UCT finances is said to be 'devolved'. This means that there are budget-unit heads – usually Deans and Executive

Directors – and they are in charge of ensuring proper budgeting, allocation, and accounting of funds available (UCT, 2014).

In 2015 UCT had a budget deficit of R79 million, and has been facing deficits since 2013. It has R9.2 billion in assets, and liabilities, for 2015, which is an increase by R1 billion from 2014. There are R7.6 billion in total for funds (UCT, 2016). Given the number of priorities from different groups at a university, one can expect competition in allocation of funding (and human resources). Annual budgets need to be drawn up and approved, and there are often set procedures to follow and comply with.

In recent years UCT (together with other South African universities) has seen a relative decline in government financial support. This has led to pressures on other income streams and thus a rise in tuition fees for students. This is reflected in figures 9 and 10. However, as stated the rate of student enrolment is increasing and there is a need for expansion of resources (Makou, Wilkinson & Bhardwaj, 2016). Thus, there is limited funding available for new capital projects.

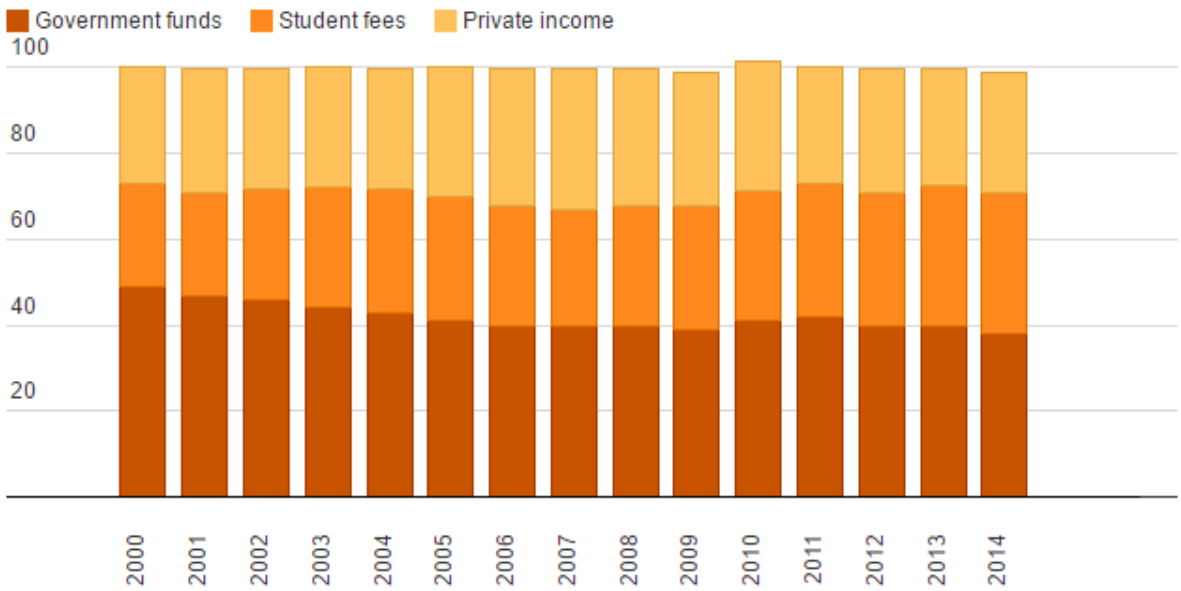

Figure 9 showing Income sources of SA tertiary education institutions (%)

Source: CHET in Makou, Wilkinson & Bhardwaj, 2016

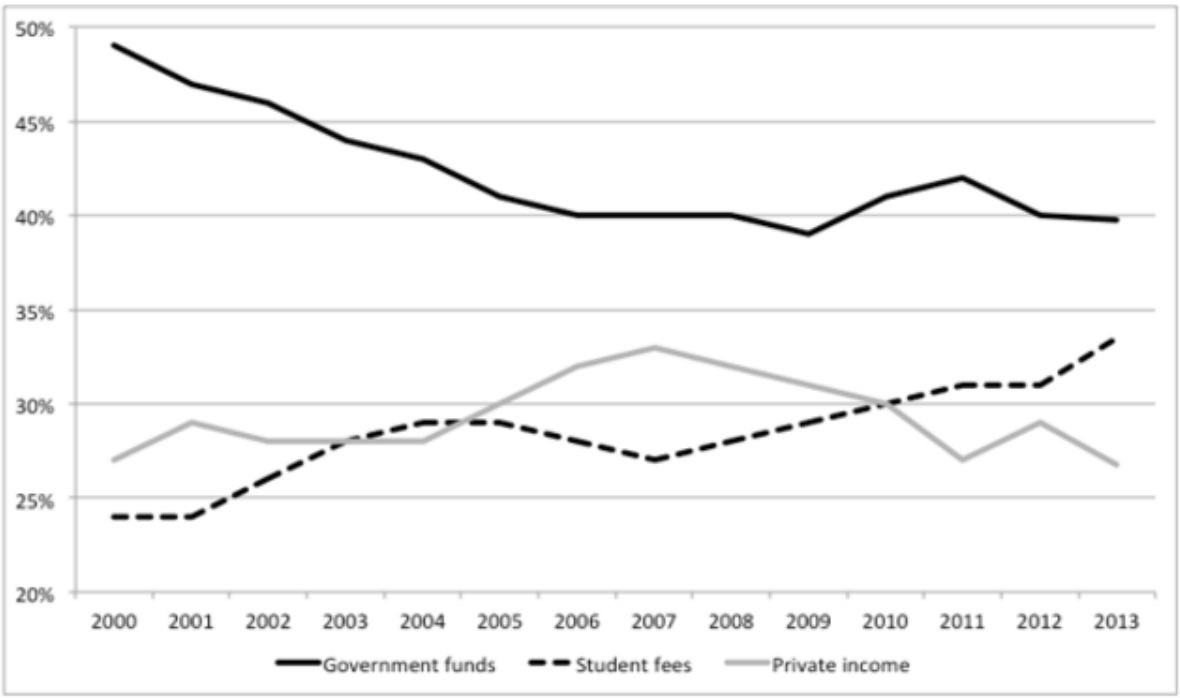

Figure 10 showing Composition of university income (all universities combined)

Source: DHET in Burger, 2016

The main source of funding is from the DHET subsidies, which can be more than 60% of a university's income. The second largest block of income is from student tuition and accommodation fees (around 30-40%). Recently student fees have increased beyond the Consumer Price Index (CPI), as the government subsidies have been declining. Universities South Africa (USAf) calculates the Higher Education Price Index (HEPI) which measures the inflation rate of universities based on its spending, such as: "academic salary increases, utility costs (especially electricity), foreign exchange based expenses … and security and cleaning contracts. These have all grown at rates higher than CPI on an annual basis" (USAf, 2016: 2). This can be seen in the table below, specifically in row (6) which shoes a negative growth in teaching input (TI) per student.

Table 3: Subsidy levels over the period 2012/2013 – 2014/2015

	2012/2013	2013/2014	2014/2015	2015/2016	Note	No.
Treasury Allocation	R20.9 bn	R22.4 bn	R24.2 bn	R26.2 bn	Excluding NSFAS	
% Increase	8.3%	7.2%	8.0%	8.2%	Above CPI	**(1)**
Block Grants	R17.4 bn	R17.4 bn	R19.6 bn	R20.9 bn		
% Increase	6.4%	5.8%	6.1%	6.6%	CPI-linked	**(2)**
Teaching Input (TI)	R11.7 bn	R12.1 bn	R12.7 bn	R13.1 bn		
% Increase	6.9%	4.2%	4.7%	3.1%	Below CPI	**(3)**
TI Units	1 071 822	1 119 033	1 169 143	1 222 348		**(4)**
TI/Student Unit	**R10 916**	**R10 813**	**R10 863**	**R10 717**		**(5)**
% Increase		-1.0%	0.5%	-1.3%	TI/student unit growth negative	**(6)**
Teaching Output (TO)	R2.5 bn	R2.7 bn	R3.0 bn	R3.2 bn		**(7)**
TO Units	134 272	141 344	149 138	159 578		**(8)**
TO/Student Unit	**R18 619**	**R19 102**	**R20 116**	**R20 053**		**(9)**
% Increase		2.6%	5.3%	-0.3%	TO/student unit growth < CPI.	**(10)**

Source: USAf, 2016: 2

Furthermore, South Africa is ranked low when it comes to higher education expenditure in relation to GDP, even compared to some BRICS partners. This is reflected in the figure below (note that this ratio has increased recently due to the relative decline in nominal GDP). This all puts a strain on the operations of a university.

Figure 11 showing Expenditure on higher education as a percentage of GDP, in 2012

Source: CHET in USAf, 2016: 4

At UCT, the Properties and Services (P&S) department is somewhat separate from the main finance committee (which deals directly with academic departments). P&S have their own finance department, which deals with all the operational aspects of the university: electricity, utilities, grounds and gardens, maintenance, safety, transport, etc. They often deal with large parts of the budget and are accountable to UFC. They also pay salaries and wages to a large staff population (especially after the insourcing of cleaning, transport and safety staff in 2016). They need to manage their own budgets effectively, together with pressures from the overall UCT budget.

It is the P&S Projects and Capital Works (PCW) department that oversees all new building projects. They work closely with the Physical Planning and Landscaping (PPL) department – that has strategic plans for all UCT campuses and properties, for the long term. Funding for new capital projects is allocated by UFC, and the sources are: government grants; designated grants and free cash (net investment income and reserves or surplus from previous years). UCT has a policy related to how investment income funds capital projects. Debt finance can also be used; however, the university is a conservative and risk-averse institution – this is partly because it is a not for-profit organisation and does not have a steady source of income to repay loans (UCT, 2014).

8.5 Risks

The Annual Financial Statement Reports of UCT list a number of key risk factors which are pertinent to the university. It is necessary to keep these in mind when making any short and long term plans; as mentioned previously the external environment can greatly influence the university's core operations. The university has a Risk Management Committee (under the University Audit Committee) that oversees operating and business risks.

The business risks are related to the above mentioned financial characteristics of a university. The university relies on state funding – which needs to be spent in the correct way and any obligations, terms and conditions placed by government need to be adhered to. Another recent risk that has arisen is limited funding from government and the implications this has on other sources of income and expenses. Yet another risk related to external funding (both from government and other companies donating money) is that that money may only be used for certain activities and is not transferable. As will be seen, this is a limitation when it comes to capital funding provided by the government (ED-F, PSS & UCT, 2010b).

Operating risks are related to the university's physical assets. The risk is related to direct and physical damage to property; but also to the risk of high costs for operating and maintaining buildings. Measures need to be in place to limit these risks and one possible way is by ensuring the design and features of the building are sustainable. This could be through using the GBCSA's rating tool, which lists a number of factors about the building and its surrounding environment, which allows for the designers and clients to think through long

term implications of the building. An example is the modelling of energy usage for the building, given certain passive (orientation, overhangs) and active (type and amount of lighting, HVAC, etc.) features, and energy tariffs. This could allow UCT to forecast its energy usage and expense, and possibly put in measures against the risk of high electricity prices (this will be discussed further in the sections below).

There are other types of risks that a university faces, related to teaching and research (but that is beyond the scope of this study). However, associated with them are reputational risks. These can range from quality of teaching and research, to issues of discrimination of its staff or students. Another risk that can be included, is of not fulfilling the mandate of being an institution offering public service to society (UCT, 2010b). As stated previously, UCT's mission is to equip students with the necessary skills to tackle real world problems. There is a risk this may not be achieved if the university does not actively pursue solutions to global issues like climate change and ensuring that it strives, along with society, towards a sustainable socio-economic and environmentally safe society.

8.6 Buildings

As of 2016 UCT already has over 150 buildings in total (including residences and other campuses) with 44 buildings on Upper. This is a total of nearly 700 000 square metres, of which Upper Campus accounts for roughly 35% (SC&A).

UCT's Upper campus is a fairly compact campus that was originally commissioned to be designed by the architect Joseph M Solomon. He drew inspiration from universities in Europe and North America and developed some design plans. However, there were many delays and he was not able to complete the plans. CP Walgate took over and designed parts of the currently existing campus. He downscaled the original designs and reduced the costs of construction. By 1929, most of the main buildings were erected; with the main library, Jameson Hall (the central, large hall used especially for graduation ceremonies) and student union buildings following soon after. As per an article in the UCT Monday Paper (2004), in the 1950s there was an increase in economic growth and development in South Africa and hence more pressure for graduates and skilled people – this led to an increase in the size and scope of UCT. From the late 1950s to late 1970s, UCT had expanded in student and building numbers (UCT Monday Paper, 2004).

From 2010 to presently, five new buildings have been constructed across Middle and Upper Campus – three of which are part of this case study, while the other two are situated on Middle Campus: New School of Economics building and Student Administration building. As off 2016, a new conference centre is being designed and built at the Graduate School of Business Campus. Also during this period major renovations were done for at least five other buildings and re-roofing and maintenance work are on-going for various other buildings. Besides these educational buildings, UCT invested R485 million in a large

residence of 6000 square metres, with 887 beds and was completed in 2011 (UCT Monday Paper, 2010b).

This shows the expansion of UCT over several decades, especially the recent increase in capital expenditure. UCT is now at the stage where there is very limited space for further construction, especially on Upper Campus. However, there is an ever-increasing number of students enrolling and there are ambitions to improve the rates of graduates and research output. (Also, there is greater demand for parking space on a yearly basis – this is a concern from management, planning and sustainability points of view. However, this is beyond the scope of this study).

For future building projects and overall physical spaces plans, UCT has developed a Campus Access Management Plan (CAMP) and an Integrated Development Plan (IDP). This is discussed in the section 'Future capital project plans'.

8.7 Electricity Consumption and Emissions

Since energy efficiency is a key part of sustainability that will be discussed in this paper, it is necessary to analyse UCT's electricity usage – specifically the volume, price and electricity bill. However, prior to that, the broader context of electricity prices need to be understood.

As stated previously most electricity in South Africa is fossil-fuel based. Currently, coal still contributes 65% to primary energy use (DoE, 2016). As can be seen from figure 12, from the late 1980s to the early 2000s, electricity prices were quite low – even less than the annual inflation rate. Besides the availability of cheap coal, there was an excess of supply. Eskom had, prior to 1990, invested in a number of large coal fired power stations. Soon after Apartheid, the new ANC government aimed to electrify many households that previously did not have any access to electricity. This, together with growth in other sectors, led to an increase in demand. Over this period no new power stations were commissioned. Then in 2007-8, Eskom could not keep up with the demand and had to 'loadshed'. This meant having periods with no electricity access in different regions, and also encouraging large (industrial) users to shift their loads away from peak hours (in the mornings and evenings). From the period 2007-2015 prices had increased over three-fold (Moolam, 2015). Table 4 below shows the average price of electricity in cents per kWh, over all the major sectors. Over a decade prices rose by 57.32 c/kWh in real terms, which equates to a 76% increase (DoE, 2016).

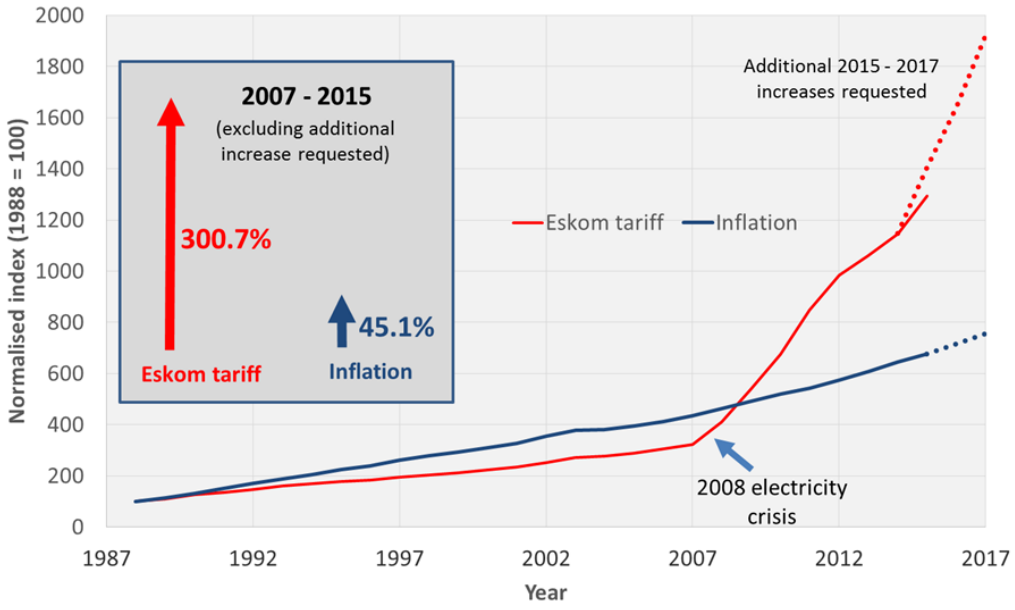

Figure 12 showing the Eskom average tariff vs. inflation (CPI) from 1987-2017

Source: Moolam, 2015

Table 4: Eskom average prices from 2006-2016.

Period	Average Prices
2006/07	18.06
2007/08	19.60
2008/09	24.97
2009/10	31.95
2010/11	42.20
2011/12	50.27
2012/13	58.49
2013/14	62.81
2014/15	67.63
2015/16	75.38

Source: Eskom yearly reports in DoE, 2016: 36

The electricity tariffs increased due to: increase in demand and lack of supply; technical constraints in the power plants (also lack of maintenance); and increase in the price of coal (DoE, 2016). As Moolam (2015) mentions that in the past electricity expense was not large and so energy efficiency was not a big concern. However, electricity prices have risen steeply over the past few years and this has led to rising expenses for many businesses, industries and households. This has resulted in more people taking energy efficiency seriously and there many that are benefiting from the savings.

What follows are details of UCT's electricity expense. Figure 13 below shows UCT's P&S department's university-wide budget for 2016. The share of utilities is 37%, of which the electricity expense is 50%. Figure 14 is from main finance, which includes other expenses, like transport (Jammie shuttles) and security services. Electricity is relatively less, at 22% of those total costs. This is a relatively small amount, and when compared to other university wide expenses, the percentage is even smaller. However, the total electricity expense for electricity over 2015-16 was R71 million (as can be seen in figure 15). Figure 16 shows the absolute electricity trends over the past 3 years. The axis on the right is the Rand cost while the one on the left is the cost per full time student (FTE). This implies that the cost of electricity increase is not proportionate to the increase in student numbers. This increase can be attributed to both rising prices and increased usage. This reflects the need for improved energy efficiency.

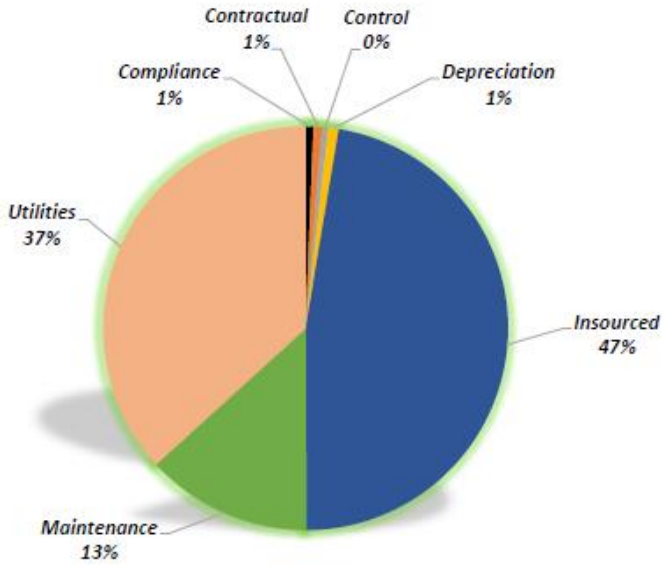

Figure 13 showing P&S's breakdown of expenses for 2016

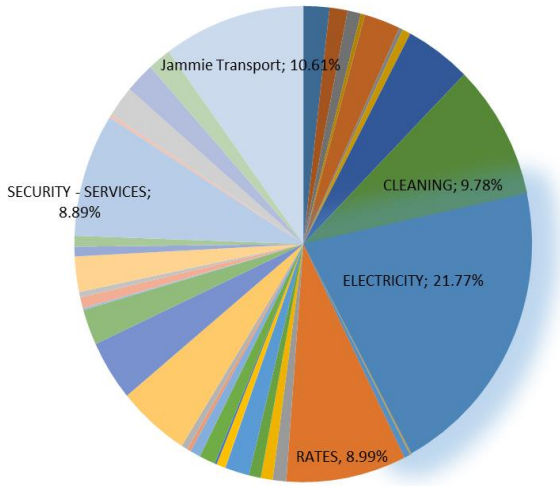

Figure 14 showing expenses as a % of total costs for 2016

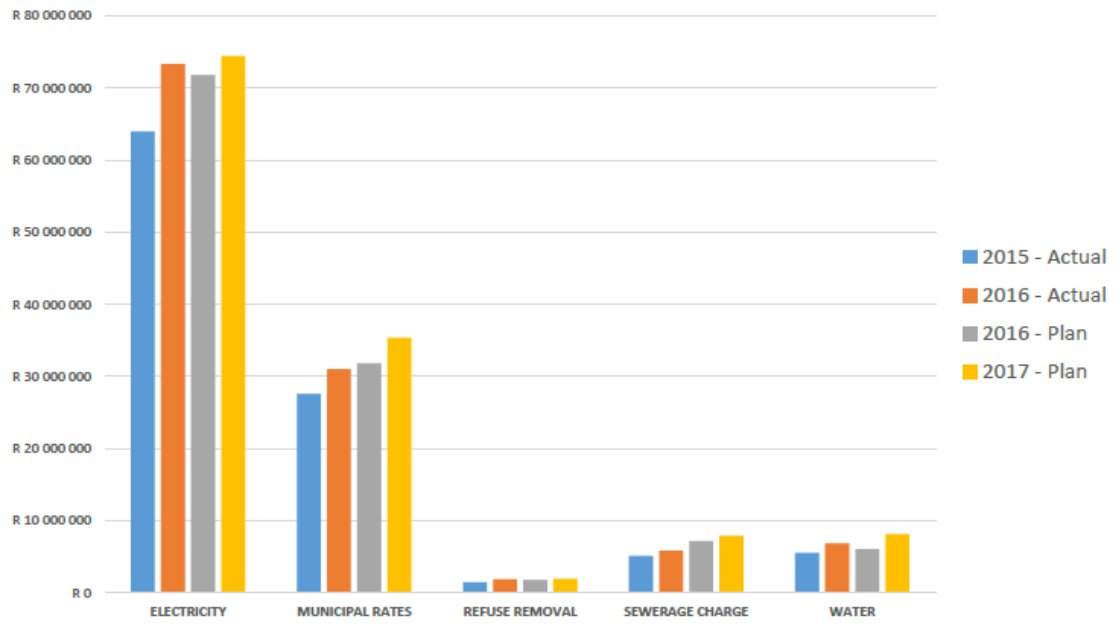

Figure 15 showing P&S main utility expenses and forecasts for 2015-17 period.

Sources: ED-F & S-F

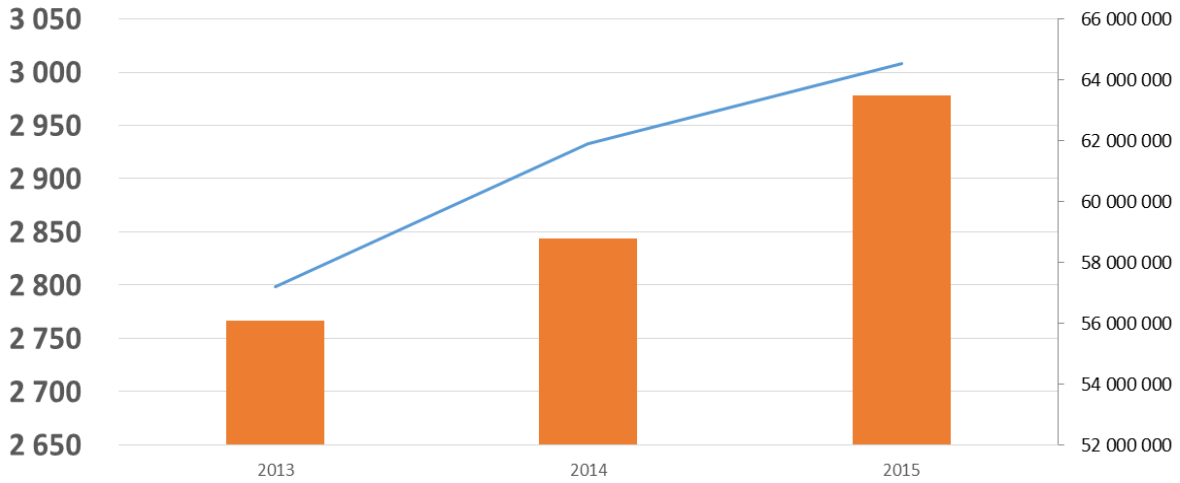

Figure 16 showing the Electricity expense per Full Time Student (FTE) (left axis) and absolute Rand amount (right axis)

Sources: ED-F & S-F

UCT is on the Time-of-Use (TOU) tariff. It was previously on the Large-Power-Users tariff, however the TOU is more appropriate for UCT. It is also important to note that most buildings have their own meters installed, this allows for better measuring and monitoring

of electricity consumption; and if need be (after analysis of the data) a new tariff plan could be adopted, if it leads to savings.

