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PLANNING

**Living lab in architecture: Integrating university campus operational support(s)
with academic programmes, case of the University of the Witwatersrand,
School of Architecture and Planning, the Old John Moffat Building**

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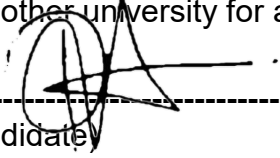
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Declaration

I declare this research report to be my work. It has been submitted to the University of Witwatersrand's School of Architecture and Planning for a Master's degree in Architecture Sustainable & Energy Efficient Cities. The research report has not been submitted to any other university for any degree or examination.



(Signature of candidate)

31 Day of May -2021

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Abstract

Essential the living laboratory concept is critical for any institution, most notably for universities where teaching, learning, and research are advanced/achieved/leading.

Living laboratories improve project outcomes, maintain policy alignment, and help boost green campus initiatives and energy policy discussions. The living laboratory approach provides innovation in planning, development and policy establishment and implementation in mitigating climate change challenges. Universities are leading in sustainable studies thus offer knowledge on climate change mitigation strategies. Global warming has resulted in climate change.

Additionally, we have universities, which increase the demand for energy and water, which are already limited resources. This problem is a direct risk to mitigate climate change challenges. Via their students' - staff research outputs, universities produce knowledge that includes mitigation strategies for addressing sustainability issues. Students and staff at Wits University cannot integrate their work output on campus to create real-world climate change solutions. By their role as a beacon of hope, universities cannot evade their responsibilities to model society's image. Thus, the main focus of this study is to test the hypothesis that universities' implementation of their students and staff green campus research outputs on campus is possible through implementing university-specific projects inside a living laboratory setting. The study's primary objective is to determine the pathways and barriers that hinder universities such as Wits University from adopting green campus policies and the concept of living labs. The study employed various methods to achieve a "humanistic orientation," including qualitative analysis, deductive analysis, and inductive analysis. Significant findings or themes identified in this study include the following: Siloed approach of working, a lack of coordination, and the inability of diverse departments to share knowledge and expertise became apparent as a problem.

A shortfall in funding for green campus initiatives is one cause for concern that must be address by the University. Universities have sought to integrate ethical values into their core activities in light of the climate change and sustainability agenda. Failure to implement and preserve green campus planning throughout its lifecycle is not sustainable for any institution or society at large. Wits University should establish an architect-led living laboratory to promote planning and development focused on win-

win strategies. This initiative will pave the way for future growth and facilitate the establishment of an eco-campus. When combined with the University's green campus initiative plan, the idea of a living laboratory would foster innovation on campus. The future University is a complex living organ that needs complex system management to deliver and influence the concept of future smart and sustainable cities. Creating a Campus Sustainability Lekgotla at the University would alleviate their primary difficulty of siloed approaches and allow for the flourishing of transdisciplinary and interdisciplinary concepts across the organisation's structures.

Keywords: living laboratory, green campus policies, pathways and barriers, innovation, climate change, sustainability, campus sustainability lekgotla.

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List of acronyms

AHES	African Higher Education Summit
BMS	Building Maintenance System
BSUA	British Sustainable University Alliance
CDP	University of the Witwatersrand Campus Planning and Development
CFM	Campus Facilities Manager
CSO	Central Sustainability Office
DHED	Department of Higher Education
EAUC	Environmental Association for Universities and Colleges
EMS	University Environmental Management System
ESRI	Environmental and Social Responsibility Index
GHG	Greenhouse Gas
GCAP	Green Campus Initiative
GCI	Global Change Institute
GCI	Green Campus Action Plan
HEIs	Higher Education Institutions
HESI	Higher Education Sustainability Initiative
HVAC	Heating, ventilation, and air conditioning
MSoUF	Ministerial Statement on University Funding
PDCA	Plan-Do-Check-Act
PDDF	Preliminary Development and Design Framework
PIMD	Property and Infrastructure Management Division
R&D	Research and Development
RIBA	Royal Institute of British Architects
SET	Senior Executive Team
SGDs	Sustainable Development Goals of the UN
SHE	Sustainability of Higher Education declaration
SoAP	School of Architecture and Planning
UCT	University of Cape Town
UDF	University of the Witwatersrand's Urban Design Framework
UI	Universities of Indonesia
UI GM	UI Green Metric Ranking of World Universities
USS	University Sustainability Strategy