Reliable electricity is very important for a university, as: there are students that work at all hours of the day and night; there are certain labs that need to be kept on at all times as there are on-going experiments; there are some high-consumption and specialised equipment; it is a large campus and for safety reasons some lights have to be kept on at all times. All this has resulted in UCT investing in several back-up generators and UPS (especially in residences). This was a priority after the 2008 and 2014 load-shedding periods.

In terms of budgeting for electricity, there is no formal procedure or proper equation; instead rough estimates are arrived at using historical data – they have generally not been grossly inaccurate. Monthly bills are paid in arrears and as will be seen there are very few existing measures in place to reduce the bill. However, it is the nature of the university that makes it difficult to predict usage (given the many departments and specialised equipment that some have) and P&S have limited control over new equipment that is bought, as this would be at the discretion of academics and HODs. The bill is aggregated (the only distinction is between main campus and residences) and thus it not possible to identify individual high users or buildings.

Another important metric is the carbon emissions from UCT's operations. An external consultant gathers the data and compiles an annual carbon footprint report. There are three emissions categories: Scope 1 - Direct emissions; Scope 2 - Indirect emissions from purchased electricity; and Scope 3 - Other indirect emissions. This, together with the methodology for calculating the various emissions, is based on the GHG Protocol developed by the World Resources Institute (WRI). However, the carbon footprint report notes that "GHG accounting and reporting practices are still evolving, requiring annual adjustments as new methods are introduced and emission factors updated" (Rippon, 2015: 7).

Figure 17 shows the emissions from various sources, as reported in the 2014 carbon footprint report – and the largest contribution is from electricity, at 77%, which increased by 3.4% since 2013. This reflects the increase in absolute electricity consumption; however, on a per capita basis, electricity consumption has decreased slightly 0.13 t CO_2e in 2013 to 0.10 t CO_2e in 2014 (Rippon, 2015).

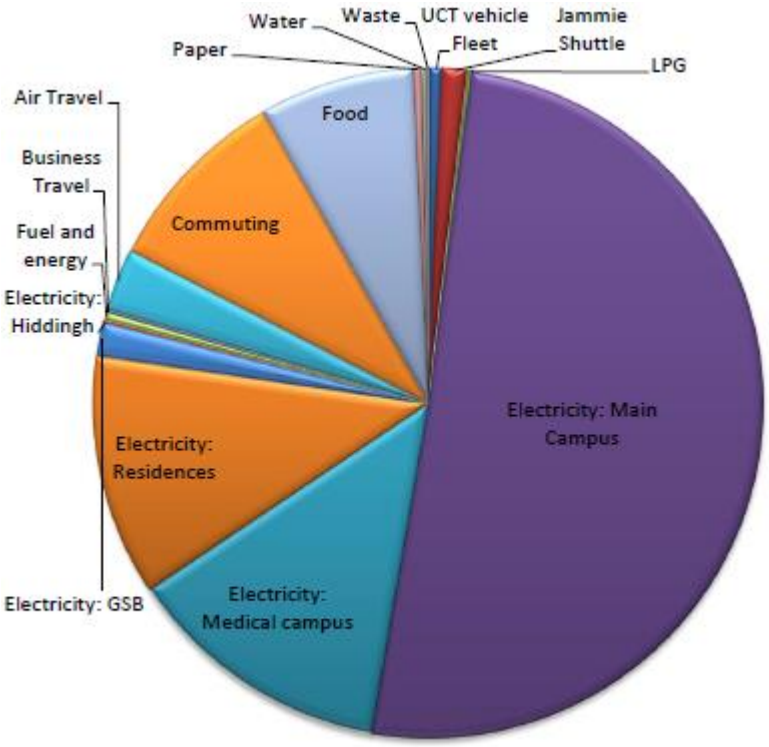

Figure 17 showing the sources of carbon emissions at UCT in 2014

Source: Rippon, 2015

Table 5 shows the absolute and per capita emissions of UCT. Compared to other universities it is the third lowest emitter, per capita. This is partly due to the type of climate in Cape Town – there are not as extreme variations in climate, as in some other countries, and therefore there is relatively less use of HVAC systems.

Table 5: Per capita tons of CO2 emissions for different universities in 2013-4.

University	Year	Population (students & staff)	Gross Total tCO2eq	tCO2e per capita
Arizona State University	2014	85 355	181 153	2.12
California, Berkeley	2014	50 511	107 984	2.14
University of Cape Town	2014	31 329	68 906	2.20
Monash University	2013	55 669	139 018	2.50
University of Queensland	2012	43 773	133 964	3.06
University of Hongkong	2013	33 525	108 726	3.24
Cornell University	2014	31 155	182 663	5.86
Carnegie Mellon Penn.	2013	16 079	97 359	6.06
University of Maryland (UMD)	2014	33 890	214 700	6.34
Mean		42 365	137 164	3.72

Source: Rippon, 2015

Figure 18 shows the amount of electricity used on main campus (this includes Upper, Middle and Lower campus). Only the time period since 2012 is shown, as prior to that there was missing information (2008-2010) and before that the reliability of the data is uncertain. However, after 2012 there has been a concerted effort to increase the number of meters used to gather information and the data has been checked for anomalies (this will be discussed in detail later). As can be seen the usage has been fairly steady, with a possible downward trend since 2014. This could be due to increased energy efficiency – especially as student enrolments and floor space at UCT has increased. However, given the short time that reliable data has been available, the trend is difficult to say conclusively.

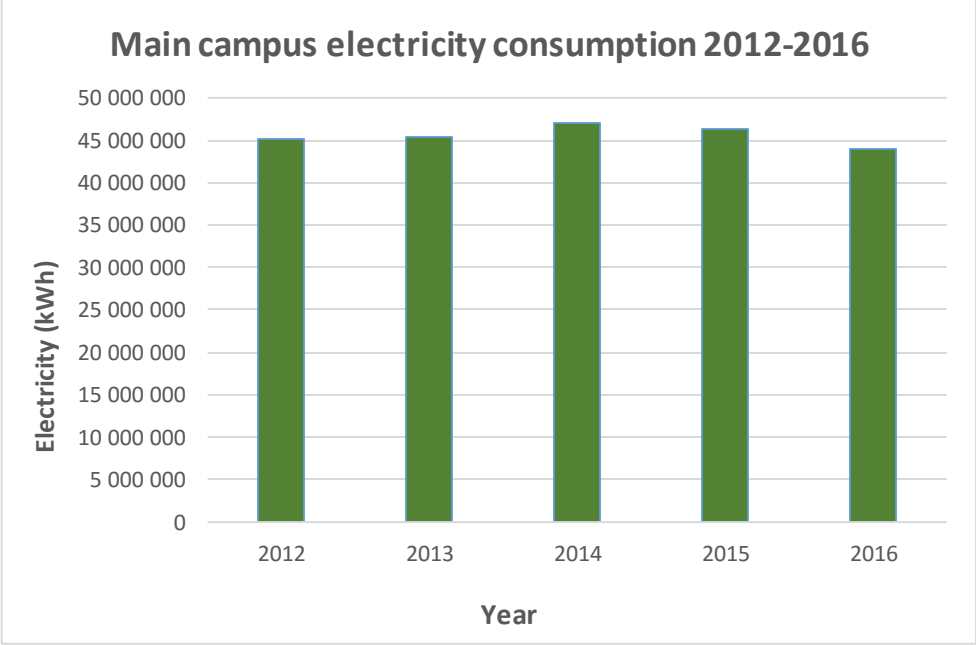

Figure 18 showing Main campus electricity consumption between 2012 and 2016

Source: SC&A & S-F

9. Sustainability at UCT

9.1 History of sustainability policies

Sustainability at UCT goes back 26 years, to 1990 when the Talloires Declaration was signed. Since then there have been a few policies, one action plan and various initiatives taken to advance sustainability at the university. This section will outline the history of sustainability at UCT up to the time of the writing of this research report.

As mentioned, in 1990, the then Vice-Chancellor Saunders signed UCT to the Talloires Declaration. This is a non-binding document that was drafted and signed by 22 university leaders from around the world – at an international conference in Talloires, France. It includes a ten-point plan (see Appendix B) which reflects the need for HEIs to integrate environmental sustainability into all parts of the university (ULSF, 2008b). As of January 2016, the declaration had 499 signatories (ULSF, 2016) from both developed and developing countries and from a range of HEIs (ULFS, 2008a).

In 2001, Vice-Chancellor Ndebele once again committed UCT to the declaration. Thereafter UCT's 2012 Teaching and Learning report noted that "the role of universities in the past included not only being factories of knowledge but also acting as agents of social change and incubators of innovation. By signing of the Talloires Declaration in 1990, as well as the International University Sustainability Network/Global Charter (in 2012), UCT has recognised that it has a critical role to play in creating a sustainable future by establishing sustainable development in research and curricula, as well as University's operations" (UCT, 2012).

In 2001, the Environmental Management Working Group (EMWG) was set up by an academic in the Environmental and Geographical Sciences (EGS) department. This member was also part of a number of other committees at UCT and was thus able to bring in various elements related to sustainability to the meetings. Other members of EMWG include: Director of P&S, Head of Physical Planning and Landscaping, Risk Officer, various interested academics from a range of departments, SRC environmental head, and at least two GCI committee members. The agenda for EMWG varies year-on-year, but over the past few years, it has stagnated with issues not being completely resolved. Furthermore, since this is a working group it lacks power.

The next major sustainability related policy was the 2008 Green Campus Policy Framework, developed by the then deputy VC Hall. This was in relation to the recommitment in 2001, together with topical issues of sustainability that were brought up at the Global University Leaders Forum at the World Economic Forum in 2007. It is interesting to note that the framework mentions the disparity in developed and developing countries by stating that "approaches are mainly based in 'first world', western and northern countries and there is a noticeable lack of comparable research that has emerged from Africa" (UCT, 2008: 3). It then goes on to mention the important role UCT can play: "South Africa, however, is an

exception in this respect and universities including UCT have significant research expertise which could be usefully drawn upon in developing policies for implementation" (UCT, 2008). It also mentions the vulnerability of climate change for the African continent. The focus was on enabling an energy efficient campus and examples are given of universities that are focusing on their buildings to reduce carbon emissions. It further states that "university sustainability programmes, once integrated into the operational aspects of the institution, provide further opportunities for innovative practices" (UCT, 2008: 7).

The Policy Framework discusses the student led Green Campus Initiative (GCI), founded in 2007 by students, for students to take part in greening the campus and raising awareness regarding all things sustainability. At the time, there was a mission to form a Green Campus Unit (GCU) which would include the whole university in order to "shift UCT towards a carbon neutral, sustainable institute [and be] an independent Unit that is a connection point between academic and administrative staff and students" (UCT, 2008: 8). The next step was to design and draft a Green Campus Plan for UCT and the idea was to have the Properties and Services department oversee the overall management and monitoring. Besides energy efficiency and emissions reduction, the policy also had recycling and water conservation as key objectives.

Thereafter, the Green Campus Action Plan (GCAP) was developed in late 2008/early 2009. This is the most comprehensive document related to sustainability at UCT. During that period, there was momentum around sustainability at UCT and hence this plan was drafted and reviewed by the EMWG over a relatively short timeframe. The development of the plan brought together both operational and academic staff. Workshops were also held and students gave input. It was mostly compiled by the Sustainability Coordinator (SC), Sandra Rippon. (She was active in this role from 2008-2012, but continues to work on some reports). However, the GCAP was not formally adopted by UCT (Argent, 2014).

The GCAP speaks of the importance of institutional transformation and recognises the challenges that exist for universities to incorporate sustainability. The long-term vision is to achieve broad sustainability, by including social and economic sustainability; however, the purpose of this plan was to focus on environmental sustainability. UCT's plan and two key ideas are based off Harvard University and its Green Campus Initiative (HGCI). The two ideas proposed are: the creation of a Green Campus Unit or Office, and implementing a Green Campus Loan Fund. Thus far, neither of these ideas have been implemented.

This plan includes six further objectives (to the four mentioned in the Policy Framework) such as indoor air quality, construction, transport etc. These categories are based on the GBCSA's rating system and tool. The reason for this was that it "provides specific criteria against which a strategy can be measured, [together with] background and technical information, benchmarks, and describes the documentary and other evidence that would demonstrate achievement of the criteria" (UCT, 2009: 23). It then includes a set of 'priority

actions' that were selected depending on the category, time to implement and cost of the action. The SC helped to implement some of these low-cost plans. The GCAP then ends off with details on the role, structure and financing of the GCU. It emphasises that roles and responsibilities need to be given in detail and ways of measuring, monitoring and reporting of progress need to be in place. It is also important to find ways of funding the various actions and initiatives outlined and then to report on the successes to the UCT community.

In 2012, VC Price signed UCT to the International Sustainable Campus Charter (ISCN) – Global University Leaders Forum (GULF). These are two partner organisations which "provide a global forum to support leading colleges, universities, and corporate campuses in the exchange of information, ideas, and best practices for achieving sustainable campus operations and integrating sustainability in research and teaching" (ISCN, 2016). It currently has more than 80 university memberships. As part of the network, regular reports are to be submitted, for which a framework is provided. It is broken down into three major sustainability categories, called principles, which were listed in chapter 7. ISCN also publishes Best Practice Reports, which showcase case studies from its members. It can thus be useful to learn from other universities and then pilot new initiatives that are relevant and applicable for UCT. Moreover, it ensures internal monitoring, measuring and then reporting which are useful for UCT's management.

During the period 2000 to 2012, other notable initiatives that took place, include the following: the Partnership for a Sustainable Environment (PASE) in 2002-2004; Initial Review towards an Environmental Management System (EMS), 2003; Review towards EMS – Aspects Impacts Register, 2003; Environment and Sustainable Development Policy, by the Property and Services Department, drafted in 2003 and adopted in 2008; carbon footprint reports since 2008; and ISCN-GULF reports since 2012.

The PASE initiative was started to determine the feasibility of setting up a 'green' office. The environmental movement was gaining momentum around the world and UCT also wanted to integrate sustainability in its operations and teaching. However, PASE was not successful as sustainability was not mainstreamed at that time in South Africa and there was still resistance at the university to prioritise environmental issues.

It is important to recognise various groups at UCT which are involved in climate change and sustainability related research and teaching. They are: Environmental and Geographical Sciences (EGS) department; African Climate and Development Initiative (ACDI); Energy Research Centre (ERC); Climate Systems Analysis Group (CSAG); African Centre for Cities (ACC); Environmental Evaluation Unit (EEU); amongst others.

There is also a Pro-VC for Climate Change (note, not sustainability). He is mostly in charge of advancing research related to climate change and is also the director of ACDI. He is not involved directly with the physical campus or strategic elements of sustainability at UCT. There were academics (mostly from the above groups) that hoped the Pro-VC would

facilitate coordination between the groups and have sustainability as the overarching theme. However, this did not happen. Instead the different groups have set up their specialised units, which are research-focused, and again, not many get involved in the operations or strategy side of UCT (A-EGS1, A-EGS2, SC&A & A&HLM).

According to SC&A, the previous ED of P&S was relatively open to environmental sustainability and advancing it where possible. Initially the VC had entrusted him with the responsibility to compile reports for ISCN-GULF; but since this has been delegated to the SC. The SC also worked hard to garner more support, especially from high level management, around sustainability initiatives. The SC approached various DVCs, but each did not see it as part of their portfolio. The Pro-VC had also chosen not to champion sustainability at UCT. Ultimately it was realised that P&S was the only large department that had been active regarding sustainability, and the previous ED of P&S took it upon himself and his department to advance it further. This has resulted in most sustainability initiatives having an operational focus.

One aspect that is lacking is the integration of sustainability in the curriculum. This has not received much attention at UCT but needs to be tackled. The Chemical Engineering department re-structured their 4-year degree to incorporate sustainability topics, methods and case studies throughout the program. This was successful because there were a few committed academics that saw value in it and drove the initiative. It is important to create an open and enabling environment around this, so that other departments and academics can initiate something similar. The above-mentioned groups would be invaluable in providing content, information and expertise regarding this. There needs to be more collaborative and sharing atmosphere to do this successfully. Table 6 summarises the key commitments of UCT to sustainability.

Table 6: Timeline of UCT's sustainability polices and plans

1990	International Talloires Declaration signed by VC Saunders
2001	Recommitment to the implementation of Talloires by VC Ndebele
2008	Green Campus Policy Framework adopted by UCT Council and Senate
2009	Green Campus Action Plan developed by Properties and Services
2012	ISCN-GULF Sustainable Campus Charter signed by VC Price

Source: Rippon, 2013

9.2 Sustainability in the context of transformation at UCT

HLM3 described the previous and recent process of strategic planning, as follows. The university drafts and sets up strategic plans for a period of 4 years. The current VC oversaw the strategic plan for 2010-2014. Not all the university's activities are covered by the plan, but the goal is to have 4 to 5 not-too-broad goals, with sub-sets of goals and targets. Therefore, some decision-making and priority setting takes place when deciding on the goals and plan. Initially there was not much engagement in the UCT community. However, the new strategic plan for 2015-2019 had much more involvement and engagement. This is partly due to the national strikes across university campuses for the free higher education. Usually the process takes 6 months, but this plan took nearly 2 years to finalise. People were divided over some issues and deliberated over context, wording, etc. In terms of environmental issues, there is no direct goal regarding it in either strategic plan. Instead it is only mentioned a few times in the sub-goals, and it is usually in relation to other topics and goals. Further to this, universities are unlike businesses that have one product or service to sell, so there is a clear directive. A university is more complex therefore it is difficult to cover all the points in one strategic document (HLM3).

The talks around transformation at UCT are mostly centred around social issues of inequality and injustice, due to the ravages of the Apartheid regime, and thus they are justifiably important issues that need urgent attention. However, there is no direct transformation in terms of the environment and sustainability. In 2015, the GCI started a campaign on Environmental Transformation, under their Institutional Development portfolio. They held workshops with key stakeholders at UCT and drafted a document of action and a letter addressed to the leadership of UCT. The campaign had momentum for a short period but GCI is hoping to engage the university and other societies further in this regard (St-GCI).

There is a Social Responsiveness Policy Framework, however this also mostly deals with social issues. The social responsiveness group is relatively inactive when it comes to environmental issues – based on the information available on their site and from an interview. Another interviewee mentioned that some people are aware of their carbon footprint and should act to reduce it, but since there is not policy or mandatory requirement, many do not take action to address it. Therefore, a group such as this has the potential to be a key enabler.

More broadly, the Environment is usually in conjunction with Safety and Health – termed SHE together. The portfolio on SRC is also called SHE. However, both safety and health are big issues on their own, and environment is tagged after it. This makes it hard to prioritise one or to sufficiently allocate resources to each department.

According to the ED-P&S there is awareness around sustainability; but there is a lack of motivation. HLM1 mentioned that sustainability is considered a technical and sometimes

economic issue; the focus needs to shift and it needs to be seen as a social issue as well. Also, systemic awareness is necessary – that could be done by changing behaviours and practices, and by integrating sustainability in teaching, learning and research. Environmental sustainability cannot just be another awareness campaign, but needed to be embedded into the structures of UCT (HLM1). This is difficult given that firstly, the curricula currently have sporadic elements of sustainability, driven by few passionate people – it is not yet part of curriculum reform – again the emphasis is on other social issues. Secondly, none of the DVCs have environmental sustainability as part of their portfolio. This reflects limited commitment from UCT's HLM.

In the corporate world, there are an increasing number and range of companies that do integrated business reporting. Some companies go so far as to make environmental sustainability the centre or anchor point, and then report outwards. This is a different but advanced way to look at reporting and strategizing, and results in embedding a culture of sustainability in the organisation.

The onus is currently on P&S to advance sustainability, and that is mostly from a physical campus perspective. More stakeholders need to engage around the three principles of sustainability as per ISCN-GULF. Currently reports are produced, but according to HLM1 there is more of a 'check-box' attitude and UCT still does not have a sustainability strategy. More effort should also be placed to go beyond the minimum (be it energy efficiency, sustainable buildings or other initiatives). The key issue that arises here is the level of commitment and ownership. Even though the responsibility has fallen on P&S by default, the question is: what can be done better and how can environmental transformation take place across the university? There is a consensus (based on the interviews) that sustainability is not yet mainstreamed at UCT.

This has also limited the scope for institutional transformation. UCT has some project success examples: recycling bins, renting bikes, reducing wastage, etc. However, it has struggled to have systemic change, behavioural shifts (such as a recycling culture) and institutional transformations (St-GCI). However, one can view the policy of green star rated buildings as an institutional environmental victory, since the physical assets of the university will be more sustainable (Sharp, 2002). This will be discussed in the following chapters.

10. Sustainable Buildings at UCT

As stated in the introductory parts of the thesis, this research is case study based, and includes the analysis of three buildings at UCT. It is important to note that a large institution like UCT has had many renovation and new building projects. Given the number of projects in just the last 10 years, this study focuses only on the three most recently constructed new buildings, especially as they are the most relevant in terms of incorporating sustainability and energy efficiency. However, for a comprehensive analysis of the topic, reference will be made to some aspects of past building projects.

Most of this chapter is descriptive, however, throughout one can see the factors that enabled the 2012 policy of new green star rated buildings being the minimum standard.

10.1 New building process

Note: all this information is collated from interview notes with ED-P&S, ED-F, H-CPW, H-PPL and PSS.

Firstly, it is often a faculty which decides that a new building is needed. This could be due to a shortage of space and facilities for current students or an increase in the number of students entering that faculty. This need is expressed to the Properties and Services (P&S) department of UCT. Sometimes the need for new buildings is due to external reasons – for example, government requires more graduates from a particular faculty or department and subsequently provides funds specifically to that faculty for the purposes of new infrastructure. Those funds cannot be reallocated or used for any other purpose.

Once a request is made for a new building, the Projects and Capital Works (PCW) department at P&S is tasked with the building project. They analyse the initial details of the project and submit a proposal to Council. An initial 'professional team' is set up that consists of architects, various engineers and UCT, as the client. UCT provides the initial brief. This initial phase is important, as this is where the first cost estimates are determined, which is then submitted to Council for approval.

Once the building in question is approved and signed-off, P&S's PCW department goes out to tender for a contractor. This is a more stringent process – whereas the architects are appointed from a list of accredited professionals (note that according to one interviewee only architects with a long and good track record are chosen – so this could prevent newer, more innovative or green architects from being chosen). The architects then showcase various designs and PCW, together with the users, choose the best and most suitable design. After going out to tender, the building design plans ideally should not change much. Thereafter, more committees get involved. The key committees are: University Buildings and Development Committee (UB&DC); Physical Planning and Landscaping Committee (PPLC); Project Implementation Committee (PIC); and User Committee (UC). Other

committees that also have a say are: Resource Allocation Advisory Group (RAAG); Space Allocation Committee (SAC); and Environmental Management Working Group (EMWG). These groups play an important, but slightly different scrutinising role, throughout the design and construction phases.

The UB&DC is a sub-committee of Council and a key group when it comes to a new building. It decides which engineers and consultants will be hired to work on the building. It also deals with the financial aspects of the building and is situated between Council, the Finance department and the other committees. Appendix C includes a governance schematic diagram that shows the placement and relationships between these key committees and groups.

The PIC is active during the construction of the building and oversees all parts of the project. The UC provides input for various aspects of the building, and this goes back to the PIC and UB&DC for approval. UC consists of multiple people (mostly academics, that are often the final users of the building). The architect has to liaise with them to make sure the building is functional and sees to the needs of the users. The EMWG is meant to look out for the sustainability of the new building and whether certain minimum standards are met – however this is also done by the other groups and is now part of the brief (since all new buildings should be 4-star green rated at the minimum). The EMWG could potentially improve the rating of the building and be the driver for even more sustainable buildings. Note, that an accredited green building professional is required to be on the team, in order to get the rating. This does increase the expenses, as these consultants can be expensive (together with the actual accreditation fees).

10.2 Funding for a new building

This section focuses on the how the budget for a new building is determined and the implications for the sustainability of the building. Firstly, it could be government that provides a grant for a specific reason – such as for the Engineering faculty to increase the throughput of chemical engineers. The funding may be for improving the facilities provided, which could mean providing more lecture and tutorial venues for students. Or it could be the case that the university identifies a lack of resources for a particular faculty or department and it needs expansion – this must also be in alignment with the broad, strategic developmental plans. UCT will then ask government for a grant or see if one has previously been provided (as the conditions for the grant are often specific, for example it can only be used for a specific department or for improving research). Government usually gives part of the requested budget (as was the case for the buildings discussed here), and then UCT has to cover the shortfall. Another reason for the shortfall is that UCT maximises its space and builds accordingly – but government spending is limited and needs to be distributed amongst other universities as well.

UCT determines initial concept plans for a new building, with an initial professional team. The team determines estimates for the project, together with a contingency and depending on expected costs, the university will add more money towards the capital project from its free cash reserves budget. Every year, UCT aims to have a 3% surplus, as the university should have 20-30% in its reserves. Thus, the portion available for capital expenditure varies year-on-year and other priorities and spending plans are also kept in mind – the RAAG committee decides on the distribution of reserves (ED-F). In terms of determining the budget required for a new building project, various calculations are done, depending on the faculty and number of staff and students the building will accommodate, to work out a cost per person. The estimated budget must be approved by Council.

After approval, more detailed plans are drawn up with an initial design teams (consisting of architects, quantity surveyors, a range of engineers and UCT as the client), together with detailed financial forecasting. Once this is determined, the UFC will approve the final budget. Thereafter, UB&DC, together with the PIC and other committees will take over. If there are any issues with the budget during detailed design phases or the construction period, then the different committees will need to manage them. If there are unavoidable costs, then alternative funding will need to be sourced. This can be through the faculty or department or the dean himself who can provide additional funding – either from the faculty's own reserves or by approaching external companies to sponsor parts of the building. This was done by the Dean of EBE – who had various contacts in industry – for NEB and Snape.

Prior to NEB, two other large new buildings were constructed on Middle Campus – the new Student Administration Building and the School of Economics building. According to ED-P&S there was a lack of integrated design; and there ended up being many 'middle-men'. This meant there were many groups, individuals or companies involved and each wanted their own mark-up. Furthermore, some of these companies were not well-reputed, and when equipment or fittings got damaged, they could not be easily replaced. This was either because they were non-standard and so hard to replace, or they were expensive and had to be imported. All this resulted in costs rising for UCT (both during and post construction). It was also mentioned by the SC&A and two academics that the building did not end up being as energy efficient as envisioned. There were problems with orientation, fittings, etc. However, this was mostly avoided for the buildings in the case study.

An interesting question that arises is who takes responsibility for such incidences or failures? According to some at UCT, it is due to lack of proper planning and coordination by the architects and consultants; whereas if one had to speak to the architects, it could be due to UCT's limitations (physical, design-wise or monetary). However, since the Middle Campus buildings are outside of the scope of this study, more research was not carried out on them. These were points that were raised by interviewees in brief comparison to the three case study buildings and their processes.

10.3 Green star rating policy

10.3.1 Sequence of events leading to policy

There is one key UCT policy related to buildings that is important to discuss: the 2012 policy that states that all new buildings constructed after 2012 will be green star rated, at a minimum of 4 stars. This is a progressive policy which will have a positive impact on the sustainability of buildings on UCT campus. This section discusses how this policy came to be, who the key role players and decision makers were, why it came to be only in 2012 and what this is likely to imply for future building projects.

As stated above, the UB&DC is the main body which oversees new building projects and other related issues. It includes a variety of people, from internal academics, operations staff members, and external experts and consultants. This allows for comprehensive analysis of new projects and the various decisions that need to be taken to ensure a fit-for-purpose building. One key academic that was part of this committee was a senior lecturer from the EGS department in the Science Faculty. He was also interviewed for this research. Another important person that led to this policy was the then Sustainability Coordinator (SC). She is an architect by trade but completed her masters under EGS, at UCT. Thereafter, she was appointed as the sustainability coordinator and has undertaken and driven many sustainability initiatives during her term.

The first time the green star rating was mentioned in writing was in the Green Campus Action Plan of 2008, which included this point: 'Adopt the Green Star SA rating system and build new buildings to a minimum 4 Star rating'. Thereafter the rating was brought up in 2009 at an EMWG meeting. Note that this was soon after the establishment of the GBCSA. This was due to the SC who was one of the first accredited Green Building professionals, so she suggested the possibility of implementing the rating at UCT to EMWG, especially given the benefits of electricity savings and reduced carbon emissions. However, EMWG is a working group, which reports to the UB&DC, and thus does not have much power. This then become an agenda item at the next UB&DC meeting. Since the agenda item was not resolved there – that is, what action would follow the suggestion to have green rated buildings at UCT – this issue was brought up and discussed at a PIC meeting in February 2010.

As per the PIC minutes from the meeting, there were discussions and concerns around the higher cost of a green building. The point was also raised whether it was worth aiming for a rating, instead of just improving the sustainability and energy efficiency features, where possible, which UCT was already doing. However, there was a push from an external consultant to consider the benefits of a rated green building. The conclusion from that meeting was to research the cost implication for going for a rating and then carefully

considering the outcome for UCT. This was followed up in latter meetings in 2010, however nothing conclusive resulted.

During this time, two new buildings were being constructed on Middle Campus – the New School of Economics Building and the Student Administration Building. The then director of P&S was aware of the discussions around green star ratings and aimed to incorporate some features of sustainable buildings into their design. Since the rating tool for public buildings had not been developed at the design phase of these buildings, the rating could not be achieved. Nevertheless, efforts were made to reduce energy usage – by ensuring the main façade was north-facing and low energy efficient bulbs were used for lighting (UCT Monday Paper, 2011).

Thereafter in May 2012, both the senior lecturer and SC drafted a letter titled 'Motivation to UB&DC for green star certified buildings at UCT' (See Appendix D). This letter outlined the various initiatives taken since the Talloires Declaration in 1990, to promote sustainability at UCT. It also mentioned the actions that were not taken to push for certain sustainability initiatives further – such as setting targets for carbon reduction and adopting the green star rating policy. These items were brought up regularly at EMWG meetings, however, they did not proceed higher up the decision-making chain. This motivation was directly sent to the UB&DC with the hopes that it could result in a final decision. This is exactly what happened at the next UB&DC meeting in May 2012 and the "proposal that UCT adopt the Green Star SA rating system and build all new buildings (and this included the new lecture theatre on the upper campus) to a minimum 4 star rating" was taken.

10.3.2 Analysis of process that led to policy

The above section described the key players, processes and timeline leading to the decision to have a policy for green star rated buildings at UCT. This section will analyse the efficiency of the process and discuss briefly what this could mean for future sustainability initiatives and policies.

Firstly, this policy took over 4 years to be verified. From 'History of sustainability at UCT', one can see that there was (and in some regard, still is) much stagnation when it comes to implementing sustainability plans, policies or initiatives. The plans that are well thought out and documented take time to get implemented or overridden by other priorities. Both the academic and SC had to make another call-to-action, specifically for this one sustainability target. This is in part, due to a lack of responsibility for sustainability initiatives at UCT. Thus 'champions' have to persist until action is taken.

Secondly, various people had to be consulted and are involved in the decision-making. These people have different roles to play in the university (either academic, operational, external, managerial), and they all have their own mandates and interests. There needs to

be enough awareness, motivation and an opportunity for action, before a such a decision is taken.

Thirdly, given the nature of committees, the different groups of people meet at specified times to discuss a range of matters (sustainability is only one amongst a myriad of agenda items). Usually all these people get a chance to voice their opinions, as this is the nature of a democratic decision-making process – however it increases the time taken to make decisions, especially if there are many contested views. Eventually, in this case, the policy was decided upon without a complete study (it was only discussed in the various meetings) and there are some people that are still not completely convinced by it.

Even though the policy has been implemented through NLT (see below), the H-PCW still believes that the rating can become a point-chasing activity and does not add much value. This is also in comparison to commercial buildings that can charge a premium to its tenants if the building has a green star rating – which is not applicable to a public building. Also, H-CPW believes that UCT has done its best to incorporate sustainability features into many of its recent new building and renovation projects. Conversely H-PPL says that some activities are done for the sake of ticking a box (including gaining some credits) and no-one at UCT considers it further. This hinders the level of sustainability over the lifetime of a building.

Some also feel that committees and individuals can take more responsibility to ensure compliance with policies. Examples are PIC, which is at the centre of the building process, and EMWG, which is mandated to consider environmental issues on campus. (HLM1, SC&A). It is important to have the university as a community to come behind policies and put them into practice. It is also important to have the mind-set that policy can be enabling, and it is not there to make processes more complicated or difficult (HLM3).

A comparative example can be found at Yale University: when attempting to institutionalise a GHG emission reduction target, they found that "achieving this institutional buy-in was not a trivial task, as it required numerous meetings with engineers, policy makers, budget personnel, student activists and eventually the office of the president" (Rauch & Newman, 2009). There are many parallels in the process followed by Yale and UCT. Furthermore, one of the outcomes of the target was 10 LEED accredited buildings on campus. This reflects the progress that can come from top-down strategies and targets.

This green building policy has led to the institutionalisation of one sustainability aspect at UCT. This a key milestone that has been achieved as: it is a formal and binding policy; it will allow for holistic building design; it is one of the first universities in South Africa to have achieved this; there will be benefits, such as reduced electricity usage and improved indoor air quality; and it is a statement of commitment for sustainability from UCT. The next section will highlight the energy efficient and sustainable features in the buildings featured in the case study.

10.4 Analysis of three recently built buildings

All three of the following buildings are located on the South side of Upper Campus. They are discussed in the order in which they were built. But prior to that, there is one old building that is of note: the Chemical Engineering Building (CEB) was built in 1999, and at that time there was an intention to build sustainably; even though there was no clear definition of a sustainable building then. It ended up being only partly sustainable; but the intention was present since that time. Thereafter, the two buildings on Middle Campus attempted to include sustainability elements as well; but that was also not as successful (mostly due to the architects' design and implementation, however no details were available). Thereafter the policy for green buildings was approved in 2012, and in 2016, UCT has managed to achieve an accredited green star rated building.

10.4.1 NEB

The first building under consideration is the New Engineering Building (NEB). NEB houses two engineering departments: civil and chemical, and has six levels. It is a multi-purpose building with lecture theatres, labs, offices, and open plan spaces. It also houses the largest electron microscope unit in the Southern hemisphere (Centre for Imaging and Analysis). NEB is said to be the showpiece building of UCT for the VC and its design was meant to be iconic. NEB does not have a green star rating but it does have energy efficient measures in place. Table 7 provides more detail.

Table 7: Details for New Engineering Building (NEB)

New Engineering Building (NEB)		
Start Date	2007	
End Date	2015	
Size	7200	square meters
Total Cost	207	Millions of Rand
Contributions to total cost:		
Government	40%	
UCT	60%	

Figure 19 showing East façade of NEB, with vertical grills for shading

Figure 20 showing inside atrium of NEB, with sky lights

Sources: Interviews and documentation from architects

The original budget for NEB was R187 million (UCT Monday Paper, 2010), but was revised to R209.6 million. Ultimately it came in under budget at R206.9 million (ED-F & H-CPW). Initially the sustainability elements for NEB were costed – by AGAMA the green building consultants – to an additional R16 million. This amount was not available, but after some deliberation, R4 million was allocated, of which R1 million was for energy modelling (A-EGS1). At the start of the project there were some members that wanted to incorporate sustainability, including the architects. There was some ambition to make it the first university building in South Africa to have a rating. However, there were budgeting issues from the start of the project, and the Dean of EBE had to ask for donations from (research-related) companies. (The University of Pretoria also wanted to make to make their building 4-star rated, however, they also had budget issues and had to scale down).

Table 8 outlines the sustainability elements included for NEB. The additional cost scale table is also included below. Where it says 'included', it means that it is not necessarily considered as a separate green element and is part of the total building cost. Total additional costs for sustainable features came to under R3 million.

Table 8: List of sustainability features, together with their costs and description – for NEB

Sustainable features	Cost	Description
Energy:		
HVAC system	Included	Variable Refrigerant Volume (VRV) system was used as it reduces annual energy consumption by upto 40%. In addition, less water will be used and Legionnaires' disease can be eliminated.
External sun shading	Included	Vertical grills provide shading and prevent excessive heating and glare.
Internal lighting	4	Energy efficient fittings, including motion sensors and light sensitivity. Additional light switchs included for better control.
External lighting	1	Energy efficient fittings, including daylight sensors.
Water:		
Fittings	Included	Low flow taps, shower heads and dual flush toilets.
Rain water harvesting	1	Rain water is collected for use in toilet flushing. Even though the cost of water is low, it is important as a water saving measure during water-stressed periods.
Water meters	1	Four water meters installed for manual reading of the main water supply, rain water system, showers, irrigation and the civil laboratory.
Landscaping	Included	Water wise planting and selection of efficient irrigation method and system.
Materials:		
Refrigerants	Included	Non ozone depleting potential (ODP) refrigerant has been used in HVAC system.
Steel	Included	Recycled content (80-100%) reinforcing steel used in construction.
General:		
Lighting	Included	High frequency electronic ballasts, to prevent flickering and enhance occupant productivity.
CO2 monitoring	2	Sensors included to reduce operating and service costs.
Refrigerant leak detection	Included	This is part of the VRV HVAC system.

Source: AGAMA, 2012

Table 9: Cost scale for NEB and NLT tables

Cost Scale	
1	0 - 200 000
2	201 000 - 400 000
3	401 000 - 600 000
4	601 000 - 800 000
5	801 000 - 1000 000

The contractor that was appointed for NEB was initially chosen because they were relatively inexpensive. However, there were concerns about their liquidity – and they did eventually go bankrupt in the last quarter of construction. It then became a 'managed project' for UCT. Interviewee PSS was part of this and said that it was a steep learning curve, especially as UCT did not have specialised staff at P&S and even though academics led many committees, it was not their role to oversee details of construction. At the same time renovations were being done to another large building and thus it was a chaotic period for all involved in the construction projects at UCT.

There are many similarities between CEB and NEB. This is due to two reasons: first, the chemical engineering department is also housed in NEB and there were academics from that department on UB&DC and UC – so they influenced the design aspects. And secondly, it is physically linked to CEB, so there is easy access to the labs and spaces in both buildings. Therefore, this limited the orientation and some design features, as the two buildings had to be aligned; also offices had to be east-facing and labs west-facing. This did have slight impact on sustainability features; however, functionality was a priority, which was achieved.

When there are academics from different departments, housed in the same building, there are sometimes disagreements between academics (and also with external consultants). Space is quite a contested topic at UCT – given its scarcity – and there is often much discussion and negotiation when allocating space. Overall, the process went smoothly for both NEB and TLB (NLT was a lecture theatre so there were even fewer issues). However, there are times when academics do not adhere to what they said or agreed upon, and then alter or deny their statements altogether. These types of political manoeuvres are always present in organisations, to some degree. As mentioned previously, a university is a large and complex institution and each faculty and department unique and has its own interests. Furthermore, overseeing a building project can be a long and arduous task. Nevertheless, it was stated by an interviewee in HLM that academics do not like to be managed and it can be a hard task to always ensure smooth operation.

Prior to NEB, no energy modelling was done for buildings; however according to A-EGS1, the head of capital works now wants it done for all future projects. However, per A-EBE-Ch who is based in NEB, the thermal properties have not been optimised: the vertical grills partly work in summer, but are not as functional in winter. According to E-A1, it is often a hard task to balance this across seasons, and so there are trade-offs. However, it sometimes becomes too cold to work in the office space in winter, and thus many staff have reverted to having their own heaters in their offices. This increases the energy usage; but there is no one or no policy to monitor this in the buildings.

10.4.2 TLB aka Snape

The second building under consideration is the Teaching and Learning Building (TLB), which is also known as the Snape building. TLB's construction started in 2009 and finished by 2015. It mostly consists of lecture theatres – also for the engineering faculty – with five levels and Construction Economics department is based on the top level. There is also a large, open-plan learning lounge at the bottom level.

Figure 21 showing the interior open-plan learning lounge in TLB

Source: Documentation from architect

Initially this building was only meant to be renovated with the inclusion of a few more floors; however, it was deemed structurally unsafe, and thus had to be demolished and rebuilt (over the original space). The original budget was R77.1 million, but had to be increased to R84.5 million. There were no government subsidies available, so it a 100% UCT contribution.

An interesting point to note, is that this building is actually seen as an extension of NEB, and thus also does not have a green star rating. Furthermore, no green building contractors were involved in TLB, unlike with NEB, which sought to actively include green features. According to A-EGS1 this shows the politics versus the policy at play. The committee members (for PIC and UC) would have also been different and it is possible they did not advocate for a sustainable building.

The basic green elements included for TLB were: energy efficient light fittings, similar material features as NEB, and few motion sensors. However, it does have more air-conditioning, as it mainly comprises of medium to large lecture theatres – which have higher occupancy rates than labs or offices. No further detail was obtainable for this building.

10.4.3 NLT

The last building under consideration is the New Lecture Theatre (NLT). This building has an As Design 4-star rating and consists of one large lecture theatre and some open plan spaces. The originally planned budget was around R30 million, however due to an increase in scope and legal issues the budget had to increase to around R60 million. However, NLT eventually came in R5 million under-budget. Table 10 provides further details.

Table 10: Details for New Lecture Theatre (NLT)

New Lecture Theatre (NLT)		
Start Date	2014	
End Date	2016	
Size	400	seater lecture theatre
Total Cost	60	Millions of Rand
Contributions to total cost:		
Government	25%	
UCT	75%	

Figure 22 showing East façade of NLT, with grills for growth of creepers

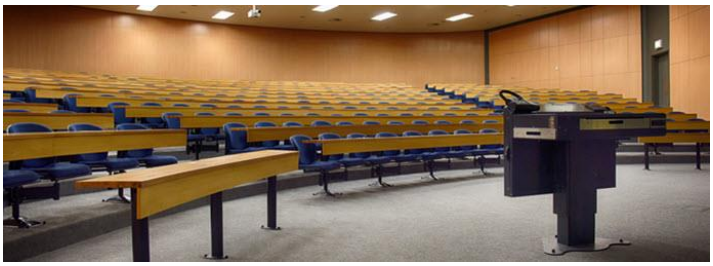

Figure 23 showing interior of lecture theatre in NLT

Sources: Interviews and documentation from architects

Initially the plan was for NLT to be an 'underground' building with a green roof. This was where the original idea came to make it a green building. However, these plans were not approved by Heritage Western Cape (HWC). There were other related legal issues that lasted for nearly 1.5 years. After HWC gave specific inputs, the plans were modified, which resulted in the current NLT.

As stated above, certain passive design features are sustainable, and their inclusion has become good design practice for some architects. AGAMA, the green building consultants also did energy modelling for NLT and made suggestions. According to E-A2, E-QS and E-GBC green building is more of a method and process, so one cannot easily separate the green elements. Some features like proper sealed windows and adequate insulation are good building practices, even though they result in lower heating and cooling requirements (E-QS). This said, a rating tool makes people more conscious about the best way to design a building. From the start of the design process, the green building consultants held workshops with the architects and engineers to describe the process and brainstorm on which credits would be aimed for in the tool. However, it is UCT, as the client, that has the

final say as they know what works best for the institution and is most suited to its needs (E-QS).

The contractors work out the price per square metre, and provide a final cost, including a contingency estimate. Due to the fees protests in late 2015, the costs increased by R0.5 million due to delays, as extra fees had to be paid for the rented construction equipment. In terms of materials, recycled concrete was more expensive – this could be due to low demand, which is harder to source and hence more expensive. Or the contractor charged a higher price, given that green buildings are a new market in South Africa. Finishings are often the most expensive part of a new building. Whereas steel has up to 90% recycled content in South Africa. Other costs included: noise insulation material (given it is a lecture theatre) and the mandatory fees for registering it as a green building. In addition, more admin is required for a green building, as one must prove that the credit was achieved (E-QS).

Table 11 shows the summarised green building rating categories and sections – the points or credits that were obtained for NLT to achieve 4-stars are included in the table (see Appendix E for full rating sheet). A brief description of each is provided, and where available the cost range is provided (same scale are above). As can be seen from the categories, besides the green features, there are points for social and well-being elements as well. 60% of the Energy credits and 31% of the Emissions credits were obtained. The highest percentage was attained for Management, and no credits were achieved for Innovation. Note that these percentages are not useful in isolation, as they are weighted differently – in other words there are more points available for, say Indoor Environmental Quality, and very few for Innovation. Within each category, the client and architect have freedom to choose which points are relevant and achievable for the building project under consideration. These points can be inferred from the table for NLT. More details on the reasons why certain points were targeted was not obtainable, and are beyond the scope of this study. Instead, chapter 11 focusses on the broader barriers and challenges that limit the overall level of sustainability for UCT buildings.

(Note: NLT was one of the first green star university buildings in South Africa; but in the same year another South African university, NMMU built a 4-star rated business school).

Table 11: Credits achieved for NLT to receive 4-star rating, together with cost and descriptions

Sustainable features	Credits (aimed for/out of)	Cost	Description
Management:			
Green Star Accredited Professional	(2/2)	4	Enagement and involvement of AGAMA.
Commissioning Clauses	(2/2)		All services commissioned according to codes and transfer of project knowledge to building owner/management.
Environmental Management	(1/2)	1	Require appointment of environmental consultant to develop project specific EMP, or require contractor to develop EMP prior to commencing demolition. For second point, require all main contractors (demo, earthworks, construction) to be ISO 14001 EMS accredited.
Waste Management	(3/3)		WMP to be implemented and require at least 70% of all demolition and construction waste to be diverted from landfill.
Building Management Systems	(1/1)		BMS to monitor and report on energy and waste consumption, and monitor and control building services systems
Learning Resources	(1/1)	1	Three sustainability initiatives (Water/Energy/Other) described and displayed and outcome continuously presented
Maintainability	(1/1)	1	Design review of plant access, ongoing maintenance, cleaning of building services. Development of Building Maintenance Guide.
Total:	(11/17)		
Indoor Environmental Quality			
Ventilation Rates	(2/2)	2	Require increased outside air rates in HVAC system i.e. 10 L/s/p (12.5L/s/p for additional point).
Daylight	(1/3)		Daylight modelling required to prove extent of daylight penetration into occupied areas. Modelling will be included in fee proposal.
Electric Lighting Levels	(1/1)		Require maximum maintained illuminance of no more than 80% of illumanace levels prescibed in SANS10114-1.
Hazardous Materials	(1/1)	1	Require hazardous materials survey to be undertaken by an occupational hygienest prior to demolition. If lead, asestos, or PCB's are found, these have to be removed in accordance with relevant standards and legislation prior to demolition.
Volatile Organic Compounds	(3/3)	1	Requires use of low VOC paints, as well as sealants and adhesives. Low VOC carpets/flooring must be installed as part of the base building to achieve the third point.
Formaldehyde Minimisation	(1/1)		Requires use of composite wood products with low formaldehyde emissions or products that contain no formaldehyde.
Stairs	(1/1)		Stairs to be highly visible, with 20m of entrance AND 25% exterior glazing OR sufficiently daylit OR open to interior on one side.
Total:	(10/22)		
Energy:			
Greenhouse Gas Emissions	(13/20)		Requires modelling to demonstrate improvement in building energy performance over and above SANS 204:2008. Energy Efficiency in Buildings. Points achieved can only be confirmed once building design and modelling has been progressed. Cost of modelling will be included in the fee proposal.
Electrical Energy Sub-metering	(2/3)		Metering and monitoring of electrical energy (1pt), metering and monotoring of thermal energy (1pt), additional pt where 1 other pt achieved AND electrical sub-metering is separate for lighting and power for 95% of building.
Lighting Zoning	(1/2)		Require all individual or enclosed spaces to be individually switched with clearly labelled switching. Individual zones should not exceed 100m2. Require an addressable (programmable e.g. DALI) lighting system to achieve second point (not currently targeted).
Unoccupied Spaces	(2/2)		Unoccupied spaces naturally ventilated OR AC designed for automatic shutdown , or designed with set-back control band.
Total:	(18/30)		

Transport:			
Cyclist Facilities	(3/3)	1	Require secure, weather-protected, bike storage area, showers and changing facilities for 3% of building staff (6% for additional point) AND student bicycle storage: 5% for 1 pt, 10% for 2 pts, 15% for 3pts.
Commuting Mass Transport	(2/4)		Points are achieved as a consequence of access to public transport from the site. No additional infrastructure required.
Local Connectivity	(1/2)		Points achieved as a consequence of the site's proximity to amenities such as banks, supermarkets, child care, gyms, etc.
Total:	(6/11)		
Water:			
Occupant Amenity Water	(7/12)	2	Require use of water efficient fixtures and fittings to achieve two points. Additional points can be achieved through use of rainwater harvesting, as well as use of greywater/blackwater systems (not currently targeted).
Water Meters	(3/3)	1	Submetering required for all major water uses in the project i.e. bathrooms, showers (for cyclists), heat rejection systems, irrigations systems, recycled water supply, etc. A system (e.g. BMS) is required to monitor all meters and consumption. Additional pt for solenoid for automatic shut-off.
Total:	(10/15)		
Materials:			
Recycling Waste Storage	(3/3)		Require dedicated recycling waste storage area suffieciently sized for collection and sorting of waste streams.
Concrete	(2/3)		Requires that the absolute quantity of Portland cement, as an average across all mixes (in situ, precast, stressed), is reduced by 30% (or 40% for an additional point). A further point (not currently targeted) can be achieved through the use of recycled or slag aggregate for 10% of structural aggregate application AND no natural aggregates are used in non-structural applications.
Steel	(3/3)		For a building predominantly framed in structural steel, at least 60% of all structural steel must have a recycled content of greater than 24% (1 point) OR for a building predominantly framed in reinforced/precast/stressed concrete, at least 60% of all reinforcing/stressing steel must have a recycled content of greater than 54% (1 point). For the two additional points, 90% of all steel (total of structural steel, reinfocing steel, and building envelope applications) has a recycled content of at least 54%.
Masonary	(2/2)	1	50% by area for 1 pt or 80% for 2 pts of the following: Clay bricks 20% perforation, concrete brick 20% perforation, concrete blocks 30% recycled content AND 10% portland cement replacement with industrial waste product.
Total:	(10/19)		
Land use and Ecology:			
Topsoil	(1/1)	1	If topsoil is present, it is a requirement to store and protect topsoil on site for reuse in the new development.
Reuse of Land	(2/2)		Requires reuse of previously developed land.
Urban Heat Island	(1/2)		Hardscape materials with SRI ≥ 29 for 1 pt; 75% of roof to have SRI ≥78 (for ≤10 ◦ pitch) or ≥29 (for >10◦ pitch) for second point.
Total:	(4/12)		
Emissions:			
Light Pollution	(1/1)		Requires that no lighting is directed into the night sky AND that façade lighting produces an average of no more than 10 candelas/m2 AND that outdoor space lighting meets CIBSE LG6 requirements for maintained illuminance.
Legionella	(1/1)		Achieved through use of air-cooled chiller i.e. no evaporative cooling systems are installed on site.
Boiler and Generator Emissions	(1/1)		All gas boilers have NOx emissions < 100 mg/kWh (at 0% excess O2) AND all generators comply with the Tier 3 emissions standards as defined by the US EPA, or the equivalent European Stage IIIA standard.
Atmospheric Deterioration Avoidance	(2/6)		2 pts for refrigerants with ODP of zero; 2 pts for 100% of refrigerant with GWP ≤10 (1 pt for 50%); 2 pts for HVAC systems in air ight enclosure AND leak detection system.
Total:	(5/16)		
Innovation:			
Total:	(0/5)		
Total Weighting %	**54**		

Source: E-GBC

10.5 Current status of energy and buildings

As stated, there is thus far one green star rated building. There are number of buildings (mostly those constructed or renovated in the past decade or so) which have incorporated sustainability features, in so far as their budgets have allowed.