UN	United Nations
UN DESD	United Nations Decade of Education for Sustainable Development
UNEP	United Nations Environment Programme
WBEP	Wits Built Environment Precinct
WEO	World Energy Outlook

CHAPTER 1: Introduction

1.1 Introduction

The current negative impact on the environment from the extraction of natural resources needed for the development and growth and the high intensive energy consumption of our cities is a cause for concern. A healthy society requires a long-term vision, collaboration. And a system-based approach to addressing environmental, social and economic challenges. This argument applies to the scenario of the university campus. A university campus is like a city or a village in itself. In other words, a university is a small scale city. As a small-scale "city," resources exist for the University to apply this experience by testing it on its campus (living lab) and then scaling it up to solve sustainability and climate change issues at the city level. The Minister for Higher Education and Training, Mr Blade Nzimande, launched the Green Campus Initiative (GCI) in South Africa in 2012 to promote sustainability in higher educational spaces (Mafongosi *et al.*, 2018). The launch aimed to make Higher Education Institutions (HEIs) aware of the negative environmental impact in their day-to-day operations (Mafongosi *et al.*, 2018).

“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”(ULSF, 2015).

The campus should be in a position to help the well-being of its inhabitants. Like the cities, energy-efficient usage and other material resources are critical to universities' development and growth. From its beginning to the present day, the industrial revolution's ultimate purpose has always been to increase humankind's standard of living. This observation implies that economic growth causes an increase in energy consumption and other material resources. The demand for energy and natural resources has resulted in adverse climate effects. The growth in energy production and excavation of natural resources within our cities are executed in unsustainable measures contributing to GHG emissions, worsening climate change impacts.

As a small city, university buildings constitute a significant energy and water consumption source, resulting in air emissions and soil degradation due to their heavy use. Thus, campus sustainability is an issue for universities and has also become an issue for university policymakers, planners and society. Generally, university campuses own large volumes of buildings, and energy consumption and electricity bills are the costliest drivers of rising university education costs. According to Alshuwaikhat and Abubakar (2008), universities use large amounts of energy, hydrocarbons and water, each with environmental impacts.

The above arguments underscore the importance of why universities need to take the lead in the field of sustainability and launch green campus action plans, borrowing from the principles of the living laboratory concept to reduce the carbon footprint of campuses. University campuses may be living laboratories that undertake (re)design, landscape change, public engagement and governance studies on holistic approaches and may provide valuable lessons and experience in larger projects (Lipschutz *et al.*, 2017). Numerous structural, infrastructural, and institutional ties and characteristics to cities and campuses can be applied in one case to another (Lipschutz *et al.*, 2017). The chapter on literature review delves deeply into the definition(s) and the concept of a living lab. Various multi-stakeholder governance teams can also run living laboratories through transdisciplinary collaborations to reduce research silos (Save, 2014). The concept of applying knowledge that the University itself generates is called a living laboratory. Therefore, the campus should incorporate the principles of sustainable universities and living laboratories to achieve its current sustainability objectives (Baletić and Samsøe, 2013). Both concepts complement each other and will enable the campus to develop new urban development scenarios that can be sampled for the best environmental, social and economic performance.

1.2 Background

In the context of the climate change and sustainability plan, we need to decarbonise our economy and development plan. We have specific institutions in our society, such as universities, where it has been identified that institutions in our society have a role to play in their physical carbon reduction and prototyping the concept of living laboratories. The universities are well-positioned to act as 'living laboratories' for new

creative technological innovations and best social practices to address the socio-economic needs of cities and regions that are still in a position to meet the needs of future generations (Konig, 2013). The University works in various areas of sustainability through the academic outputs of its students and faculties. This research output is valuable information that has been developed. Universities, therefore, have a critical role to play in state, national and global systems that promote sustainable social and technical structures through their integrated mission in science, education and citizen participation.