This is the start of the part of the thesis that will examine factors that hinder further advancement of both sustainable buildings and sustainability in general. The rest of this chapter alludes to these elements, but they will be drawn out and discussed further in chapter 11.

10.5.1 Building and energy managers

There are no energy managers or building managers presently at UCT. Buildings manager posts were discontinued prior to 2003 (as stated by one interviewee); whereas there has never been any energy manager. Instead there are facilities and IT managers which are charge of the any complaints and issues related to buildings. These complaints are then logged with the P&S maintenance department. Details for this process were only obtained for the Engineering and Built Environment (EBE) faculty. The PSS member that was interviewed mentioned how they were only in charge of IT for EBE but the dean asked them to oversee facilities as well, so they ended up in charge of 9 EBE buildings. This shows the informal processes that happen, and which are often not predictable. Otherwise it is upon academics to log complaints, but this increases their administration workload. PSS also mentioned that the academic staff are not always aware of the P&S staff or the best processes to follow when it comes to building and energy related matters. Over time PSS has worked to establish relations and contacts; however, this is likely not the case for every faculty. This highlights the inefficiencies, especially when formal or at least well-known procedures are not in place. Even if the procedures are in place, it can still be a daunting task to identify the correct people (PSS). P&S themselves find it difficult to communicate with relevant people in departments and buildings, as they have to go through many channels (IT, facilities, HODs, etc.).

There is no specific program for retrofitting equipment for energy efficiency. Instead departments sometimes put in requests for certain offices. This was the case for a lecturer at the Energy Research Centre. After many requests for replacement of magnetic ballasts to electronic ballasts, they were eventually replaced, but only in that one office – the benefits of electronic ballasts are: energy efficiency, lower lifetime cost, less flickering and noise (Lacoma, 2017). Thus, there is no fixed protocol for complaints or modifications. Also, most academics are not aware of the technical aspects of energy saving, and even if they are, they may not be sure who to contact at UCT.

Otherwise, for replacements of fittings and equipment, the end-of-life model – only when something is broken, is it replaced. For bulbs the turnover is fairly quick and so more efficient lights are being phased in. However, overall maintenance is reactive.

At night, it is usually the cleaning and security staff that are in charge of switching off unnecessary lights. They also report to managers if anything is broken or if doors are kept open, etc. Some lights cannot be switched off for safety reasons, such as near entrances, lifts and toilets, and in some hallways and open spaces. However, many lights are sometimes still left on by students and staff (see Behavioural issues section below). There is also no way to monitor whether these staff do the above-mentioned. There are limited staff members and there is no pay for overtime.

10.5.2 Measuring and monitoring

No energy audit has been done for UCT, except in 2008, when Kramer building was audited by an academic that had an interest in sustainability. This was to measure and motivate for installation of energy efficient equipment, amongst other sustainability efforts. The proposal included a financial analysis with payback periods of various interventions (A-L&E).

As of 2016, most buildings have their own energy meters installed. There are 50 transformer meters, 50 for buildings and an additional 45-50 for generators. An external consultancy company, Terra Firma Solutions have installed the meters and they receive the electricity usage details per building. According to one interviewee at P&S, Terra Firma will also analyse the data and report back to P&S with recommendations. At the time of the write-up of this study, these reports were not available. The main goals of Terra Firma would be, firstly, to internally analyse the trends and identify any inaccuracies, and secondly, to provide each department/building with their individual usage. This is the first step (measuring) to reducing usage. There are various behavioural factors that need to be considered (these will be discussed later), however it is important for the users to know their level of consumption.

In terms of general sustainability, there needs to be more targets in place – this will also help with proper monitoring (A-EGS1). Various targets and strategies were outlined in the GCAP, however since 2012 there has been limited effort (by GCI and EMWG) in achieving them. They provide a good base; however, they could be modified to include current trends in sustainability and address issues pertinent to UCT.

10.5.3 ESCOs

It was asked in one interview (ED-P&S) whether an Energy Service Company (ESCO) could be considered for UCT. This was initially suggested by E-ES, as it has many potential benefits and could solve UCT's two main constraints (lack of human and capital resources). However, it was stated that another university in South Africa had hired an ESCO, but the experience was negative. This is because the finance department at that university assumed that this

was an unnecessary expense, and did not identify that they were paying a portion of their energy savings to the ESCO. The remainder of savings were still being achieved for the university. This is how ESCO contracts are typically (ED-P&S): they pay for and install the retrofits and then receive a fixed portion of the savings derived from the retrofits. Part of the negative experience could be attributed to staff turnover and loss of information. Nonetheless, this seems a poor excuse to not further consider ESCOs as potential partners to reduce UCT's electricity usage.

On the other hand, it was stated by ED-P&S that there is an aversion to inviting many companies to partner with UCT. In their experience, there have been many individuals or companies that have approached UCT with different products or schemes. However, P&S has had a few negative experiences (for example, the equipment breaks down and cannot easily be replaced) and this has led to a more conservative approach. Instead, stricter tender processes are followed. Nevertheless, it was mentioned by an A-EGS1 that sometimes UCT need to be more open-minded and allow innovative companies the opportunity to create an impact – otherwise it is not possible for the market around green products to grow.

10.5.4 Maintenance backlog

A key related issue is the large maintenance back-log present at UCT. An audit was done by an external company a few years ago, which estimated that the backlog was R380-400 million. This includes: periodic re-roofing; lift servings; replacement of plumbing (as old ones could have lead issues); network infrastructure; roads; surveillance; etc. Since the audit, some but limited, advancement has been made in reducing the backlog. As per some interviewees, the backlog may even have increased. This reflects the two problems that will be discussed in the next section: the lack of finances and the lack of monitoring. This backlog, together with limited money, impacts negatively on energy efficiency, as UCT does not have the capacity to start new initiatives. The lack of monitoring means key problem areas cannot be immediately identified and resolved.

As mentioned under the buildings funding section, academics can approach industry and corporate contacts for funding of new buildings. It has also been mentioned that P&S itself is under-resourced. Improved communication between the academic, managerial and operations departments would be useful; after all, the first two groups use the buildings that P&S and operations build and maintain. PSS suggested it could be an option for academics to help fund maintenance and reduce the backlog; however, it may be hard task to convince them. Eventually a plan will need to be made to tackle the backlog, but that will be when a dedicated team (with a manager) and funding is available (H-F).

10.5.5 Renewable energy

There are several universities that have implemented renewable energy – mostly in developed nations (Goldfarb, 2016); however, a university in New Delhi has plans for

sourcing green energy (Jain & Pant, 2010). It is often a combination of on-site generation and purchasing from renewable suppliers. Some universities off-set their emissions using trading schemes (EPA, 2017) – but thus far there are limited offset options in South Africa (SC&A).

South Africa has recently run a successful Renewable Energy Independent Power Producer Procurement Programme (REI4P). Several companies bid competitively to have different renewable energy projects set up across South Africa. This resulted in the electricity prices from solar and wind technology especially coming down steeply over four rounds of bids. Long term Power Purchase Agreements (PPAs) were signed with Eskom, which would then pay the investor companies the price of electricity that they won in the bidding window (Eberhard, 2014).

This has had many benefits: renewable energy prices have decreased, up to a point where grid parity was reached and some prices are lower than the new price of electricity based on coal (from the new power stations Medupi and Kusile); it has helped Eskom supply electricity over the electricity crisis and relieved pressure during the load shedding period, in 2014-5; and this has had positive economic benefit as businesses could continue running (Moodley, 2015).

There are many benefits to renewable energy, from reducing carbon emissions to improving energy accessibility. It is worthwhile for universities to consider generating their own electricity: they can reduce their carbon footprint; rely less on the national grid, thus being more energy independent; and they could save in the long term, given rising electricity tariffs.

Recently the department of Electrical Engineering at UCT conducted a study for a pilot 1 MW solar PV installation at UCT. The HOD presented this study at an EMWG meeting, and is summarised as follows: 7000 m^2 of solar panels are required, for which there is space on many large buildings on Upper; 1825 MWh energy can be generated per annum; this will save 1825 tons of carbon equivalent per annum; and the cost estimate is R22000 per kW. This would result in: energy savings of R1.5 million per annum; R0.4 million annual maximum demand savings; the return on investment (ROI) would be in the range of 6-11%; and the potential of research subsidies from dissertations based on the PV installation would be in the range of R100000-R500000.

The ED of P&S was keen to pursue this pilot study further. He suggested setting up a steering committee to discuss the numbers in detail, source funding for the installation, and set up processes to pursue this for UCT. This is a positive step for UCT, as reflected by the HOD's motivations that this project makes financial sense – besides the added benefits to the environment and research outputs.

One key challenge is to source funding of the estimated R22 million for 1 MW. The HOD mentioned that it is important to ensure that a reasonable installation cost is charged – for which a careful tender would need to be drawn up. If this pilot is successfully launched, then it will be the first for a university in South Africa.

10.6 Future capital project plans

The Physical Planning department at P&S oversees long-term, strategic, broad and detailed planning of all the spaces at UCT. It has developed a Campus Access Management Plan (CAMP) and is currently finalising an Integrated Development Plan (IDP). There are no plans for new buildings in the short term (given both space and financial constraints), however there are plans for building new accommodation and teaching buildings. Further to that, there is a project called MySpaces, which is looking to use current spaces more proactively. This is important given the shortage of space; thus, there is a need to 'retrofit' areas on Upper Campus. This includes possibly having large, shared and centralised labs that can be booked; in contrast to the multiple labs with lower occupancy rates – that leads to wastage of electricity (H-PPL).

Given the possibility of upgrades and new buildings, it is important to track the progress of sustainability in the buildings and whether the rating will increase beyond 4 stars and/or whether an 'As built' rating will be targeted. This advanced rating was not considered for NLT, as there would be an extra cost of R0.5 million, due to Measurement and Verification and accreditation fees (ED-P&S).

At the time of writing this study, a new conference and multi-use venue is being built on the GSB campus. The target is a 4 star, 'As design' rating, like NLT. There are some that are calling for an 'As built' rating, as it will add an educational component and be more sustainable in the long-term. However, there are various barriers that impede the level of sustainability at UCT, which the next section will discuss.

11. Barriers and challenges

There are a number of challenges that come with improving sustainability at a university. Many of these barriers and challenges are well-documented in the literature. This section will go through these barriers, especially those that are relevant to UCT. As will be seen, even though these challenges and barriers exist in mostly developed country universities, they are very relevant and applicable to UCT – in other words they are not isolated by geography or ranking. However, there are some unique barriers given local characteristics and constraints. This section is broken into three subsections, which highlight the barriers and challenges that exist for different levels of sustainability, related to the research question and broader contextual questions. These sections are: general sustainability; sustainable buildings; and energy efficiency and renewable energy.

11.1 General sustainability

11.1.1 Lack of awareness, motivation and commitment

These were the recurring challenges (from literature and interview responses) when it comes to ensuring environmental sustainability. There is certainly much information available about climate change and related sustainability concepts, and as mentioned in the history of sustainability at UCT, there are various research departments and groups whose core or related research focus is on the environment, climate change, energy, improved resource use, urban planning, etc. However, this information and awareness is seen as isolated and in pockets. Also, environmental initiatives seem to happen 'under-the-radar' and only get reported on afterwards. Therefore, there is lack of accessibility for the average UCT student or staff member (based on interviews with A-EGS1, A-EGS2 and SC&A).

One key student-led group that aims to raise awareness and promote sustainability through events and campaigns, is the Green Campus Initiative (GCI) society. They have played an important, yet limited, role in improving campus sustainability. The structure and portfolios of GCI is as follows: chairperson, vice-chair, treasury, and marketing (its executive) and then various portfolios – residences, bikelink (promoting renting and using of bicycles), ridelink (car-pooling), recycling, institutional development, green police (branding), and others depending on major or minor campaigns – such as Enough With The Cups and Fossil Fuel Divestment.

GCI faces its own constraints that limit its scope and depth of reach. They firstly, lack office space – this is related to the limited availability of space on Upper Campus. Secondly, there is no office or officer for sustainability; it is only GCI that is officially driving sustainability. Thirdly, there is generally limited support for student societies, as there is not enough staff or effort dedicated to developing these student leaders. According to St-GCI, the staff that oversee student societies do not provide enough formal training, or if they do, not many

students attend. In addition, during the academic year there is a lack of support or guidance. Societies are only required to submit a few reports, which are meant to monitor the progress of the society; however, no feedback is given on these reports. Fortunately, GCI does report to EMWG which has important decision makers present, thus there is some accountability and also a push for implementation (though mostly from GCI to EMWG and not vice-versa).

Another key point to make here is the lack of curriculum development when it comes to incorporating environmental topics into university courses. As mentioned in the Motivation section, education is a key component – and given that a university is an HEI, it is the ideal location to educate and raise awareness (Dahle & Neumayer, 2001). It is necessary to have integrated these topics into the coursework of students; otherwise events run by the GCI can seem inadequate. This is because events allow for a short contact period and it is often those that already have a degree of awareness that attend these events in the first place. Thus, it is important to include sustainability as part of the core teaching and learning. This will allow the university to fulfil its vision to equip students with the skills and knowledge to tackle present, real-world issues.

It is obvious that departments like EGS have environment as its core competency, as do some science degrees. However, other departments and faculties have limited scope for this. It is only the Chemical Engineering degree which has made concerted efforts to include resource management and environmental issues in its four-year program. Nevertheless, there has been an increase in the number of individual course that deal either directly or indirectly with sustainability. Of note are the courses in the GSB's MBA (and other) programs (SC&A).

Related to awareness is motivation. Although lack of motivation is not listed as a separate challenge, it is present and related to many other challenges. This point was raised by at least four, wide-ranging interviewees: ED-P&S, A-L&E, SC&A and E-ES. In fact, E-ES was previously a staff member of UCT and mentioned that initially P&S were not interested in sustainability issues, and instead saw it as interfering with their normal duties. This was experienced by SC&A, as other staff were not accommodating to sustainability ideas nor cooperative, and certain requests had to repeated multiple times before they were addressed.

Even in many other universities, the driver for environmental sustainability is not based on the moral imperative, or that climate change is an issue needs to be addressed urgently – instead, it is based on finances and economics (Dahle & Neumayer, 2001). Although many interviewees (including HLM) are aware of the non-financial aspects to improving sustainability; this is not translating into motivation for change (HLM1, HLM2, ED-P&S).

Lastly, even if there is enough awareness and motivation to change; commitment is a major hurdle. Most importantly, it is important for HLM (especially from the VC and DVCs) at UCT

to show its commitment, by: setting explicit strategies for sustainability; developing polices around environmental issues; setting clear targets (with deadlines), as mentioned in the GCAP; providing resources for monitoring and reporting on these targets; and leading by example. Both A-EGS1 and SC&A believe there is more room for P&S (and other management) portfolios to have sustainability as part of their mandate and job descriptions.

As stated, monitoring and reporting on targets, together with improved communication of success stories are necessary to advance the sustainability agenda. Reporting has improved over the past few years, mostly due to SC&A who compiles both the carbon footprint and ISCN-GULF reports. These reports collate information from diverse sustainability initiatives and provide recommendations for improvement. However, no one (individual, committee or other) holds the university or its members to account on what is reported or recommendations suggested. Given the current structures and stakeholders, the EMWG and GCI would be best placed to do this. According to A-EGS2 there needs to be someone in a HLM position – besides the director of P&S – that takes more responsibility and provides resources and support for implementation; otherwise these recommendations will remain just that.

Sometimes universities do not truly transform – they will sign up to declarations or create 'action plans' but not integrate them into university functions (as mentioned previously). They only partially adapt and attempt to layer-on changes to existing structures and practices. In other words, they "mostly symbolically adapt to new challenges, which are exogenous to them", which are due to habits and well-established practices (Kurcken, 2003: 18). This will be further discussed in 11.1.5.

11.1.2 Lack of resources

There are two main resources that are constrained and thus limit the advancement of sustainability at UCT: human and financial.

In the literature, lack of money is often a major barrier that prevents universities from transforming into green universities. Globally, universities are seeing high growth rates, but shrinking budgets (Bates, 2011). At UCT, there is a budget of around R1.5 million for sustainability. However, this comes from the P&S maintenance budget. It is mostly for reports (carbon footprint and ISCN-GULF), GCI and occasionally for improving energy efficiency (ED-P&S). There is a lack of accountability for this budget and no further details were obtainable. Since this is the only budget that is used directly for sustainability initiatives, this reflects on the lack of strategic plans and responsibility for improving environmental sustainability.

According to S-F, UCT has seen a declining reserve margin over the past few years. Currently it is near break-even point, however, if income keeps decreasing (fees and grants) and expenses rise further (electricity, labour costs, etc.) then UCT will be facing deficits for the

next few years. P&S-F further stated that austerity measures have been in place for the last 3-4 years, because in 2012 government subsidies started decreasing (as shown in figures 9 & 10). Initially increases were capped and thereafter the formula for allocation to the different universities was changed. UCT did not adjust its budgets accordingly, which led to a loss of reserves. Now faculties are expected to cut budgets even further over the next two years, by around R7.7 million each, according to PSS. This puts a limit on many initiatives, and new staff cannot be hired in many departments. There are other direct impacts as well: in 2016 there is already a shortfall of R60 million for capex according to H-PPL.

Furthermore, P&S staff are currently over-worked, especially given the new insourcing of cleaning, transport and safety staff. They cannot hire more managers due to the budget cuts (ED-P&S, P&S-F, PSS). Therefore, the onus has fallen back on academics and students to further the sustainability agenda. It is also important to have HLM show support. Besides staff, students have limited time – those that get involved with GCI, do so as volunteers. Also, it takes students longer to understand the dynamics of UCT as an institution and organisation. Moreover, student turnover is high and they are only at the university for 3-6 years. This all limits their impact, even if they have commitment.

Furthermore, there are external factors that are not within a university's control: low growth rates, nationally; fluctuating exchange rates and weaker Rand; lower investment returns; etc. These affect the finances of the university and the risks need to be managed effectively.

Given all the above, it is unlikely that a sustainability hub could be initiated or full-time staff hired in the near future. The current staff do not have enough time to initiate new sustainability campaigns, and even if they do, they will not be paid for overtime. For instance, PSS sates that there is in fact only one Health and Safety representative at UCT, and the rest are volunteers. Therefore, even this has to be incorporated into the daily work of current staff. In reality, the duties get devolved to staff on lower levels, as there is a lack of both time and responsibility. Hence it is unlikely that sustainability will be driven by some staff.

There has been talk of starting a green (revolving) fund. This has been successfully implemented at Harvard. This could comprise of contributions from say, staff and students that use air travel and want to offset their emissions. They can pay an emissions levy, which could start up the fund. This money can then be used for green projects, including those that have quantifiable savings and payback periods. A second option is for UCT to use green bonds, and invest it in green buildings. Thereafter, the savings can be used to pay back the bond with interest (SC&A, A&HLM). The third option is to leverage green climate funds and agencies that want to invest in green projects in developing countries. Yet another option is to source some funding from government departments that have budgets related to climate

change, including DoE (Horhota et al., 2013). Once again, someone has to take responsibility for overseeing and coordinating this.

Decisions affect costs and vice-versa and thus there needs to be a good balance, together with measures for monitoring. PSS says there is often a conflict between what is good for UCT in the longer term and the day-to-day activities that need to be taken care of. Financial and human resources may be limited, but there are different ways of efficiently allocation them. UCT has yet to allocate enough to sustainability initiatives.

11.1.3 Competing priorities

A university is a large, multi-faceted and complex institution. As stated earlier, the core functions of a university can be described as: teaching, learning and research; and based on this the two main stakeholders are academic staff and students. However, as has been discussed thus far there are many more people, operations and processes that are required to ensure smooth and efficient running of a university, and for it to meet its vision and goals.

As discussed above, and stated by A-L&E, sustainability is also low on the motivational hierarchy and often gets pushed down the priority list. Besides the challenges present with advancing environmental and climate change issues (broad and abstract); it has to compete with a number of other goals, motivations, issues and interests at the university. In terms of P&S, the priorities are dependent on: money, time, people, resources and attention. And oftentimes sustainability does not receive enough of any of these factors. This is reiterated by Sharp (2002: 7): "If we do manage to get the environmental imperative on the agenda of university decision makers it is often seen as a late arriving competing priority that will have to wait its turn to be addressed – and who knows when this will be". This was echoed by A-EGS2 who believes that sustainability is seen as an afterthought at UCT.

Other social transformation issues have also been low on the priority list. However, in recent times, some social issues have come to the forefront due to student protests. These matters are also important and in the past, they had not received enough attention. This is unique to UCT, as a university in a country that has many competing socio-economic problems. Although these issues are not in direct competition with environmental ones, their impact is felt, given the lack of resources discussed above. However, instead of seeing environmental issues as a competing priority; more focus should be given to addressing multiple transformation issues, by using more holistic and systems-orientated approaches. There are many examples where social, economic and environmental problems are interrelated, thus more emphasis needs to be placed on collaboration instead of competition – especially when resources are already scarce.

However, competing priorities do lead to trade-offs. One specific example of a trade-off is spending towards maintenance of buildings and equipment versus improving energy

efficiency. Given the high maintenance backlog, it is imperative to reduce it where possible, as in some cases delays to maintenance can lead to greater inefficiencies. For example, replace one air-conditioner which is inefficient but expensive versus 50 bulbs that are comparatively less inefficient but cheaper to replace. P&S Maintenance has to weigh up the priorities and resources available to make the right decision, as often only a portion of the budget requested is given (due to reasons discussed above). In general, they have a plan but it is flexible and dependent on the (lack of) resources. Also, operating expenses do not receive nearly as much attention as capital expenditure; even though the lifetime of a building can be very long.

According to ED-P&S universities do not often give up on certain goals – thus various issues get layered on top of each other; leading to a lack of resources. Cohen, March & Olsen (1972: 3) state the importance of understanding "the attention patterns within an organization, since not everyone is attending to everything all of the time". Given this, there are pros and cons to having strategic plans: until resources are made available, there will constantly be trade-offs, so a decision needs to be made about priorities and this needs to be communicated to relevant stakeholders. Or more long-term, systematic and transdisciplinary plans need to be identified. Ultimately, these strategic plans need to translate to action plans and practical implementation.

Even for the DHET, the priorities for capex funding allocations are: student housing, maintenance, and improving accessibility for disabled people. So even when UCT applies for funding, they are restricted by the categories provided by DHET. This, together with the campus strategic and long-term development plans, dictates where funding is allocated (HLM2).

A comparative case was found from a Melbourne university, which had very similar stagnation and lack of progress with regards to sustainability. Their property services unit is also tasked with improving sustainability, but the "lack of priority, tradition and value for implementing sustainability initiatives within property services practices have been the dominant barriers to change. As a result, initiatives to achieve changes within campus infrastructure, facilities and utilities have been ad hoc and generally short lived" (Bekessy, Samson & Clarkson, 2007: 9). They also have strategic plans that do not explicitly account for environmental sustainability. Furthermore, competing priorities and lack of funds led to the failure to appoint an energy manager. UCT is in a very similar situation.

11.1.4 Lack of coordination

Given the range of people and departments (academic, managerial and support), each will have its own set of mandates and priorities. Also, given that a university is bureaucratically structured, the top-level management has to oversee the workings of various departments and then allocate resources – money, labour and other support – accordingly. At the same

time, there will be various processes running in parallel; and even though there is autonomy, some coordination across the organisation is necessary.

The main point under this section is that UCT does not have an office nor an officer for sustainability. This was mentioned under 11.1.1, where GCI is seen as the main body promoting and raising awareness around sustainability. Since there are many faculties and departments, together with a range of sustainability issues, it is important to have a central coordinating hub or office to oversee all aspects related to sustainability (such as the ISCN principles mentioned before). Also, it would be difficult for an academic department to deal with day-to-day physical operations of UCT and to monitor the varying elements of sustainability. Instead it would help (especially management) to have one group which monitors, reports back and drives environmental transformation. Given the current lack of resources, it does not need to have a physical space, but should at least help with sharing of knowledge and resources, and promoting collaboration.

Coordination between different stakeholders and governance groups is important; yet can be difficult, because of the complexity of the organisational structure and range of decision-makers (Sharp, 2002). Furthermore, since the institutional structure and organisational culture take time to change – it would help to have an independent and flexible body such as a Sustainability Hub. In 2011 more than 75% HEIs in North America had full-time staff overseeing sustainability, and more than 50% had a central office (Finlay & Massey, 2011). And over 2007-2010 universities with a sustainability coordinator doubled in the US alone (Kurland, 2011).

According to A-EGS2 there are some unanswered logistical questions for setting up a sustainability hub, such as: where in the UCT system it would sit; who will be part of it; who does it report to; how much power does it have; will it compete with other groups; will academics have enough time to be part of it; where will the funding come from; and other practicalities to having a physical hub. Some of these were answered when PASE (discussed under 'History of sustainability policies') was being set up, however, it did not come to fruition, mostly due to the challenges discussed thus far. More commitment is needed if this is to be successful in the future. However, for the time-being – given that sustainability is advancing in pockets – these agents of change need to coordinate and share resources and networks more effectively (Velazquez, Munguia & Sanchez, 2005).

Besides the different levels of staff that are key decision makers; there needs to be engagement and cooperation between students and staff. Student governance bodies like the SRC have an annual turnover, and it is often the case that major reform topics and transformation themes change every year depending on the leadership group. Staff need to help with effective communication and management, as they are there for longer periods of time, and if there is any unfinished business there should be processes in place to complete them. This has happened to GCI, on more than one occasion in the past, where due to

changes in the SRC office, GCI was hindered in its tasks. This does damage to the green movement on campus and is a barrier towards greater environmental transformation (St-GCI).

However, another challenge that is not often considered is staff turnover. This applies for all levels of staff. According to PSS, deans have short to medium term contracts, while HODs rotate every 3-5 years. New members are then in charge of making important and strategic decisions, however handovers are not always done properly and information gets lost in the transition. Academics also go on sabbatical and thus processes stagnate or are not completed properly. This can all lead to loss of institutional memory; A-EGS1 said that more succession planning is required. Moreover, academics primarily want to teach and research; but other administrative duties are thrust upon them and some just do them for the sake of doing it. However, there are now office managers (at EBE) that help with this knowledge and paperwork transfer (PSS).

As stated in chapter 7, sustainability is both a process and end-goal. Thus, change will take place incrementally. As HLM3 stated, both collaboration and coordination cannot be forced; but need to take place organically and in a manner that may seem haphazard. Often, informal networks are formed first; thereafter, pathways of action are found; and lastly, formal avenues are explored or new ones are defined (Arnaboldi & Azzone, 2005). This can be seen with the green building policy: information was first sought, and two people advocated for change and eventually a policy was created in a formal setting.

11.1.5 Inertia to change

Inertia to change is closely related to the institutional structure and organisational culture of the university. As described in pervious sections, the structure of a university is bureaucratic and quite rigid. There are specific rules, norms and procedures to follow – for both everyday processes and for new ones. However, when it comes to implementing something new, there is inertia to change. But before that, the person or people that want to create change need to firstly understand the status quo, what the procedures are, who to speak to, and finally what needs to be done to modify or initiate something new.

This process takes time and can be discouraging, especially if students are involved (be it individually, as a group, or even as an official society). For example, the GCI has a portfolio called Institutional Development, which aims to deal with the physical campus and broad policies relating to campus-wide sustainability. They have struggled to develop new methods or ways of thinking, and have had agenda items that have continued over multiple years. According to St-GCI, management seems to be happy to provide the bare minimum and not much more. It up to the students to continually engage and push for change, as otherwise things do not get done on time. Students also have limited time given their studies. On the other hand, it is important to have more students engage with various socio-economic, political and environmentally related topics, as this shows that students care and

want to see change. This also then requires engagement and collaboration with staff, which could catalyse change and overcome the barrier of inertia. Students are the future leaders and workforce; therefore, this engagement could provide valuable experience. One of the recent slogans of SRC sums this up well: "Where students lead; institutions are reimagined" (Email correspondence, 2017).

Inertia can also come from habits and norms which makes change harder. This also has to do with mind-sets and the willingness to adapt. For example, according to ED-P&S and PSS some academics have been at UCT for a long time and are 'set in their ways'. So when new policies and procedures are proposed, there could be resistance to changing habits. Therefore, it is important to include many role players and encourage input from both top-down and bottom-up. This will help facilitate change across the middle and horizontal levels.

According to SC&A, in the past UCT has shown a certain institutional reluctance for innovation and change regarding environmental transformation. There is a lack of pressure, to shift from the status quo, from outside (government and society) and inside (any of the mentioned stakeholders). Johnson (2001: 14) elaborates on this problem: "because of the traditional, bureaucratic nature in most institutions of higher education, some senior administrators are unwilling to try a new technique unless they are in a crisis situation and may have failed to meet their budget". University institutions also show path dependency, and "new ideas only slowly diffuse into practice, and the orientation toward historically entrenched concepts plays a much stronger role" (Krucken, 2003: 3). This is often a critique of institutions; however, academic institutions have the opportunity to lead and showcase its strength amongst new challenges, especially given the knowledge and expertise that is housed within it. Ultimately strong leadership is required – not just from management – but from other staff and students as well. UCT stands to benefit from being flexible and willing to transform with new times and priorities.

James & Card (2011) offer a different suggestion: attempts should be made to accommodate individual faculties and departments as far as they want to get involved – instead of pushing inter-disciplinarity and using a blanket approach. This sentiment was also echoed by HLM3. This approach is most relevant when attempting to integrate sustainability into the curricula – rather than forcing (top-down) processes; each department should have room to tailor make and adjust their courses at their pace, with available resources – thereby also overcoming inertia from the bottom-up.

11.1.6 Risk aversion

Universities are relatively conservative and risk-averse compared to other institutions and organisations, especially corporate ones. Public universities and state-funded and thus have an obligation to spend wisely, and sometimes they have reforms and restrictions placed on them by government. This limits the scope of their spending and thus may not be able to

prioritise large sustainability initiatives, such as installing or utilising renewable energy. This is reflected under the finances at UCT section, which speaks about ensuring financial stability for UCT. It describes the limited use of debt and investment income, and that capital expenditure must be in line with strategic plans.

However, given the recent financially constrained environment, according to ED-F UCT is now looking more closely at debt options and quantifying how much income would be needed to cover interest expense. In fact, the new finance director has already sourced debt (at a lower interest rate) for UCT. The money from the loan has not yet been allocated, as it will depend on financially sustainable projects. The loan amount is large and can be used for building projects, but that will be at the discretion of the finance and P&S directors, and other high-level management and capital projects staff. Otherwise, it is likely that if a department or group needs the money, it must provide a good business case for it (ED-F, P&S-F).

The last point is applicable if one wants to use the money towards energy efficiency. But before that, one needs good estimates, which depends on data that is measured (which is still a work-in-progress). The Finance Director of UCT is also planning on bringing in more corporate-like strategies in the future; this is especially important given UCT's recent declining surplus and reserves, and loss of fee income (ED-F, P&S-F). This is in line with global trends of entrepreneurial universities.

11.2 Sustainable buildings

Note that the above general sustainability barriers and challenges still apply when it comes to buildings. What follows are more specific barriers that were discovered through the case study interviews.

11.2.1 Actual and perceived higher cost

As has been mentioned previously, a key theme for this research is the funding of universities and its effects on capital and operating expenditure, and on the sustainability level of buildings on campus. When the initial proposal came for making all new UCT buildings minimum 4-star rated (in 2009), one of the first concerns was regarding the higher cost of green buildings. It is important to note that at that time, the GBCSA was still new and relatively few buildings were making use of the rating tools. This implies a new and emerging market around green buildings as well (see next section).

Often when one thinks of a green building, one may imagine that many technical retrofits are required – however this is not always necessary for a sustainable building. This issue was highlighted by Richardson & Lynes (2007), where staff misperceived that green buildings had technologies with long payback periods; and thus were averse to constructing sustainable buildings. In fact, as per the architects interviewed for UCT buildings (and in the

literature), the first aspect of green buildings is good passive design. This includes ensuring the orientation is correct, windows and doors are sized and positioned appropriately, and shading is used – to ensure optimal light and heats gains. This lowers the energy use for both lighting and air conditioning. The rating tool also encourages Integrated Design Process (IDP). This allows for holistic designing and management – and if done well, can lead to lower capex and opex costs.

The 'Guide to Costs and Trends' booklet, which was recently released highlighted the increasing penetration of green (office) buildings in South Africa and decreasing green cost premium – which is defined as "the additional cost of green building over and above the cost of conventional construction, expressed as a % of the total cost of the project" (GBCSA, ASAQS & UP, 2016: 8). The conclusion was that the average green cost premium was 5% over conventional buildings. However, this range varies from 1%-15%, depending on: rating level (the higher the rating, the more the cost, but also less variance); location (higher in Western Cape); size (larger projects had a lower premium); date of certification (there were no clear trends, as the market is still fluctuating); and tenant mix. The largest cost premium is attributed to the Energy credits. Furthermore, if a higher rating is targeted, then the architects, client and builders can add more equipment, technical elements and use different materials to increase the sustainability level of the building. These are often the aspects that can lead to a higher cost.

According to E-GBC and SC&A, the cost of a 4-star building will soon be on par with a normal one (if there is an extra cost it is likely only for the accreditation). When the GBCSA was first established, costs were about 10% higher for a 4-star, but since then there has been a decreasing cost premium. One finding of the Richardson & Lynes (2007: 7) study was that there "was consensus amongst permanent university staff that green buildings have a higher capital cost to design and build, while sustainable building 'experts' that were interviewed asserted that green buildings had equal or lower capital costs". This was also a finding from this research.

University buildings are unique in that the owner and occupier can be seen as the same (even though there are a variety of users: this will be discussed under 'Split incentives' below). This contrasts with the commercial sector, where the developer, owner and users are different. Each has their own profit-maximisation to consider and it may not be in the interest of the owner to build sustainably, especially if they will not be paying for energy. This is not the case for a university, as it must pay its own bills. This also provides motivation for the university to consider investing more upfront in sustainability and realise savings throughout the long lifetimes of its buildings.

11.2.2 Incomplete cost analysis

One of the categories in the GBCSA's rating tool is Management, and under this credits can be earned for Life Cycle Costing (LCC). LCC analysis allows one to "account [for] all costs of

acquiring, owning, and disposing of a building or building system. LCC analysis is especially useful when project alternatives that fulfil the same performance requirements, but differ with respect to initial costs and operating costs, have to be compared in order to select the one that maximizes net savings" (Fuller, 2016). The savings can then be used to motivate for a higher initial cost, if necessary. The key concept of LCC is to consider the value of a building over its life and this theme is reflected in other categories of the rating tool. These methods encourage long-term and holistic planning: the focus of the green building rating is on the environment and people; while the LCC is more a financial analysis. This also speaks to the inclusion of externalities into decision making (often the externalities in energy generation, especially from fossil fuels, are ignored).

However, the process and results of a LCC are difficult to implement at UCT, as the operating and capital budgets are kept separate – in other words, the initial project budget (discussed previously) is determined without considering any aspects of the operating and maintenance expenses, over the life of the building. Thus, any operating savings cannot be properly accounted for, and therefore cannot be used as motivation for a higher initial budget. Until this is corrected, there is no direct value to doing the LCC. UCT would also lose out on any energy savings later in the life of the building, which implies greater electricity expense and higher carbon emissions. This reflects that short-term views are emphasised over long-term planning.

Another important point to note is that there are not many experts in calculating the LCC - as it does require a lot of work and a specific skill set. Also, not many clients (generally in Cape Town and South Africa) require this, so oftentimes it is not even considered. Thus, for now, it is not a standard or norm that is followed or required in South Africa. Furthermore, in South Africa people are reactive to issues like maintenance and future operating costs. Therefore, the entire building sector needs to develop, and here government (which owns many public buildings), can be a driver and leader (E-QS).

In addition, the operational budget is small and partly based on a certain percentage of asset replacement cost, which is 0.75% for UCT. This is meant to go towards maintaining the asset or the building. This is relatively small, and it cannot be used towards implementing energy efficient initiatives. Moreover, the operational budget is one pool, and not disaggregated according to individual assets or buildings. P&S maintenance department has to prioritise items on the maintenance backlog (around R400 million) and spend accordingly. In this way maintenance is quite reactive. They are not incentivised to invest in retrofits, as they are a once-off cost with no benefits, for P&S (Richardson & Lynes, 2007). Johnson (2001) highlighted this as a common feature for many universities: including the fact that most funding is received for new capital projects and not for maintenance. This then leads to trade-offs and also affects renovation projects. It was interesting to note that multiple interviewees brought up the issue of the large maintenance backlog, when it came to investing more for sustainable buildings or energy efficiency. This speaks to barriers

discussed thus far: competing priorities, lack of resources, lack of commitment, split incentives and this section.

Lastly, as mentioned under the 'Funding of a new building' section, a per square metre cost is worked out, depending on the faculty and its requirements – which then informs the final budget. One flaw with this process is that detailed designs are not considered at that initial stage. Instead, a few equations (accounting for occupancy rates, number of lectures, other faculty requirements, etc.) determine the cost per square metre, which ultimately becomes a cap for the budget. This type of estimation is restrictive and an incomplete way to arrive at the budget; especially if more sustainability features need to be considered. Also if costs rise during the final design or construction phase, often sustainability features are the first to be reduced (PSS). UCT may need to look at improved ways to determine the initial and final budgets, as currently this is a top-down and one-directional method – which could lead to the perception that a green building is unaffordable. In addition, even though a contingency is built into the budget of a building, there needs to be an adequate escalation in costs incorporated, as these projects can run over multiple years and there is inflation uncertainty.

11.2.3 Emerging green market

Given the relatively young age of the GBCSA, the market around green techniques and products is still growing. Some materials are difficult to obtain or are expensive, such as recycled-content concrete, sustainable timber, or double-glazed windows. Whereas others are more easily available now and becoming the industry norm, such as low VOC paint and recycled steel. GBCSA's technical manual helped to drive this supplier market transformation, and they managed to piggyback on Australia's GBC progress (which was also fast). As with most markets, the greater the demand (prices may increase for a while) but supply will rise and this will lead to lower prices. Also, the higher the demand, the more the market expands and innovates. The trends discussed above reflect this.

According to E-ES the moral imperative to build sustainably is still lacking in South Africa. This contrasts with some European countries and universities. There university members see the onus on themselves to transition to sustainable universities or are mandated through government policies. The South African policies and acts related to energy efficiency were discussed previously, have also helped advance the market; however more can still be done to encourage all electricity consumers to be more prudent.

There was also talk of getting government to subsidise green buildings directly, given the various motivations stated at the beginning. Several South African universities could come together to advocate for this. There was only some discussion around this with SC&A and the previous ED of P&S. This could be pursued further, because as mentioned above, the inertia to change barrier can be overcome through external means.

11.2.4 Heritage Western Cape

UCT Upper Campus is built on a heritage site. Therefore, it has a number of restrictions placed upon it, when it comes to modifying or building new structures. This was particularly a problem for NLT. The plans had to be completely changed to conform to the restrictions and this took extra time and money. Certain heritage rules also restrict which exterior materials and colours can be used for buildings, as they affect the aesthetics of the whole campus. For example, a specific 'university plaster' had to be used on the exterior, which allows for creepers to grow on it (this is the same for all the buildings that face the city). Also, any stainless-steel structures should have creepers growing on them. Both aspects are hard to maintain but have to be complied with. This can limit the scope for sustainability, as alternative materials may be more cost effective and thermally efficient.

Besides the heritage issues, according to ED-P&S there are internal problems when some academics or other staff want UCT to look like it did decades ago. This could include wanting buildings to retain their authenticity or original features; however this has cost implications and could negatively impact on its sustainability level. On the other hand, there are managers at P&S that want to incorporate new materials and features into buildings, but are restricted by heritage rules.

11.2.5 Inefficiency in committees and structure of organisation

It is important to provide foreground to this section with: "Universities are multi-structured, complex organization that exists without any single observation point or any single control centre from which university wide changes can be programmed and implemented. Further to this there are numerous subcultures of decision-making styles, time constraints, priorities and experiences that exist within the university organization and varying degrees of differentiation between schools and also between students, administration and faculty within schools" (Sharp, 2002: 6). The latter part speaks to the barriers uncovered in section 11.1. The former part is unpacked in this and the next section.

Firstly, there are various groupings and committees across UCT and they often interact with each other. However, given their large number and range, there can be an issue of redundancy, especially when some of the same people sit on the different committees. There is also the risk that this prevents better accountability and could be a hindrance for more progressive and sustainable buildings. An example of this is can be seen with EMWG: it is a working group with limited decision-making power and it has many of the same people on the committee, such as the ED of P&S, the director of Physical Spaces and other members of UB&DC. It also has a limited and often repeated agenda. This prevents it from truly being effective and transformative.

Conversely, it helps to have the same members from other committees, as they are aware of the agendas and broader issues brought up in those meetings – they can help clarify any

issues quicker and any conflicts in priorities or limitations (especially in terms of the budgets) can be highlighted immediately. The main purpose of these smaller and focussed task teams or working groups is to address specific or niche topics. Often the higher up a committee is, it has more items on the agenda and less time to discuss each item with proper deliberation. Hence the reason why there are several committees and substructures that deal only with new building projects. Nevertheless, it is important to ensure that efficiency does not decrease with increasing number of groups, in other words there is decreasing marginal utility. Ideally someone (preferably in HLM) should audit the effectiveness of individual committees and/or their relations with other committees and groups.

Secondly, a related point is the interactions of the various internal committees, with each other, and then with the external parties: architects, engineers, quantity surveyors and range of consultants (especially the green building consultant). Three interviewees (ED-P&S, E-ES, SC&A) mentioned the importance and need for a better Integrated Design Process (IDP). This is actually a methodology present in the building industry and speaks to the way in which designs are formulated from the initial conception phases to the integration of user requirements to the final design and construction phase. Building a new building is a time and resource intensive process, and there are various steps that need to be carried out. Hence it is important to have a set procedure (that everyone involved is aware of) to facilitate efficiency, creativity and ultimately achievement of the client's requirements. E-ES also noted the importance of having a systematic energy management process in addition to IDP. This is discussed in the following sections.

Thirdly, a more fundamental inefficiency could be the number of committees and groups present at many universities these days. According to E-A2 universities often create new committees and task teams to delegate responsibility, but this results in even less implementation. Krucken (2003: 18) states that a university's "typical organizational responses [are] the creation of representatives and offices. These responses are not intended at fostering institutional change. On the contrary, they allow universities to adapt to broader societal expectations without risking too much institutional change". This is counterintuitive to the purposes of committees.

Fourthly, sometimes in the UB&DC and UC meetings there is much debate about various issues. This lengthens the process and makes it more difficult for architects to meet everyone's requirements. At times, academics are not best-suited to make decisions for a building, even if they will be the users. Extensive debate can become problematic when academics argue on details and it is then up to H-PCW to interpret and make the best decision; unless an academic has enough power and overrides the decision (PSS). In addition, academics have other teaching and research responsibilities, which impact on their time and workload. It was asked in an interview whether some positions on committees cannot be taken up by more consultants, but it was said that firstly, there is not

enough money to hire more consultants, and secondly, academics do not want to give up control of decision-making. Velazquez, Munguia & Sanchez (2005: 4) highlights this issue: "Even though this organizational structure allows more people to provide inputs into decisions, consensus on campus is rarely reached. As a result, sustainability leaders limit the scope of their initiatives to one building or one academic department". This contrasts with how it is done for other (corporate) clients. There is a clearer mandate and fewer people to work with when building, say a corporate building. Also, for developers, they aim to ensure profitability and so the processes will be quite different.

Fifthly, another disconnect is that central finance (UFC) is more involved with new buildings than P&S Finance, even though P&S maintains and operates the buildings after construction. P&S-F said it is important for their department to be more involved in decision-making and to be included in UB&DC. There is a perception that Finance often imposes restrictions – so they are not as welcome with the architects, engineers, etc. in UB&DC. But according to P&S-F, they need to be given the opportunity to understand others' points of view (for example, sustainable buildings) and to give input (the various trade-offs). Further decision-making processes and challenges for a university are discussed next.

Lastly, beyond this, for sustainability in general, the specific facets of university organisational structures lead to inefficiency. This is summed up by Velazquez, Munguia & Sanchez, (2005: 3) when they mention that the "lack of integration [is] due to its decentralized management, bureaucracy, students and faculty turnover, and many non-standardized processes." They go on to state that risk-aversion leads to lack of opportunities; which is exacerbated by lack of inter-disciplinarity. Shriberg (2002) notes the importance of having cross-institutional tools that surpass divisions and departments across the university. The next section will discuss the third component of university governance.

11.2.6 Decision making processes

According to four interviewees, there is a fairly democratic decision-making process. According to ED-P&S, this slows down the process, as everyone has a voice and often each one carries weight. This is in contrast to how decisions are taken in a corporate organisation – there is more bureaucracy, less negotiation and not everyone's complaints are taken into account. At a university, there are a number of committees and groupings, and the purpose of some are to hear everyone's views and opinions. SC&A also echoed these views and stated that it is harder for decisions and policies to be implemented consistently. There are also complications for managers when they have to account for everyone's views. According to HLM3, this process of decision-making is important, as the university is a large and complex institution. Academics are an important group, as they teach, conduct research and interact with the other large and important group (students). Their insights, experiences, and opinions are vital to the on-going operation of a tertiary institution.

This was also stated by ED-P&S and A-EGS1: opposing voices are necessary as they generate new, competing and creative ideas – which is important if the institution aims to be flexible and dynamic. It is important to note that not everyone will be thinking about sustainability all the time, so it helps to have stakeholders lobbying for their interests. Also, if there are many like-minded people on one committee, the best decisions may not be taken, as all factors may not be accounted for.

One example of this can be seen with the demolition of Snape instead of renovation: A-EGS1 who was on UB&DC was initially opposed to the idea and thought it was a waste of resources to rebuild. However, A-EGS1 now agrees it was a good idea and it has become a more functional building. The only problem is when it comes to certain buildings and operational topics, the multitude of voices can be more harmful than useful, especially if too much time is spent on trivial matters.

It is important to note that all universities are unique and even amongst South African HEIs, there is a difference in how decisions are made, committees are set up and so on. Ultimately, a balance needs to be struck to ensure effective decisions are made, and they need to make sense for the university in the short and long-term. H-PPL mentioned that more people need to think of creative of solutions, and not just see it as job that needs to be completed.

A key issue that arises is the lack of responsibility for sustainability – this is largely since it has not been delegated to anyone at UCT, and so it is harder to make clear decisions regarding sustainability. Current initiatives are driven by champions, those that can commit time, and those that have some knowledge about the university structures and processes. There are few people that possess all three, and this stunts the growth of sustainability at UCT (SC&A).

Lastly, when making decisions, one needs to consider long-term strategic and sustainable planning versus short-term priorities and gains. There is a constant trade-off and tension between the two – not just at a university, but for many other organisations and businesses as well. Given the staff and student turnovers, it is easier to make decisions for the short-term. Moreover, staff KPAs are often based on short-term, tangible and quantifiable goals. This impacts their decision-making processes. However, the vision and goals of the university are for the longer-term and cover a range of aspects, which require proper planning and good foresight. This is easily seen with designing buildings, as they need to last for many decades, and given the constraints at UCT, retrofitting and investing in energy efficiency is not often considered. Besides that, sustainability as a goal is a long-term commitment and requires decision makers to be aware of the challenges and barriers (together with the institutional frameworks), to ensure the best decisions are taken for the foreseeable future (Horhota et al., 2013).

11.3 Energy Efficiency & Renewable Energy

Once again, the following barriers and challenges are in addition, and follow on from the previous ones. Some of the barriers are repeated, but they provide more detail in the context of energy efficiency improvement or the inclusion of renewable energy on campus.

11.3.1 Financial constraints

This is a recurring theme and the effects of limited funds are more evident at lower levels. UCT has made progress in some regards around energy efficiency: incandescent lightbulbs are being phased out to CFLs, and more recently LEDs; solar pumps and heaters installed in some residences; policy of no air conditioners in office spaces; general awareness raising about decreasing consumption; and most recently the installation of building meters which will measure and monitor usage, which will help towards reducing energy further.

Firstly, an activity that has been delayed is the auditing of UCT's buildings and their electricity consumption. There was a short audit done for the law building, Kramer, over 2008-2010, analysing the potential energy reductions and monetary savings. This was a thorough study and audit conducted by an interested academic in that department and his student. Funding for the audit was made available via the Law department which is housed in Kramer (A-L&E). The results of the audit showed many potential savings by changing light fixtures, types of bulbs, using motion sensors, and reducing the number of light fittings. A pilot study was also done, with some of the above-mentioned recommendations. The potential for energy usage reduction was 70% and an annual saving of more than R60000 could have been achieved (Herbstein, 2008 and Grimwood & Herbstein, 2010).

This small audit gives an idea of the potential for reductions and savings. If more money is invested in conducting a wider audit, UCT management could have a better understanding of the potentials. However, firstly there are other priorities (e.g. maintenance) that take precedence over hiring external consultants to do an audit (as there are no staff at P&S that could do the audit themselves, due to lack of time and skills). And the funding for a large-scale audit would have to come from the capital budget; not maintenance (as they would only oversee implementation).