The Living Laboratory idea is based on the University using its sustainability research outputs by actual testing and implementation in its buildings. Previously, Wits University's Property and Infrastructure Management Division (PIMD) investigated and reported on well-ventilated infrastructure and environmental issues on campus through organisational structures to relevant Wits University main stakeholders. These include deferred maintenance audit reports (Heating, ventilation, and air conditioning (HVAC), Energy, Waste, etc.) commissioned by the University and infrastructure planning and management departments - PIMD and Campus Planning and Development (CPD). Second, staff and students from Wits' diverse sustainability campus communities developed academic output research on the University's eco- and green-campus initiatives. For example, with an emphasis on the John Moffat Building (JMB) Precinct and in keeping with South African universities' Green Campus Initiatives, Wits University's staff and students undertook sustainability research that culminated in specific proposals that can be tested and implemented on JMB. The ultimate goal of this research output strategy produced by students and staff is to maximize energy and water use, waste reduction, the introduction of renewable energy technologies, the sustainability of land use, and the indoor environmental quality for the Wits University community.

Examples of reports coming from the University's research by staff and students, mainly with the specific focus on the JMB:

- John Moffat Building installed power audit report (Cronje, 2008);
- Preliminary Development and Design Framework for the University of the Witwatersrand. Johannesburg (Hansen *et al.*, 2009);

- Wits Eco-campus: Towards a greening framework for the BE-Precinct upgrade (Akoob *et al.*, 2012);
- The John Moffat Building: a conservation report. School of Architecture and Planning, University of the Witwatersrand. (Keeling & Leuven, 2014);
- Towards a Wits sustainability strategy (Erasmus, 2018);
- Eco-campus report: Wits Built Environment Precinct, School of Architecture and Planning, Faculty of Engineering and the Built Environment, the University of the Witwatersrand (Paschini, 2015.).

Examples of reports from the University's research by staff and students mainly focus on the Wits University Spatial Planning and Development.

- An improved version of the Preliminary Development and Design Framework 2008/09 for Wits is the 2020 revision. The revision is a working document called Spatial Development Framework: Braamfontein & Parktown Campuses (Ludwig Hansen Architects and Urban Designers, 2020);
- The project "Building a Resilient Johannesburg to Climate Challenges" focuses on developing long-term and short-term strategies to establish a resilient city in the face of climate variability and climate change (GCI); Deferred Maintenance Audit reports, PIMD and CPD (Wits, 2020).

1.3 The University of the Witwatersrand, Johannesburg, in context

The University of Witwatersrand, also known as Wits University, is a well-known Higher Education Institution (HEI) in South Africa and is recognised and rated as one of the most highly ranked universities in Africa and the rest of the world. Wits University is located and spread over 400 acres of land in Parktown and Braamfontein, on the outskirts of downtown Johannesburg, near the M1 highway, and is surrounded by highly dense commercial and residential areas **Figure 1** below.