Secondly, even if an audit is commissioned, it is likely that UCT will not have the money to implement any recommendations from the audit (which would be a similar result to the Kramer audits). Therefore, even though the energy savings would be recurrent, there is no funding available for the initial investment of replacing existing fixtures. Nevertheless, there has been improvement in energy efficiency in recent years (as highlighted in figure 18 in section 8.7); without which the electricity bill would likely have been larger.

Thirdly, A-L&E noted that there was limited awareness at the time of the audit about sustainability (especially at UCT) and there was also a lack of motivation (from P&S) to

pursue the recommendations from the audit. This speaks to the general barriers to sustainability discussed above. Nevertheless, this audit shows the impact of bottom-up approaches. It was interested individuals that saw a lack of sustainability, identified an opportunity in their own department and funded their own initiative, to completion. Ultimately, funding and budgets are a key enabler and hindrance to sustainability and all things sustainability-related.

11.3.2 Lack of data and imperfect information

Measuring and monitoring are key recurring themes in the literature (Filho, 2000; Sporn, 2001; Dahle & Neumayar, 2001; Jain & Pant, 2010; Kurland, 2011).

The reasons for a lack of a campus-wide audit were discussed above. However, the implication of this is that UCT management and operations department do not have all the information about its energy usage. In other words, there is incomplete data about: who the big users of electricity are; if there are any anomalies in energy patterns; if there are large and inefficient equipment that are consuming too much energy; etc. This lack of information does not allow for effective management of energy consumption and there could be large energy saving opportunities that are not being identified. Moreover, there is no energy manager to oversee this (which reflects on barriers mentioned in the first section). This contrasts with many universities in other countries, which have energy managers, that are part of operations (Dahle & Neumayer, 2001).

As stated previously, energy meters have largely been installed on a building level. One of the main reasons there was a delay in installing meters (which took over 7 years since first proposed) was lack of money and commitment. As of 2017 all meters should be installed, and reports will be generated by an external company that has been hired to monitor and analyse the information. However, up to the time of the writing of this paper, no information was disseminated to the users of the buildings. UCT P&S still have to work out the best way to collate and disseminate the information to incentivise reduction in consumption. It was also mentioned that after all the data is available, UCT plans on conducting detailed analyses of a few buildings at a time, when time and resources permit. This will also allow for more targeted reduction strategies (H-M&O, ED-P&S).

The ED-F mentioned that there is a need for more indicators, such as: cost of buildings per square metre (prior to and after construction), kWh usage per square metre, and other indicators related to property rates. This was echoed by H-M&O and that there is also a need for improved recording and collating of information. Currently, there is no information management systems; in addition to a lack of building and energy systems. For NEB and NLT monitors were installed to showcase the usage of electricity and provide users some information related to the building. However, the monitor in NEB was disconnected (and no-one has since reconnected it), while the other one only shows the UCT bus timetable (H-PCW). Even though some staff are aware of the problem; it is yet to be fixed.

One Denmark university set up an integrated system that monitors buildings, energy and even security. It combines data from multiple systems, however it saves on costs as it runs on a single network. Their energy managers are better equipped to manage energy and real-time data can be shared with multiple users (Bates, 2011). Petratos & Damaskou (2015) emphasise that "sustainability management strategies for campus energy conservation which make the most of building utilization include optimum scheduling, registering students to full-space capacity, sequential space occupation, shutting down power to unused buildings and reducing energy inflows to buildings during off peak hours". However, given UCT's lack of resources, it is not likely this solution will be considered soon.

Some data is available and this feeds into the carbon footprint reports. However, the compiler of the data and information has to request P&S multiple times to get access to the data. Lack of time is often quoted as the reason for this; but it is also related to sustainability not being a high-enough priority and this is seen as an extra task to the normal activities. In the past when the compiler had a good working relationship with one staff member of P&S, the process was smoother. This reflects that it is sometimes informal relationships and processes that are more effective (SC&A).

Furthermore, it is important to share achievement of targets and successful initiatives, and to regularly update the UCT community about progress (or even lack of) around sustainability. This consistent presence can raise awareness and further the cause of mainstreaming sustainability (Filho, 2000).

11.3.3 Split incentives

The university has many different levels of decision makers, staff and students. As discussed, the university is a hierarchical organisation, with some horizontal interaction. Another distinction is between operational and academic staff: the two groups do not interact much, especially with academics not as aware of the people and their roles on the operational side of UCT (that is, P&S). Moreover, there is a split between the way electricity is paid for at UCT. It is the academic and administrative staff and students that consume most of the electricity, however, it is P&S that pays the electricity bill. Each faculty does pay per square metre to P&S, which covers: electricity, insurance, telephone, and cost of maintaining space. This goes to P&S, which is how they recover part of the electricity expense (PSS). However, electricity is not explicitly account for. More importantly the amount paid square metre is fixed and not dependent on the actual usage of electricity for that building, department, division, or individual.

This implies that there is no incentive to reduce personal consumption, as one is not directly seen to be paying for it. This split incentive issue also makes it more difficult to raise awareness and promote reducing electricity consumption. The next section also discusses a related issue: any savings that are made do not go back to the departments or faculties that saved; instead it would go in a pool that P&S manages. Thus, what would normally be an

incentive for saving electricity, becomes a disincentive in a university departmental context. Given that there is no energy manager, P&S has to develop new methods to deal with split incentives, especially if electricity tariffs keep rising. According to H-PPL, there may come a point where departments are charged directly for electricity. This will require a new policy, and will likely be linked with how space is used. Also, with the new space and property related plans, more ideas around maximising space and optimal energy utilisation will be needed.

Besides this, P&S has limited control over the volume of consumption (dependent on users) and tariff (dependent on Eskom and the municipality) – which means it has a lack of control over electricity expense. According to one P&S interviewee about 20% of expenses are within their control; of which 12% is for maintenance. This once again shows the disconnect between the different members and stakeholders at UCT. It is thus up to the users to adjust their behaviour, which is in their control; but this cannot be monitored all the time – unless incentives are modified.

11.3.4 Behavioural issues

Given that the frameworks for analysis in this study are the institutional and organisational structures, and decision-making processes – at the centre of these processes are the people. The staff and students drive the institution in different directions, and they create and work within institutional boundaries. If there is any conflict, this can lead to inefficiencies and losses. When it comes to energy efficiency and the reduction of electricity consumption, people need to take some form of responsibility. This becomes a complex issue in a multi-faceted organisation like a university.

Firstly, there are systems in place (that have been decided upon by management and operational staff) that aim to encourage energy efficiency. Examples are: improved light fittings, limited air-conditioners, motion sensors, etc. Some, like CLF bulbs and magnetic ballasts work well and do not have interferences. Others, like the no air-conditioner policy in offices, does not always work. There have been instances where staff buy their own heaters and fans and at peak times (in winter especially) there is a surge in electricity usage. This issue is dependent on individual behaviours, and if there is not enough monitoring, people will not adhere to policies (A-EBE-Ch). Then there are some systems that fail: the motion sensors in NEB, especially in the labs, were contested. There were complaints of lights switching off when one is stationary for too long, which is both a nuisance and safety risk (late at night in labs) for some. Some people requested the motions sensors to be overridden (by using a remote) or uninstalled and refitted with normal light fixtures. This resulted in an extra expense for UCT. Furthermore, if lights were to be kept on always, the electricity bill also increases (PSS). One way to bypass this is to have test cases for new equipment and fixtures, where possible. This has an added benefit: they can be used to observe behaviours and optimise according to UCT. Another solution is to educate and

communicate the reasons for having, for example motion sensors in place. If people are informed about the wider context, they may be more accepting of these green features (SC&A).

Another important group consists of students: they occupy lectures theatres, libraries, classrooms, labs, etc. and often at varying or all hours of the day and night. There have been instances of lights being kept on in lecture theatres all night, either because no one switched them off, or a few students are working in that venue and have all the lights on. Once again there are no monitoring procedures in place and it is up to individuals whether they switch them off or not. This relates to the split incentives discussed above – the students are not directly paying for the electricity and there is a disconnect between their fees paid and the electricity bill for UCT. Even if some students are aware and environmentally conscious, and switch off unnecessary lights, there is no direct benefit for them – they will likely not see a lower fee if UCT saves a certain percentage on their bill. The same applies for staff – even if they are conscious and reduce usage, they do not pay less. Conversely if they use more electricity (e.g. keeping hallway and office lights on) there are no negative consequences – they still pay the same utilities rate.

A-EBE-En stated that people need to be reminded to do good behaviour. An example of this is the Power Alerts that Eskom ran on TV during load-shedding. It was a scale that showed how much electricity was being used at that time nationally, and whether users need to decrease their usage. Something similar could be adopted for UCT – it goes back to increasing awareness and motivation. The major barrier of split incentives needs to be removed and then such campaigns targeting better behaviour can be implemented. Another suggestion is to have a list of energy efficient appliances (such as heaters which use less electricity to heat up a given space) that can be distributed to staff. As mentioned above, some buy heaters anyway, especially if offices are too cold for comfort. So instead, UCT can monitor these usage trends and provide solutions that do not increase the electricity bill as much (A-EBE-En).

Secondly, there are barriers related to adopting new ways of utilising space on campus. One that was mentioned by the H-PPL is the proposed increased use of open-plan spaces. Conventionally offices for staff and some postgraduate students are separated. There is now a shift to include more open-plan and communal spaces – starting with postgraduates and then undergraduates – to facilitate group work and encourage collaboration between different student groups, tutors and lecturers. There are also proposed plans to have more multi-use venues and include advanced technological facilities. There has been some resistance to this from certain departments; however, both features have been included in NEB and NLT and have been quite successful (H-PPL). Johnson (2001) states the importance of matching space and the current requirements of that faculty – by incorporating the latest technology; otherwise there will be long-term capacity issues. The key point here is to have flexible institutions that can shift with changing needs of its users (Bates, 2011).

Thirdly, sometimes UCT venues are rented out for short periods of times (usually after-hours or over weekends) for seminars, conferences, etc. This means that various external people are using the space, buildings and equipment. They are likely not aware of UCT's policies and ask for air-conditioners to be kept on. The ED-P&S has to comply as they are a source of income for UCT, and it is often the case that the lights and air-conditioners are left on for extended periods. This again results in a higher bill for UCT. Even if rules and policies are made for external parties, there is a monitoring and compliance issue.

Lastly, if there is a lack of (especially convenient) infrastructure, then there will be a distinct lack of improvement in sustainability. This was the result of a study that analysed (student) behavioural barriers to campus sustainability (Horhota et al., 2013). A simple solution would be to have more motion sensors, so one does not have to rely on having someone physically switching off lights. Barring the above-mentioned nuances, there should be a reduction in electricity consumption.

11.3.5 Logistical issues (for renewable energy)

Section 10.5.5 described the proposed pilot PV installation project for UCT. There are however three major challenges. Firstly, the initial cost of setting up a wind or solar farm are quite high and pay back periods can be long. The prices of renewable energy have come down, but the projects that have been successful in the REI4P are due to large foreign investment. A university, as discussed, has a different funding model and limited income sources. To develop a renewable energy system, UCT would have to seek large, external funders, sponsors or loans.

Secondly, UCT would still need to connect to the national grid, and so the details around this, self-generation, and peak demand periods would need to be analysed. However, university buildings are similar to the commercial sector, where the electricity demand profile aligns with PV generated electricity (that is, the peak is during the afternoon). No other university has attempted to generate their own electricity in South Africa, so this would be a pilot project.

Thirdly, the orientation of Upper Campus is East-West and not North-South facing. This orientation limits the maximum amount of sunlight that can be harvested, if rooftop PV is installed. This could result in lower amounts of energy generated, relatively more Eskom generated energy would have to be used – and this could lengthen the payback period.

11.3.6 Historically cheap electricity

As stated previously, electricity was relatively cheap in South Africa, therefore there was little focus on reducing electricity usage. This has prevented greater energy efficiency in the past, and still limits it today. However, with the increases in tariffs (which are set to continue) many large institutions are examining their electricity bills closer.

Compared to other university (utility) expenses, electricity and water are the two that UCT still have some control over. Labour costs will also keep increasing and rates also cannot be controlled internally. Thus, energy efficiency initiatives are an investment for the long term, which is financially and environmentally sustainable.

On the other hand, the per square metre energy figures for UCT are relatively low (table 3). Thus, ED-P&S does not see much value in having energy managers; instead there is a shortage of staff in other departments of P&S currently. In other words, the marginal benefit to hiring energy or building managers is low for UCT presently given its consumption.

Figure 24 shows the visual summary of all the barriers and challenges discussed in this chapter. For the sake of completeness, it also shows the improvement or lack thereof for the various barriers. Bold shows progress and likelihood of improvement in the future, underlined barriers show no to little progress and are likely to remain a hindrance in the near future, and those in italics are no longer a major barrier.

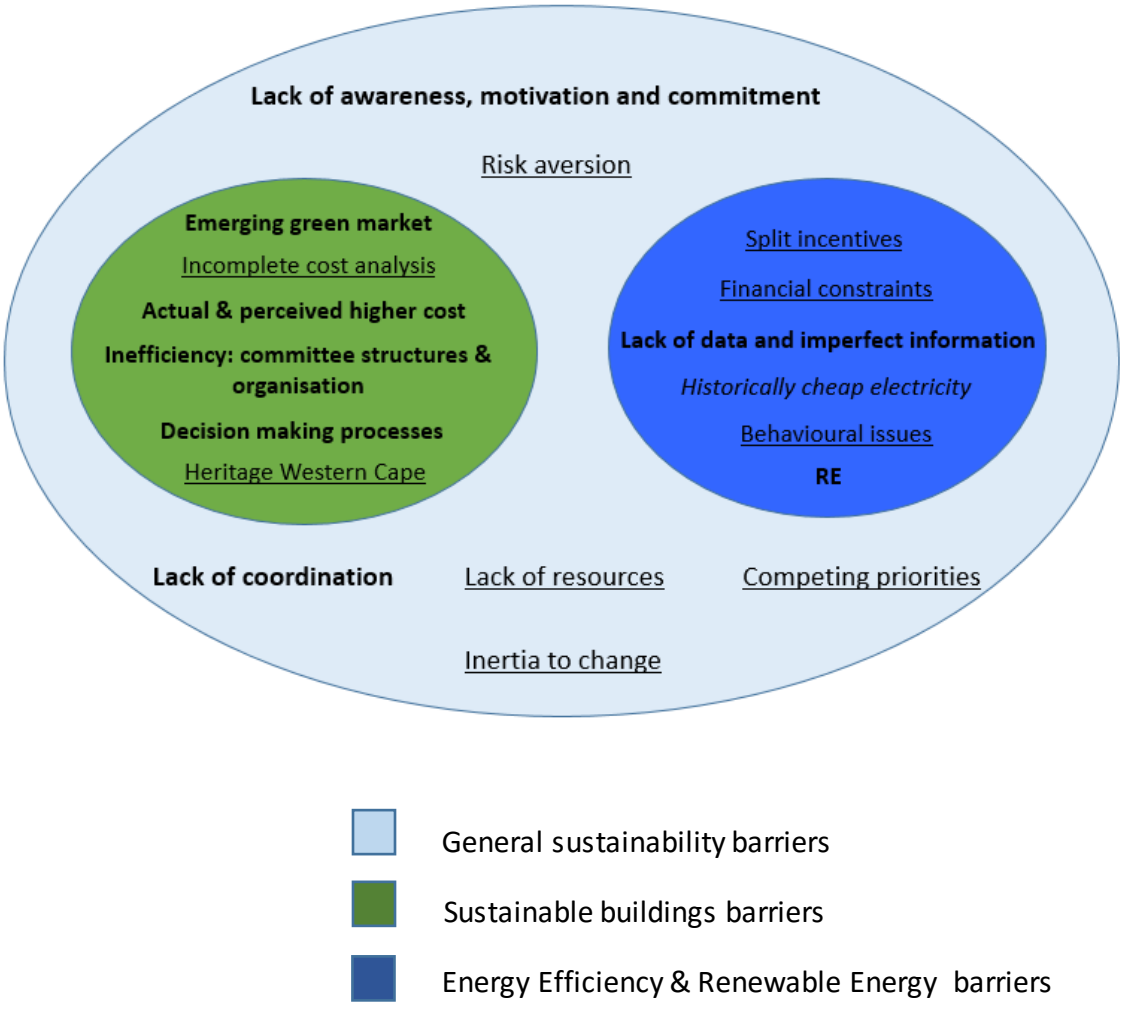

Figure 24 showing all barriers and challenges discussed in chapter 11

12. Change at universities

As Fumasoli & Stensaker (2013: 12) aptly state: "The debate on changes in higher education has focused on the ongoing forces pushing for transformation of the university from an institution within society to an instrument of society". One important part left of the analysis is how change takes place at a university, especially given all the above barriers and challenges mentioned. In other words, for change to occur, certain or most of the above-mentioned barriers need to be broken down or avoided to achieve a specific outcome. This section will outline a few major elements that have proven effective at UCT, and in the literature, to enable improved sustainability levels.

This chapter will discuss the elements that can be used to promote further sustainability at the university. Therefore it can be seen as the Recommendations section of the thesis, in parts.

12.1 University structures and processes

The chapter on university structures and some of the barriers highlighted the importance of understanding the structures of the university as an institution, and its organisational groups. For change to occur, the institution needs to be flexible and dynamic. This means that the institution should be able to learn with time (North, 1994). However, the institution is an inanimate framework; thus, it is the individuals that operate in the context of the institution that need to be able to learn, adjust and change.

For change to happen, it is important for the actors to envision something new – in other words, to change their perception of 'what is' to 'what can be'. There needs to be a shift in mental models (North, 1994) – and the whole issue of climate change and sustainability requires a large and difficult shift in individuals' and society's mental models.

This will require: awareness of a problem or gap; motivation to address that problem or fill that gap; and an opportunity to solve that problem. This does not have to occur in this order; sometimes an opportunity will be present without an obvious problem. Or there could be a desire to change and improve the status quo, but there is a lack of awareness (e.g. technical) or pathway to achieve that desire (Honig et al., 2015). The barriers to all three have been dissected above.

It imperative to provide reliable information about the issue at hand, to close the awareness gap. Thereafter simple and useful ideas will help motivate people to change – and hopefully create new habits. Opportunities can be identified by various stakeholders; but it will be more beneficial if HLM create policies and incentives which can create more opportunities. Sometimes raising awareness is not enough – incentives, infrastructure and the means need to be provided to create lasting change (Jain & Pant, 2010).

Brinkhirst et al. (2011) wrote a paper, titled 'Achieving campus sustainability: top-down, bottom-up, or neither?' This is a key question that needs to be answered, given the intricate layers and networks present in a university organisation. They state that HLM and student leaders are often seen as the key change agents; but they face various constraints, as seen in figure 25. Instead, a vital group for "sustainable change" are the "institutional middle" – faculty and staff (Brinkhurst et al., 2011: 8). Both academic and administrative staff are attuned to the going-ons at the top and bottom; and with their knowledge, position and networks, they are capable of leveraging change. The middle cohort can also anchor initiatives and ensure their longevity. HEIs are unique institutions that have at their disposal a variety of experts, who given the opportunity, can foster innovation and change (Thompson & Green, 2005).

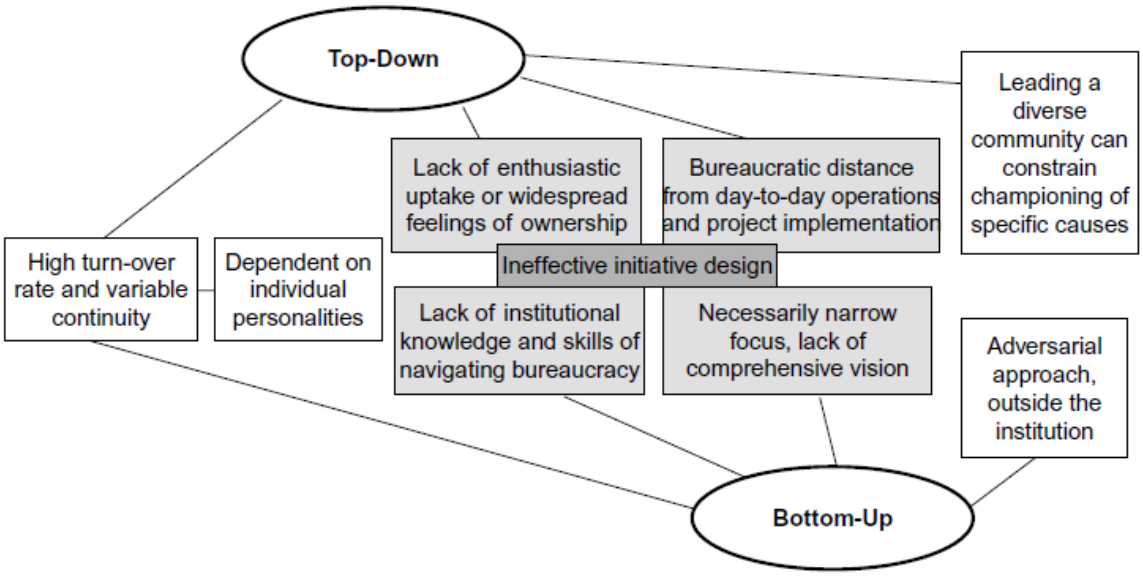

Figure 25 showing Challenges facing top-down and bottom-up change makers

Source: Brinkhurst et al. (2011: 7)

Given the complexity and size of a university, there are often vast and intricate networks present. This layer of informal connections has already shown the potential for driving change, but it can become ineffective if it is too big or inaccessible to those that new or outside the network. This also speaks to the need for individuals in the organisation to change their habits and mind-sets, which in turn will translate into change in the organisational culture, and thereafter the institutional rules and processes themselves will adapt (Kothari & Handscombe, 2007).

For example, a university in the US has faculty members that take part in custom-designing power plants for their campus, and they involve their students, which allows for hands-on

learning (Kurland, 2011). Thus, academic staff can be the bridge between the knowledge (learning) and operational divisions (Barth, 2013).

One successful example at UCT is: the idea and initiation for calculating UCT's carbon footprint came from the ERC, which is a department that sits within EBE. This idea was then escalated to P&S and the sustainability coordinator became in charge of the project and compiled these reports. Also, the idea and push for the green building policy did come from an academic and a consultant that were part of the institutional middle.

Lastly, but importantly, a university needs to be adaptive. Sporn (2001) identified various factors that can lead to adaptive universities, at various institutions. The results are summarised in table 12. These categories and descriptions are reflective of the sections that have been discussed throughout this study.

Table 12: Towards adaptive universities: Critical factors and their descriptions

Critical Factors	Propositions
Environment	Adaptation at universities is triggered by environmental demands which can be defined as *crisis* or *opportunity* by the institution.
Mission, goals	In order to adapt, universities need to develop *clear mission statements and goals*.
Culture	*An entrepreneurial culture* enhances the adaptive capacity of universities.
Structure	*A differentiated structure* enhances adaptation at universities.
Management	*Professionalized university management* helps adaptation.
Governance	*Shared governance* is necessary to implement strategies of adaptation.
Leadership	*Committed leadership* is an essential element for successful adaptation.

Source: Sporn (2001: 9)

One can apply the above as follows: climate change is seen as a global crisis; however, this is not directly translated at a university level – rather tackling this problem can be seen as an opportunity. Environmental sustainability needs to then be clearly stated as a university goal. This will increase its awareness and affect the priorities, resources and culture of the university. However, this will not happen at once; instead it will filter through differentiated structures and an empowered institutional middle, as discussed above. The process can be effectively facilitated by management that shows leadership in this matter. Ultimately through cooperation and coordination, and competent governance, the vision of a more sustainable university can be achieved.

12.2 Student activism

Generally, students are assumed to be "less involved in social justice sorts of activities on campus in part because they are tuned to coming to campus for class only and then leaving" (Kurland, 2011: 24). However, this has not been the case for UCT. One interesting and relevant example of change was seen across South African universities over 2015-2016. This was the issue of free tertiary education. As mentioned, state subsides started to decline since 2012. This put a strain on university budgets and hence they increased fees at a higher rate annually. More students were financially excluded, especially those from previously disadvantaged groups. This reached a peak in 2015 when Wits university students protested the high fee increases. This sentiment was echoed by many other universities in South Africa, and escalated to a point where the police were called onto campuses to limit protests. Violence erupted between students and police, and eventually campuses had to be shutdown. This was also during the November exam period, which resulted in exams being postponed and some students having to defer exams given the uncertainty and tension surrounding campus events. Protests were also carried out in the streets of major cities and at parliament. Eventually the minister of DHET intervened and announced a 0% fee increase for 2016.

As an aside: this issue of high fees and resultant exclusion of students that cannot afford fees, is not unique to South Africa. This is a prevalent issue in a number of universities across the world. It is also not a recent issue: a Canadian paper in 1982 mentioned this same problem of rising fees and expenses (Lawless, 1982).

The above shows the effects of a large body of students protesting for a common cause. There were many factors that led to the success of the students' goal, and several articles have since been published analysing the events. However, a few key points that stand out are: hundreds of students coming together to fight for one goal; disaggregated student leadership – that allowed for different student voices to be heard; some students engaged with management to a certain extent, but mostly worked to mobilise and unite other students. In sum, collective action in this case demonstrated the power to change.

One of the outcomes of the UCT protests was an increase in the number of task teams and working groups. Given the nature of the protests, there was greater inclusion of students in decision-making. Also, communication seems to have improved (though not that much, according to some students) about the processes for reconciling many of the issues brought up during the protests – as witnessed by the number, type and length of emails sent during and after the protests. This increased communication leads to better transparency. Also, through the use of social media and its features, parts of the protests and the meetings held with management and student representatives were disseminated to the wider public. This allowed for direct access to the proceedings and allowed both staff and students to be more involved and aware of all the going-ons. This reflects the impact technology can have in the

way information is disseminated, and how decisions are made. Even though the average student is not a powerful decision maker, they now have access to the way decisions are made and can identify the key stakeholders and those in power.

It is unlikely that students at UCT will protest directly for increased environmental sustainability. However, globally many activists protest for greater action against climate change. In some countries the largest climate change related student activism movement has been for divestment from fossil fuels. This concept originated at one university and spread to many others (UCT also has its own divestment campaign). This shows that students can have a very loud voice and can dictate priorities and agendas – which years of committee meetings might not be able to do.

According to A-EBE-Ch, the students brought forward what they thought was important, and environmental sustainability was not one of their protest points. This speaks to the lack of awareness and action at UCT around climate change and sustainability. Other points that lead to successful student activism are: the size of the university – student voices are heard louder in smaller universities; usually a simple and clear goal; coalitions with other internal and external groups; and more formal means, such as garnering staff support and increasing participation in decision-making processes (Barth, 2013).

12.3 (Green) Champions

There are arguments for having uncoordinated sustainability efforts. It is not always effective to have centrally driven and top-down efforts; instead passionate individuals with a fixed goal can achieve more, over a shorter period. Moreover, collaboration needs to happen organically, because if it is forced it will likely not be effective or last for a long time. People need time and space to create their own relationships and networks, and thereafter goals can be achieved together. Brinkhurst et al. (2011: 8) also emphasise: "that change happens 'organically' … scattered throughout the institution where individuals and small groups actively cultivate it".

Champions are those that have taken an interest in understanding the status quo and have a desire for change. They can bring together like-minded people in a creative way and find opportunities in the vast university organisation through their own networks. They are less likely to be restricted by rules and work to embed new norms in the institution. They also work with their own limited resources (time and money).

However, a problem with champions is they (especially students, but also staff), can change or move out of the university, "creating gaps in leadership" (Brinkhurst et al., 2011: 7). This also means there is limited scope for consistency, continuity and commitment. Students and societies like the GCI often take on short-term, high-impact projects. Students often cannot invest in institutional development and longer-term initiatives, given the time it takes to understand university structures and processes (Sharp, 2002 and Barth, 2013).

Instead, it is important to encourage more staff to include sustainability in their decision making. One way to do this is by including it as part of their KPAs. If it is included as part of their job description, then it will feed into budgets. This disaggregation and less reliance on one champion will have a greater impact. According to SC&A, this is becoming best-practice in the architecture field. It will also encourage people to take sustainability more seriously and see it as a priority. In the past, no-one at P&S had environmental sustainability or energy efficiency as part of their assessments. However, there are now few members (part of PPL) that have it included (but none of the managers or the ED have it included yet). ED-P&S mentioned that this is something that will be considered in the near future.

This is the end of the findings and analysis section of the thesis. What follows are the summary and conclusions.

13. Summary and Conclusions

This last chapter provides a summary and conclusion, especially of the key findings and analysis of the dissertation. The first part provides an overview of the purpose of this research, its focus and the methodology used. The next part is a review and summary of the findings and analysis chapters. The last part comprises of key conclusions based on the major barriers and challenges discussed above (including implicit recommendations). This section ends with two paragraphs on the current status of sustainability at UCT and a possible way forward.

Climate change is one of the most pressing problems facing the world today. It has led to people becoming more aware of the effects of their activities on the environment. This has created the space for individuals, businesses, organisations, institutions and governments to interrogate how environmentally sustainable they are. Universities are one such institution that have incorporated sustainability elements into their operations, teaching, learning and research. Universities are unique in that they teach the future workforce and leaders, and thus have the opportunity to ensure that these students are equipped to tackle complex, real world problems.

The path or strategy that most universities follow to improve environmental sustainability is as follows: signing the Talloires Declaration; establishing frameworks and plans; setting targets; measuring and monitoring different aspects of sustainability; having a student and staff body that raises awareness and drives initiatives; building green buildings and retrofitting existing ones; installing or buying renewable energy; and finally integrating sustainability in various courses and degrees. This is roughly the order that most international universities have followed, based on the literature review. Also, some universities have stronger focus on some parts than others – and none is championing all these aspects, yet (Finlay & Massey, 2011). UCT has also followed a similar order, however, it has yet to accomplish the last few.

The focus of this research was on how one university, UCT, has progressed in integrating sustainability into its functions. Since this is a large and multifaceted topic, the focus was narrowed to sustainable buildings, and what factors have either enabled, hindered or promoted their advancement. In order to analyse this, three lenses were chosen, especially as they are important aspects of a university and were identified in the literature: institutional structures, organisational culture and decision-making processes. In particular three of the most recently built buildings formed part of the case study (NEB, TLB aka Snape and NLT). In depth interviews were conducted with key internal and external stakeholders of UCT. Through the findings and analysis many interesting factors influencing both sustainable buildings and sustainable buildings were discovered.

Another key focus of the study was on a 2012 policy that stated that all new buildings constructed at UCT would be 4 star green rated, at a minimum. This was an important decision and thus it was interesting to understand the decisions and factors that led to this policy. In order to unpack this, the three most recently constructed buildings were analysed – the last of which achieved the 'As design' 4 star green rating by the GBCSA in 2016. Open ended interviews were conducted with the key stakeholders and decision makers at UCT, to aid an in-depth understating of the research question and its contexts.

A recap of the structure and content of the thesis is as follows: The initial chapters (1-4) provided background and context, and explained the methodology. Figure 26 provides a visual representation of the key sustainability contexts. Next, chapters 5-7 described and examined the various components of this question, through analysing the literature. Thereafter, chapter 8 outlined various relevant features of UCT. Afterwards, chapter 9 explored the path of sustainability at UCT. This set the scene for the description and some analysis of the findings in chapter 10 – the key enablers of sustainable buildings at UCT were discussed and some factors that hinder them were alluded to. Chapter 11 then analysed and discussed in detail the barriers and challenges which exist at UCT – those that hinder the level of sustainability, specifically that of buildings. Lastly, chapter 12 above examined some key features and processes that could further promote change and advancement of environmental sustainability for UCT.

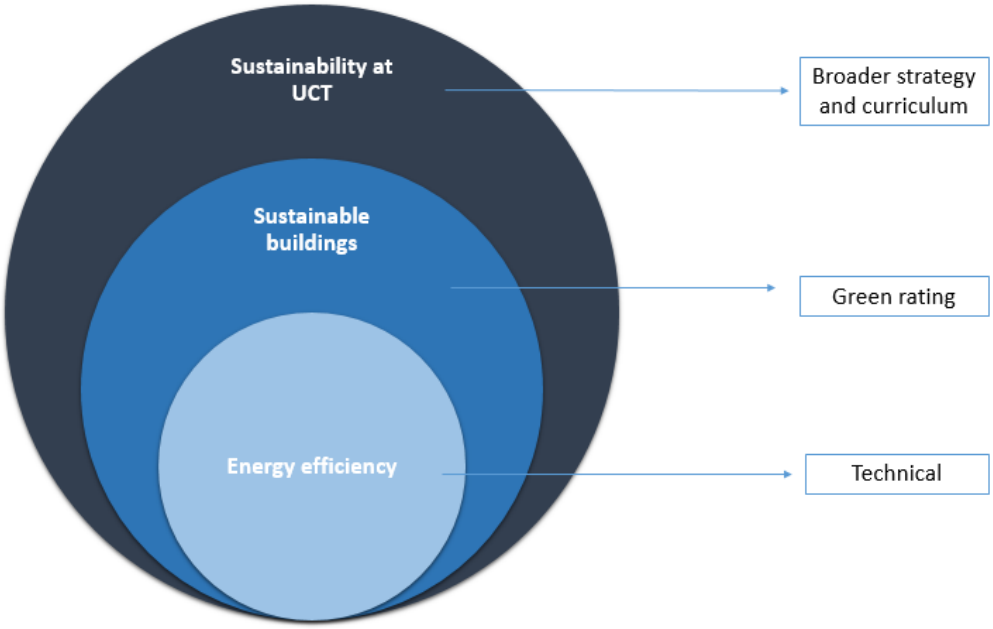

Figure 26 showing visual summary of the key research contexts of this study

A brief summary of the findings and analysis chapters follows. Chapter 8 provided the background and setting for UCT, to aid the analysis. UCT is one of the oldest universities, founded in 1829, that has steadily grown and expanded in size and student enrolments. The number of buildings have also increased and now there is limited space on campus to

expand. UCT has a number of committees and groups that help with management and governance. One key theme described was the decrease in funding, especially in recent years. This is due to declining government subsidies, resulting in UCT's reserve margin decreasing and thus resulting in financial austerity measures for all departments.

It was important to understand electricity use, price and emissions trends as they are a driver for energy efficiency. In South Africa the price of electricity has increased steeply, especially since 2007. This has resulted in UCT's electricity bill also increasing. Even though it is not a relatively large amount (compared to other expenses), there is an opportunity to save. For the year 2016 the expense was R71 million. Even though the per capita electricity consumption figure is relatively low compared to other universities; the largest source of carbon emissions for UCT come from electricity use. Therefore, there is motivation for energy efficiency.

Chapter 9 then described UCT's path and progress of sustainability. UCT has certainly made progress since it first signed the Talloires Declaration in 1990, to the construction of one of the first green star rated university buildings. However, sustainability at UCT has had a stop-start nature. There was some momentum in the period 2007-2012, especially when a sustainability coordinator was hired, and various green plans and frameworks were developed. There was ambition on paper, but it did not always translate into action. The main issue was the lack of targets, and measuring and monitoring of those targets. Nevertheless, a few committee structures were set up to aid environmental sustainability and the student body also took initiative. Since then there have also been pockets of initiatives, actions and campaigns occurring – by various academic groups and committed individuals. There have also been a few social transformation issues that have come to the forefront at UCT, especially over the past two years. However, there has been little activity regarding environmental transformation, and even though this has been driven by a small group of students, there is yet to be more initiative regarding this from HLM.

Chapter 10 then moved onto specifically explore the events leading up to the 2012 green building policy, through analysing the three recently built buildings on Upper campus. Firstly, the process for constructing a new building on campus was outlined. The key decision makers (committees, groups, architects and individuals) were mapped out. Thereafter the funding options for a new building are discussed.

Secondly, the events that led to the 2012 policy, that all new buildings will be rated 4 star at a minimum, were described and analysed. It required the sustainability coordinator and an academic to motivate and push for it. Thereafter, it was raised in a number of meetings and eventually after certain issues were resolved (such as the cost of green buildings), after four years, the members of UB&DC voted in favour of having the policy. Some members were still sceptical about having the rating and mentioned that UCT was already incorporating sustainability features, where possible. This can be seen, especially with the NEB and Snape

(but also two buildings prior to them). Nevertheless, this green building policy has led to the institutionalisation of one key sustainability aspect at UCT.

What followed was a description of each of the three case study buildings, together with their budgets, timelines, sustainability features, and other interesting aspects. NLT received the 'As design' 4 star rating by GBCSA and the list of credits that were targeted in each of the nine categories was shown.

The last part of the chapter discussed five varying themes and issues. One, UCT does not have building or energy managers. This makes it difficult to manage energy use. Two, there is limited measuring and monitoring of energy usage, and since no thorough audit has been conducted, it is harder to set and achieve targets. Three, the option of using an ESCO was briefly discussed; it is unlikely to be used in the near future at UCT. Four, there is a R400 million maintenance backlog and this makes it difficult to allocate funding for various building and energy efficiency projects. Lastly, the option of renewable energy is being considered. A pilot study has been conducted and there is approval to implement it, however, funding needs to be sourced for a 1 MW solar PV installation.

Thereafter chapter 11 drew up a long list of challenges and barriers that hindered the advancement of sustainable buildings at UCT. Figure 24 provided a visual summary of the barriers, and so that will not be repeated here (however, a list of the key points from each sub-section can be seen in Appendix F).

Chapter 12 shifted the focus to three strategies that could be used to promote sustainability. Firstly, there are some unique elements of a university's structures and processes that could be leveraged for change. The intuitional middle can use their networks and organisational groups to promote sustainability, as this has been shown to be difficult to do simply using traditional top-down and bottom-up approaches. Instead the cross-institutional structure can disseminate information more effectively to each other and each department can be empowered to initiate change within their smaller groups. With time, the larger organisation and university can shift to a more sustainable path. It would also help if the university is adaptive, and environmental sustainability is listed as a mission. This together with leadership (from both HLM and academics and students), will result in effective change for the institution over time.

Secondly, the recent fees protests at UCT and other South African universities was discussed. This was used to highlight the impact that a large body of students can bring, if they are committed to a common cause. The outcomes from the fees protests was: increased university communication, more committees set up to address issues and streamlining of some processes. Even though it is unlikely that UCT students will protest for environmental reasons in the near future, there is much scope for impact if the student body lobbied for more responsibility and action from the institution regarding sustainability.

Thirdly, green champions have managed to achieve results in the past and will likely continue to do so. Even without mass support, restrictions due to institutional structures and limited resources and support; there is potential for passionate and dedicated individuals. Sometimes this is difficult given student and staff turnover, which raises challenges of continuity and institutional memory loss. Instead, there is also a push to have a number of champions in different departments. This can be facilitated through including sustainability in staff job descriptions, which should feed into budgets and thus provide more support for initiatives. Ultimately, there should be no need for green champions as everyone would have integrated sustainability practices into their routine, together with mindset and organisational culture shifts.

In conclusion, UCT has shown slow but steady improvement in the level of sustainability of its buildings. From initially wanting to incorporate sustainability elements in the Chemical Engineering building (without a complete understanding of what this entailed), to incorporating energy efficiency and sustainable design features in NEB and Snape, to finally achieving a green star-rated NLT. This reflects that there are some factors that enable and promote increasing the level of sustainability of buildings. This included two green champions advocating for a specific policy to be adopted, at key points in time – that is, when there was some receptivity to environmental issues. It was also the time when the GBCSA tools were being taken up by different sectors and there was opportunity to develop one specifically for educational buildings. UCT's sustainability coordinator at the time motivated for the green building policy, especially as she was also a green building professional. The possibility of creating the policy was brought up in various (but specific) committees and once the necessary information was gathered, people who had decision making power, voted in favour. This process did take some time, however since this is now an official policy, it will be enforced and should result in the operational side of UCT becoming more environmentally sustainable.

However, while unpacking UCT's structures and processes, it become evident that there were still a range of issues that were preventing further advancement of both general sustainability and sustainable buildings, including energy efficiency. The key issues raised by multiple interviewees are, in order of most mentions: lack of funding; competing priorities (especially other transformation topics); sustainability not being mainstreamed at UCT; trade-offs; and lack of commitment. These major barriers have been unpacked in the case study, by providing some context and through the analysis of three buildings. However, there are other specific challenges (some which are unique to UCT) that need to be addressed as well.

Some authors (Dahle & Neumayer, 2001) mention that often barriers such as lack of resources are used as an excuse, or that there are other overarching barriers that are more important to consider. However, for UCT, this is not necessarily the case. Given the increasing constraints on the budgets, protests for fee reductions, and insourcing; there is a

lack of human and capital resources, especially for sustainability projects. Nonetheless, the above two points cannot be overlooked, as reflected in the history of sustainability at UCT. Unless sustainability rises up the priority list, these reasons may continue to proliferate and limit progress.

Nevertheless, there has been some progress in terms of improving data collection and monitoring of energy use. Therefore, in the near future energy budgets could be developed, together with the dissemination of energy usage per building, and awareness-raising about ways to save electricity. In this way, a culture of energy efficiency could be embedded at UCT. However, this requires all stakeholders – from high-level management recognising the issues and developing policies and rules, to staff that engage with these topics, to students who can also become active participants and responsible users of electricity. Evidently, when new buildings are built, the design and budget planning should consider all these barriers and challenges – together with more holistic costs analysis and incentivising users where possible. Some external barriers are beyond the control of UCT, such as the emerging green market in South Africa and restrictions imposed by Heritage Western Cape, but the construction of NLT has proven that sustainable buildings are possible at universities.

It is important to note that there are key features of a university that lend themselves to either enabling or hindering further sustainability initiatives. The nature of bureaucratic institutions, together with cross-cutting structures (due to operational and academic arms, each with its own structure) means that coordination across the university will be difficult. Ideally a 'sustainability hub' or 'green office' or at least a sustainability coordinator would be useful in addressing this challenge. However, the lack of resources issue has been discussed and there are some logistical issues as well. Instead it is useful to allow for collaboration and coordination to happen organically. This is particularly effective if the institutional middle is more active and empowered.

This last point is also related to inertia of large institutions to change. If anyone within the university wishes to effect change, then they firstly need to understand the complex nature of institution – how things are done, who does what, who has power and what procedures need to be followed to initiate something new. This however, requires much time and effort and can become discouraging (especially students that are not at university for long). Inertia is also related to habits and norms – it is even harder to shift mindsets – but once again people need to be given autonomy to explore and develop their networks, and use them to enact change where they are and with the resources they do have.

In some instances, inefficiencies in committee and organisation structures can be problematic. Given the many committees and groups at UCT, there can be redundancy. Even though it is useful to have multiple interests represented to account for a range of issues; managers and committee chairs need to take everyone's views into account and maintain a democratic process, which can lengthen the process. Furthermore, if decision

making processes are non-standardised, this can complicate things and make it difficult to maintain consistency. There is also a lack of responsibility for sustainability decisions and there is often a trade-off between long-term strategic and sustainable decisions versus short-term priorities and gains.

Overall, the timing is said to (still) be unsuitable for advancing sustainability at UCT. Given the many other transformation topics that are at the forefront, receptivity to environmental issues will likely be low. Nevertheless, there are pockets of change occurring and efforts will continue, by individuals and groups of both staff and students. The fundamental change that still needs to occur is in the mind-set of individuals regarding sustainability. Only then will priorities shift and some of the barriers will fall away or be reduced. Even though some barriers may be persistent, with enough commitment and dedication one can find constructive ways to work around or within them, to reap the long-term benefits of sustainable initiatives.

Ultimately the university is an amorphous entity with permeable boundaries, that does have opportunities for change, but one first needs to unravel some of its complexity. Since the global issue of climate change requires urgent action, it is worth having to understand, examine and critique institutions and their processes. There is value to the university and benefits to broader society and the world, if universities proactively address sustainability issues – both through their physical campus buildings and operations, and through their teaching and curricula which prepares students to tackle real world issues.

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Appendices

Appendix A

Application for Approval of Ethics in Research (EiR) Projects
Faculty of Engineering and the Built Environment, University of Cape Town

APPLICATION FORM

Please Note:
Any person planning to undertake research in the Faculty of Engineering and the Built Environment (EBE) at the University of Cape Town is required to complete this form **before** collecting or analysing data.The objective of submitting this application *prior* to embarking on research is to ensure that the highest ethical standards in research, conducted under the auspices of the EBE Faculty, are met. Please ensure that you have read, and understood the **EBE Ethics in Research Handbook**(available from the UCT EBE, Research Ethics website) prior to completing this application form: http://www.ebe.uct.ac.za/usr/ebe/research/ethics.pdf

APPLICANT'S DETAILS		
Name of principal researcher, student or external applicant		Jigisha Mandalia
Department		Energy Research Centre (ERC), Mechanical Engineering
Preferred email address of applicant:		Mndjig001@myuct.ac.za
If a Student	Your Degree: e.g., MSc, PhD, etc.,	MPhil
	Name of Supervisor (if supervised):	Dr Andrew Marquard
If this is a researchcontract, indicate the source of funding/sponsorship		Click here to enter text.
Project Title		Sustainable buildings at UCT: an exploratory analysis of decision making processes

I hereby undertake to carry out my research in such a way that:

- there is no apparent legal objection to the nature or the method of research; and
- the research will not compromise staff or students or the other responsibilities of the University;
- the stated objective will be achieved, and the findings will have a high degree of validity;
- limitations and alternative interpretations will be considered;
- the findings could be subject to peer review and publicly available; and
- I will comply with the conventions of copyright and avoid any practice that would constitute plagiarism.

SIGNED BY	Full name	Signature	Date
Principal Researcher/ Student/External applicant	Jigisha Mandalia		**23 Nov 2016**

APPLICATION APPROVED BY	Full name	Signature	Date
Supervisor (where applicable)	Dr Andrew Marquard		**23 Nov 2016**
HOD (or delegated nominee) Final authority for all applicants who have answered NO to all questions in Section1; and for all Undergraduateresearch (Including Honours).	Samantha Kern Click here to enter text.		20/2/2017 Click here to enter a date.
Chair : Faculty EIR Committee For applicants other than undergraduate students who have answered YES to any of the above	G. Sitbole Click here to enter text.		21/2/2017 Click here to enter a date.

Page **1** of **2**

Appendix B

The Talloires Declaration and 10 Point Action Plan

Association of University Leaders for a Sustainable Future

The Talloires Declaration
10 Point Action Plan

We, the presidents, rectors, and vice chancellors of universities from all regions of the world are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer and emission of "green house" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

We, therefore, agree to take the following actions:

1) Increase Awareness of Environmentally Sustainable Development
Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2) Create an Institutional Culture of Sustainability
Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.

3) Educate for Environmentally Responsible Citizenship
Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4) Foster Environmental Literacy For All
Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional students.

5) Practice Institutional Ecology
Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6) Involve All Stakeholders
Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and nongovernmental organizations to assist in finding solutions to environmental problems.

7) Collaborate for Interdisciplinary Approaches
Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8) Enhance Capacity of Primary and Secondary Schools
Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.

9) Broaden Service and Outreach Nationally and Internationally
Work with national and international organizations to promote a worldwide university effort toward a sustainable future.

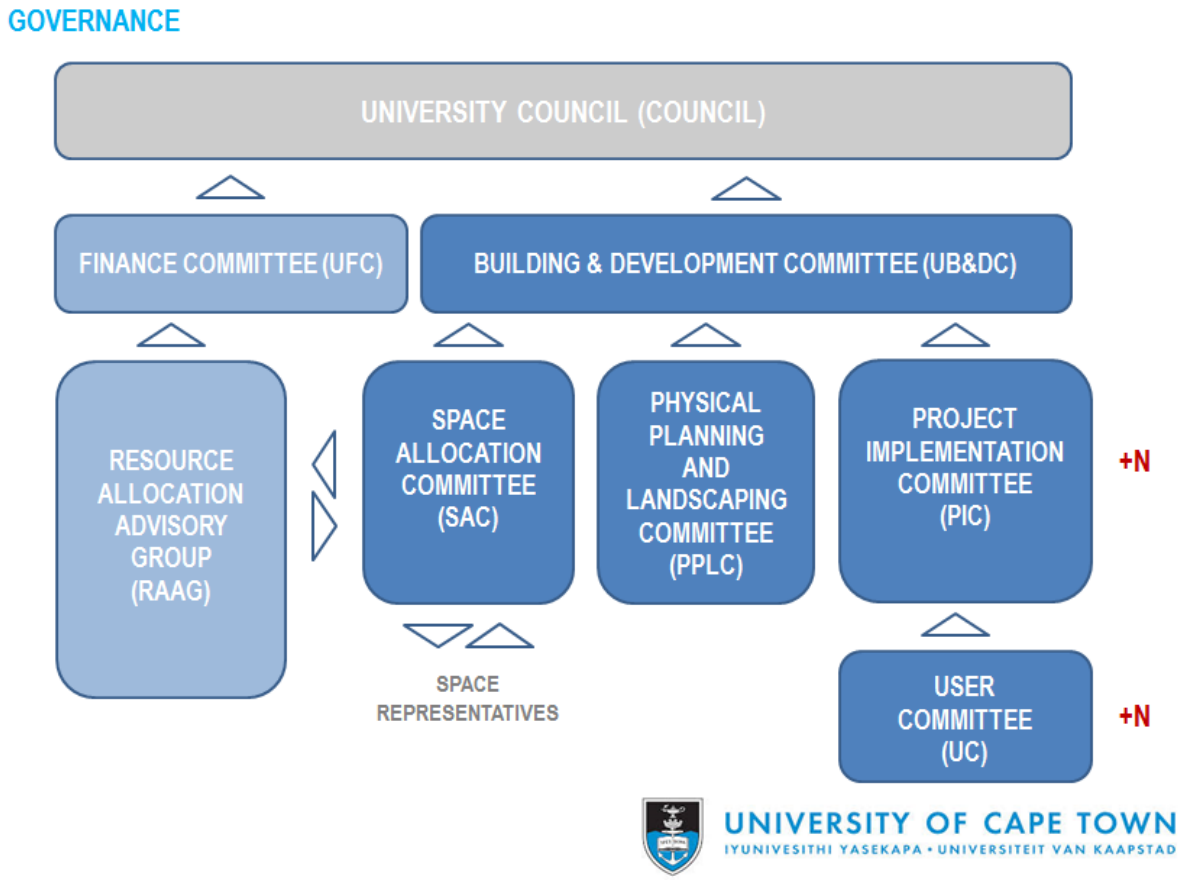
10) Maintain the Movement
Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

1994 Updated Version

Source: SC&A

Appendix C

Schematic showing the governance structures of UCT, in relation to a new building project



Source: ED-P&S

Appendix D

MOTIVATION TO UB&DC FOR GREEN STAR CERTIFIED BUILDINGS AT UCT

16 May 2012

Compiled by Sandra Rippon

UCT's commitment to campus sustainability began over two decades ago with the signing of the **Talloires Declaration** in 1990. In 2002 the Vice-Chancellor, Professor Njabulo Ndebele, recommitted the university to the Talloires Declaration. This declaration calls for universities to:

*'**set an example** of environmental responsibility by establishing institutional environmental policies and practices of **resource conservation**, recycling, waste reduction and environmentally sound operations'.*

Under Talloires we further commit to ensuring that '*all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens'*.
A further initiative to develop a policy framework was launched by Vice-Chancellor Njabulo Ndebele following discussions at the Global University Leaders Forum (GULF) at the World Economic Forum in 2007. University leaders were urged to adopt a significant goal for reducing GHG emissions between now and 2020.

This resulted in the development of the ***Green Campus Policy Framework*** in May 2008 by Deputy Vice Chancellor Martin Hall. Significantly, the Framework was formally adopted by the University Building and Development Committee, Senate and Council in 2008/2009.

The Framework called for a Green Campus Plan for UCT, having as its main strategy the reduction of the university's carbon footprint through targeted objectives for:

- energy savings;
- reducing carbon emissions;
- recycling;
- water conservation.

The Framework calls for:
 'specific milestones and delivery targets to be adopted for the areas identified' (resulting in the development of the ***Green Campus Action Plan*** of December 2008, only adopted by the EMWG)
 The adoption of ***The University of Cape Town Environment and Sustainable Development Policy*** *(2003) (*included in the Framework as an Appendix).

The Framework states that there is:
'*significant scope for UCT to improve its energy usage patterns. This is viewed as imperative as the current context of 'cheap electricity' will not last. UCT therefore needs to explore costing options. These and other budgetary considerations need to be viewed holistically enabling Properties and Services **to prioritise green building methods** which often carry larger capital costs but which have recurrent savings' (emphases added).*

Most recently, UCT's international commitments have been extended by its ongoing membership of the GULF group. Vice-Chancellor Max Price is a signatory to the Global University Leaders Forum (GULF), a small group of only 25-30 universities (including Yale, Harvard, Cambridge, Oxford, Stanford) with UCT the only one in Africa, convened by invitation only. This community fosters collaboration between top universities in areas of significance for global policy and helps shape the agenda of the World Economic Forum.

The GULF community has taken on collaboration with the International Sustainable Campus Network (ISCN), setting a standard for the implementation of sustainable practices and the measurement of performance of academic institutions in reducing their carbon footprint. UCT now intends to report in terms of the ISCN-GULF ***Sustainable Campus Charter*** by June 2012. This involves committing to set their own, concrete targets against shared Charter principles, and reporting transparently on their progress against those targets.

The Charter comprises three Principles dealing with; 1) buildings and their impacts; 2) campus-wide planning and 3) integration of research, teaching, facilities and outreach

Principle 1: To demonstrate respect for nature and society, sustainability considerations should be an integral part of planning, construction, renovation, and operation of buildings on campus.

Principle 1 promotes the adoption of life-cycle costing (taking into account future cost-savings from sustainable construction).

Thus, UCT needs to:
1) Adopt a carbon reduction goal/target
2) Identify strategies to reach those targets, including Green Star certification of buildings
3) Monitor progress – measured by the GS certification
4) Change the capital cost approach for developments to a life-cycle costing approach to enable prioritisation of green buildings

Postscript by Richard Hill

In the last few years UCT has spent R1 billion on new buildings and yet we are still some way off from formalising the commitment made in the Green Campus Action Plan of December 2008 to '*Adopt the Green Star SA rating system and build new buildings to a minimum 4 Star rating'*. While we have made some progress in the adoption of green technology in each of these recent buildings, we have not adequately documented what we do in the planning, design and construction process, which is required by the Green Building Council of South Africa's rating system. This lack of monitoring and documentation of what is learned on each project is contrary to our mission as a University to be an outstanding place of learning, addressing the challenges facing our society, and sharing the knowledge generated by our research with students and society.
On Friday 11 May 2012 the Environmental Management Working Group of the UB&DC, in its review of the latest version of the Green Campus Action Plan, reconfirmed its adoption of item 8.1, under Section 8: Construction and Building Maintenance, which reads '*Adopt the Green Star SA rating system and build new buildings to a minimum 4 Star rating'*.

Source: SC&A

Appendix E

Table showing full set of credits available for green star rating, and credits achieved for NLT

UCT New Lecture Theatre
Green Star Strategy Workshop

agama ENERGY

Rev 8
Date: 15 September 2015

Category	Title	Credit No.	Points Available	Included	Recommended	To Be Assessed	Not Achievable / Not Applicable	Credit Description
MANAGEMENT Credit value 0.65	Green Star Accredited Professional	Man - 1	2	2	0	0	0	Requires engagement of AP. Engagement and involvement of AGAMA will satisfy this credit.
	Commissioning Clauses	Man - 2	2	2	0	0	0	Requires that all services be commissioned according to CIBSE Commissioning Codes. The 2nd point requires transfer of project knowledge to building owner/management.
	Building Tuning	Man - 3	2	0	0	0	2	Requires contractor to commit to 12 month building tuning contract with monthly monitoring and quarterly reporting, and full re-commissioning at the end of the 12 month period.
	Independent Commissioning Agent	Man - 4	1	0	0	0	1	Requires engagement of ICA to inform services design during early design phases, and to oversee entire commissioning process and building tuning.
	Building Users' Guides	Man - 5	1	0	0	0	1	Requires the development of an easy to read building guide that explains to building tenants (not technical staff) how the building is intended to operate from a sustainability perspective. AGAMA to include development of BUG in fee proposal.
	Environmental Management	Man - 6	2	1	0	0	1	Require appointment of environmental consultant to develop project specific EMP, or require contractor to develop EMP prior to commencing demolition. For second point, require all main contractors (demo, earthworks, construction) to be ISO 14001 EMS accredited.
	Waste Management	Man - 7	3	3	0	0	0	For 3 pts, WMP to be implemented and require at least 70% of all demolition and construction waste to be diverted from landfill.
	Building Management Systems	Man - 10	1	1	0		0	BMS to monitor and report on energy and waste consumption, and monitor and control building services systems
	Learning Resources	Man - 13	1	1	0	0	0	Three sustainability initiatives (Water/Energy/Other) described and displayed and outcome continuously presented
	Life Cycle Costing	Man - 14	1	0	0	0	1	LCC carried out covering construction, operations, maintenance, and of life. Considers environmentally preferable options. Justify which option is chosen.
	Maintainability	Man - 15	1	1	0	0	0	Design review of plant access, ongoing maintenance, cleaning of building services. Development of Building Maintenance Guide.
	sub-total		17	11	0	0	6	
	Points Weighting		11.0	7.1	0.0	0.0	3.9	
INDOOR ENVIRONMENTAL QUALITY Credit value 0.68	Ventilation Rates	IEQ - 1	2	2	0	0	0	Require increased outside air rates in HVAC system i.e. 10 L/s/p (12.5L/s/p for additional point).
	Carbon Dioxide Monitoring & Control	IEQ - 3	1	0	0	0	1	Requires installation of CO_2 sensors in all return air points on each floor that adjust (increase) outside air rates depending on occupant density.
	Daylight	IEQ - 4	3	1	0	0	2	Daylight modelling required to prove extent of daylight penetration into occupied areas. Modelling will be included in fee proposal.
	Daylight Glare Control	IEQ - 5	1	0	0	0	1	External glare control (i.e. shading devices) or internal blinds required as part of the base building provision that restrict direct sunlight falling on the working plane 1.5m in from the building façade.
	Electric Lighting Levels	IEQ - 7	1	1	0	0	0	Require maximum maintained illuminance of no more than 80% of illumanace levels prescibed in SANS10114-1.
	External Views	IEQ - 8	2	0	0	0	2	Require uninterrupted views (8m beyond façade) to the outdoors for at least 60% (80%) of the occupied space (excluding auditorium and
	Thermal Comfort	IEQ - 9	2	0	0	0	2	Require thermal comfort levels to be between -1 and +1 on the PMV thermal comfort scale. Modelling is required.
	Hazardous Materials	IEQ - 11	1	1	0	0	0	Require hazardous materials survey to be undertaken by an occupational hygienest prior to demolition. If lead, asestos, or PCB's are found, these have to be removed in accordance with relevant standards and legislation prior to demolition.
	Internal Noise Levels	IEQ - 12	3	0	0	0	3	1 pt for building services noise not exceeding SANS 10103 levels; 1pt for overall building noise not exceeding SANS 10103 levels; 1 pt where other 2 pts achieved AND surface area with material of NRC of at least 0.7 exceeds total ceiling area OR reverberation time not exceeding set values
	Volatile Organic Compounds	IEQ - 13	3	3	0	0	0	Requires use of low VOC paints, as well as sealants and adhesives. Low VOC carpets/flooring must be installed as part of the base building to achieve the third point.
	Formaldehyde Minimisation	IEQ - 14	1	1	0	0	0	Requires use of composite wood products with low formaldehyde emissions or products that contain no formaldehyde.
	Mould Prevention	IEQ - 15	1	0	0	0	1	Requires control of humidty in occupied spaces to no more than 60% RH and no more than 80% RH in supply ductwork.
	Dedicated Exhaust Riser	IEQ - 16	0	0	0	0	0	Requires installation of exhaust fan and riser in all printing/photocopy areas per floor, per tenancy.
	Stairs	IEQ - 23	1	1	0	0	0	Stairs to be highly visible, with 20m of entrance AND 25% exterior glazing OR sufficiently daylit OR open to interior on one side
	Sub-totals		22	10	0	0	12	
	Points Weighting		15	6.8	0.0	0.0	8.2	
ENERGY Credit value 0.83	Conditional Requirement	Ene	0	0	0	0	0	Modelling required to demostrate that the building energy performance is equal to or better than the notional building (with deemed to comply fabric and services) described by SANS 204:2008 Energy Efficiency in Buildings. Cost of modelling will be included in the fee proposal.
	Greenhouse Gas Emissions	Ene - 1	20	13	0	0	7	Requires modelling to demonstrate improvement in building energy performance over and above SANS 204:2008. Energy Efficiency in Buildings. Points achieved can only be confirmed once building design and modelling has been progressed. Cost of modelling will be included in the fee proposal.
	Electrical Energy Sub-metering	Ene - 2	3	2	0	0	1	Metering and monitoring of electrical energy (1pt), metering and monotoring of thermal energy (1pt), additional pt where 1 other pt achieved AND electrical sub-metering is separate for lighting and power for 95% of building
	Lighting Zoning	Ene - 4	2	1	0	0	1	Require all individual or enclosed spaces to be individually switched with clearly labelled switching. Individual zones should not exceed 100m². Require an addressable (programmable e.g. DALI) lighting system to achieve second point (not currently targeted).
	Maximum Electrical Demand Reduction	Ene - 5	3	0	0	0	3	Require active reduction of peak electrical demand e.g. using cogeneration or onsite renewable energy.
	Unoccupied Spaces	Ene - 11	2	2	0	0	0	Unoccupied spaces naturally ventilated OR AC designed for automatic shutdown , or designed with set-back control band
	Sub-totals		30	18	0	0	12	
	Points Weighting		25.0	15.0	0.0	0.0	10.0	

TRANSPORT Credit value 1.00	Provision of Car Parking	Tra - 1	2	0	0	0	2	Require that the minimum parking allowances are not exceed by more than 10%. To achieve two points, the minimum parking allowances should not be exceeded at all.
	Fuel-efficient Transport	Tra - 2	0	0	0	0	0	Dedicate at least 5% of all parking spaces (AND 3% of staff bays) to car-pool/hybrid/alternative fuel vehicles AND 1 scooters/motorbike bay for every 20 car bays (or total 5 bays). These parking spaces should be located in preferred locations i.e. close to lifts.
	Cyclist Facilities	Tra - 3	3	3	0	0	0	Require secure, weather-protected, bike storage area, showers and changing facilities for 3% of building staff (6% for additional point) AND student bicycle storage: 5% for 1 pt, 10% for 2 pts, 15% for 3pts
	Commuting Mass Transport	Tra - 4	4	2	0	0	2	Points are achieved as a consequence of access to public transport from the site. No additional infrastructure required.
	Local Connectivity	Tra - 5	2	1	0	0	1	Points achieved as a consequence of the site's proximity to amenities such as banks, supermarkets, child care, gyms, etc.
	Vehicle Operating	Tra - 7	0	0	0	0	0	Traffic infrastructure improved, reduce peak hour CO2 emission by 15% (1pt) or 30% (2pts)
	Sub-totals		11	6	0	0	5	
	Points Weighting		11.0	6.0	0.0	0.0	5.0	
WATER Credit value 0.80	Occupant Amenity Water	Wat - 1	12	7	0	0	5	Require use of water efficient fixtures and fittings to achieve two points. Additional points can be achieved through use of rainwater harvesting, as well as use of greywater/blackwater systems (not currently targeted).
	Water Meters	Wat - 2	3	3	0	0	0	Submetering required for all major water uses in the project i.e. bathrooms, showers (for cyclists), heat rejection systems, irrigations systems, recycled water supply, etc. A system (e.g. BMS) is required to monitor all meters and consumption. Additional pt for solenoid for automatic shut-off
	Sub-totals		15	10	0	0	5	
	Points Weighting		12.0	8.0	0.0	0.0	4.0	
MATERIALS Credit value 0.63	Recycling Waste Storage	Mat - 1	3	3	0	0	0	Require dedicated recycling waste storage area suffieciently sized for collection and sorting of waste streams
	Building Reuse	Mat - 2	0	0	0	0	0	Requires reuse of at least 50% of existing building façade, as well as at least 30% (or 60% or 90% for additional points) of existing building volume.
	Recycled Content and Re-used Materials	Mat - 3	2	0	0	0	2	Requires that at least 0.5% of the project's total contract value is represented by reused products/materials such as bricks, windows, cladding, flooring and doors etc.
	Concrete	Mat - 5	3	2	0	0	1	Requires that the absolute quantity of Portland cement, as an average across all mixes (in situ, precast, stressed), is reduced by 30% (or 40% for an additional point). A further point (not currently targeted) can be achieved through the use of recycled or slag aggregate for 10% of structural aggregate application AND no natural aggregates are used in non-structural applications.
	Steel	Mat - 6	3	3	0	0	0	For a building predominantly framed in structural steel, at least 60% of all structural steel must have a recycled content of greater than 24% (1 point) OR for a building predominantly framed in reinforced/precast/stressed concrete, at least 60% of all reinforcing/stressing steel must have a recycled content of greater than 54% (1 point). For the two additional points, 90% of all steel (total of structural steel, reinfocing steel, and building envelope applications) has a recycled content of at least 54%.
	Sustainable Timber	Mat - 8	2	0	0	0	2	Requires that at least 50% by cost (or 95% for an additional point) of all timber products used in the building and construction works is either: reused timber, post-consumer recycled timber, FSC certified timber.
	Design for Disassembly	Mat - 9	1	0	0	0	1	Requires that 50% of: structural framing, roofing, and façade cladding systems are designed for disassembly OR 95% of the total façade is designed for disassembly.
	Dematerialisation	Mat - 10	1	0	0	0	1	Requires implementation design strategies to produce a net reduction in material used in project. Relates to building structure, ductwork,
	Local Sourcing	Mat - 11	2	0	0	0	2	Requires that at least 20% of the total contract value is represented by materials or products that have been sourced from within 400km of site. An additional point is available where 10% of the projects contract value is represented by materials that have been sourced from within 50km of the site.
	Masonary	Mat - 13	2	2	0	0	0	50% by area for 1 pt or 80% for 2 pts of the following: Clay bricks 20% perforation, concrete brick 20% perforation, concrete blocks 30% recycled content AND 10% portland cement replacement with industrial waste product
	Sub-totals		19	10	0	0	9	
	Points Weighting		12.0	6.3	0.0	0.0	5.7	
LAND USE AND ECOLOGY Credit value 0.58	Conditional Requirement	Eco	0	0	0	0	0	Automatically satisfied due to reuse of urban site.
	Topsoil	Eco - 1	1	1	0	0	0	If topsoil is present, it is a requirement to store and protect topsoil on site for reuse in the new development.
	Reuse of Land	Eco - 2	2	2	0	0	0	Requires reuse of previously developed land.
	Reclaimed Contaminated Land	Eco - 3	2	0	0	0	2	Requires that land was contaminated at the time of purchase and that the site is fully decontaminated prior to construction.
	Change of Ecological Value	Eco - 4	4	0	0	0	4	Requires improvement of ecological value of site. Not achievable in urban setting.
	Urban Heat Island	Eco - 5	2	1	0	0	1	Hardscape materials with SRI ≥ 29 for 1 pt; 75% of roof to have SRI ≥78 (for ≤10◦ pitch) or ≥29 (for >10◦ pitch) for second point
	Community Facilities	Eco - 8	1	0	0	0	1	Freely accessible community facilities provided for 5% or 50m2 of site area (whichever is greater)
	Sub-totals		12	4	0	0	7	
	Points Weighting		7.0	2.3	0.0	0.0	4.7	
EMISSIONS Credit value 0.44	Watercourse Pollution	Emi - 5	3	0	0	0	3	Requires that the development does not increase (pre-development) peak stormwater flows for rainfall events up to a 1-in-2 year storm (1-in-20 for additional point) AND total suspended solids (TSS) are reduced by 80% for the runoff volume resulting from a 1-in-2 year storm. A further point can be achieved by ensuring that the run-off volume resulting from the 1 day rainfall, that is equalled or exceeded on average 3 times per year, is either captured and reused on site or infiltrated within the site.
	Discharge to Sewer	Emi - 6	4	0	0	0	4	Up to two points can be expected through installation of efficient fixtures and fittings. For additional points, greywater or blackwater systems are required to reduce flows to sewer (not currently targeted).
	Light Pollution	Emi - 7	1	1	0	0	0	Requires that no lighting is directed into the night sky AND that façade lighting produces an average of no more than 10 candelas/m^2 AND that outdoor space lighting meets CIBSE LG6 requirements for maintained illuminance.
	Legionella	Emi - 8	1	1	0	0	0	Achieved through use of air-cooled chiller i.e. no evaporative cooling systems are installed on site.
	Boiler and Generator Emissions	Emi - 9	1	1	0	0	0	All gas boilers have NOx emissions < 100 mg/kWh (at 0% excess O2) AND all generators comply with the Tier 3 emissions standards as defined by the US EPA, or the equivalent European Stage IIIA standard.
	Atmospheric Deterioration Avoidance	Emi - 11	6	2	0	0	4	2 pts for refrigerants with ODP of zero; 2 pts for 100% of refrigerant with GWP ≤10 (1 pt for 50%); 2 pts for HVAC systems in air tight enclosure AND leak detection system
	Sub-totals		16	5	0	0	11	
	Points Weighting		7.0	2.2	0.0	0.0	4.8	
INNOVATION Credit value 1.00	Innovative Strategies & Technologies	Inn - 1	2	0	0	0	2	Not targeted as part of base credits.
	Exceeding GS Benchmarks	Inn - 2	2	0	0	0	2	Not targeted as part of base credits.
	Environmental Design Initiatives	Inn - 3	1	0	0	0	1	Not targeted as part of base credits.
	Sub-totals		5	0	0	0	5	
	Points Weighting		5.0	0.0	0.0	0.0	5.0	
	TOTAL UN-WEIGHTED		147	74	0	0	72	
	TOTAL WEIGHTING		100.0	54	0.0	0.0	46.2	

Included	54
Included + Recommended	54
Included + Recommended + TBA	54

Ratings	
4 Star	45-59
5 Star	60-74
6 Star	75+

Source: AGAMA, 2012

Appendix F

11.1 General sustainability

11.1.1 Lack of awareness, motivation and commitment

- The role of GCI has been important in raising awareness
- Motivation tend to wane amongst people, groups and over time, this limits progress
- This in turn limits commitment – which is also related to a number of other issues, for example, there needs to be clear opportunities to effect change, otherwise people become frustrated and give up
- There is no moral imperative for environmental sustainability yet at UCT and more broadly in South Africa – which some justify given the range of urgent socio-economic issues prevalent

11.1.2 Lack of resources

- Money: funding sources are decreasing, especially from the government; internal pressures (fees protests & insourcing) have led to austerity measures
- Human: staff, especially at P&S are over-worked; sustainability is not in their job descriptions or KPAs (for the large part); support is not provided (again, includes finances)

11.1.3 Competing priorities

- Environmental sustainability has struggled to rise up the priority list; more recently, other social transformation issues have come to the forefront
- Amongst operations – maintenance issues and retrofitting are currently trade-offs
- At any given time a university has a range of goals and new ones are kept being added, without resolving previous issues

11.1.4 Lack of coordination

- The nature of bureaucratic institutions, together with cross-cutting structures (due to operational and academic arms, each with its own structure) means that coordination across the university will be difficult. This is important given the nature of sustainability, as it is applicable to a range of departments and processes, however, sustainable buildings own their own are relatively simpler to manage
- Ideally a 'sustainability hub' or 'green office' or at the least a sustainability coordinator would be useful in addressing this challenge. However, there is a lack of resources and there are some logistical issues as well
- Both students and staff can be more involved but each faces their own constraints – e.g. turnover and loss in continuity and institutional memory
- Collaboration and coordination cannot be forced – it needs to happen organically

11.1.5 Inertia to change

- Firstly need to understand the complex nature of institution – how things are done, who does what, who has power and what procedures need to be followed to initiate something new
- This requires much time and effort and can become discouraging (especially students that are not at university for long)
- Inertia is also related to habits and norms – it is even harder to shift mindsets
- Once again need to allow people autonomy to explore and develop their networks and this does sometimes create change

11.1.6 Risk aversion

- Some universities have historically been risk-averse and less likely to, for example use large loans, especially to fund big projects – but this would be needed if renewable energy was to be used
- This may change in the near future – also entrepreneurial universities are growing

11.2 Sustainable buildings

11.2.1 Actual and perceived higher cost

- Green buildings do not need much technology – there are creative ways (especially using passive design) that minimises costs
- Green premium in South Africa has been decreasing – and the more players there are in the market, the faster it will develop and aid further cost reductions

11.2.2 Incomplete cost analysis

- LCC is not taken into account, also not used widely in South Africa yet
- Budget is worked out a priori and there is limited room to expand it later – therefore if a project goes overbudget, some sustainability features are removed – but this could mean higher operational costs for the building

11.2.3 Emerging green market

- GBCSA is relatively young – market is still maturing
- Some materials are becoming more easily available, but others are still expensive or need to be imported

11.2.4 Heritage Western Cape

- This is an external barrier – there is limited scope to eradicate this
- However NLT was successfully designed to get the 4 star rating

11.2.5 Inefficiency in committees and structure of organisation

- There are many committees and groups at UCT – so there can be redundancy. This can lengthen the process. However, it is useful to have multiple interests represented

- There can sometimes be a mis-match between university processes and external ones – therefore architects needs to be aware of how the university organisation functions and meet their needs
- Democratic process also lengthens process sometimes – managers and committee chairs need to take everyone's views into account
- Processes are non-standardised which also complicates things

11.2.6 Decision making processes

- Sometimes difficult to apply processes consistently
- Lack of responsibility for sustainability decisions
- Trade-off between long-term strategic and sustainable planning versus short-term priorities and gains

11.3 Energy Efficiency & Renewable Energy

11.3.1 Financial constraints

- Recurring theme – leads to trade-offs between maintenance and energy efficiency retrofits
- Also no clear budget allocated for the above
- No audit has been done – again no money to hire consultants – and even if it is done, there is no guarantee that retrofitting will happen

11.3.2 Lack of data and imperfect information

- Meters are now installed on nearly all buildings – should get better data about big users, etc.
- Need to develop new indicators for measuring and monitoring usage
- Need to disseminate information to users to encourage energy reduction

11.3.3 Split incentives

- Lack of interaction between users and operational side of UCT (they pay the electricity bill)
- Users (staff and students) do not directly pay for electricity (comes from amount paid per department from cost of maintaining space and fees respectively) – therefore lack of incentive to save as users do not directly get the benefit of savings

11.3.4 Behavioural issues

- Some people found that motion-censor lighting was a safety risk and so the light fitting had to be reinstalled in some instances
- Students sometimes leave lights on in lecture venues – difficult to monitor
- More needs to be done to raise awareness – e.g. switching lights off
- Moving to more open-plan and multi-use spaces – this could improve efficiency – but there is some resistance to this
- Also difficult to control external users of UCT venues
- Need to make it as easy and convenient as possible for people

11.3.5 Logistical issues (for renewable energy)

- Need to firstly source funding for a renewable energy project
- Need to conduct a pilot study to determine feasibility and iron out any technical and logistical issues
- UCT Upper Campus is East-West and not North-South facing – so limits power generation from solar PV

11.3.6 Historically cheap electricity

- In the past electricity was cheap in South Africa so there was less incentive to be energy efficient – but this has changed now with steep increases in tariffs

END