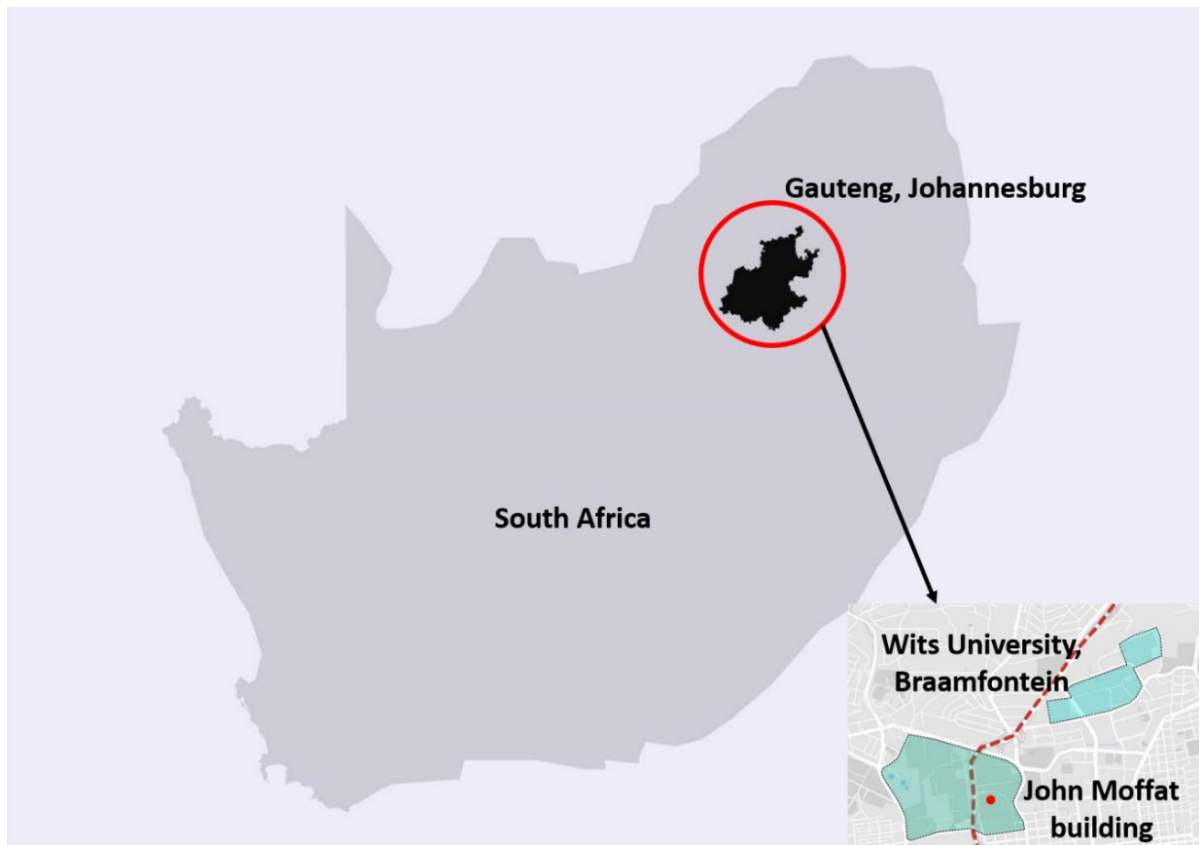


Figure 1: University of the Witwatersrand locality map (mapz.com – map data OpenStreetMap Odb and Rodney Matentshi, 2019).

The South African School of Mines established the University, founded in Kimberley in 1896, transferred to Johannesburg as Transvaal's Technical Institute in 1904 and renamed the “South African School of Mines and Technology” in 1906 (Wits University, 2020).

Additional departments were added as the institution grew, and the name of the university college, Johannesburg, was changed in 1920 (Wits University, 2020). The College was granted full university status as the University of the Witwatersrand in 1922, effective 1 March (Wits University, 2020).

Between 1947 and the 1980s, the number of students increased rapidly, reaching 6 275 in 1963, 10 600 in 1975 and 16 400 in 1985. The total student population of Wits University risen from 33 711 in 2015 to more than 40 000 in 2019 (Wits 2019 Annual Report), and currently, Wits offers approximately 3,400 courses to 40,259 students in five faculties (commerce, law and management; engineering and building environment; health care; science) and 33 schools. Wits University Vice-Principal

presented the 2020-2025 Enrolment Plan, which proposes that the University should have a total headcount of 44 000 by 2025, with a stable base of 36 000 contact students, and that the number of part-time and distance learning students should increase to 8 000 by 2025 (Wits Annual Report, 2019). Over the same period, the Wits Campus Operational Strategy to manage resources such as water, energy, food, transport, land use, and waste has been relatively moderate.

1.4 Architect led green campus initiative living lab – Wits School of Architecture and Planning

The roles of architectural schools such as the Wits School of Architecture and Planning (SoAP) were to prepare their students visually, artistically and technologically for the practice and production of architecture. The primary objective of the Wits School of Architecture and Planning (SoAP) is to provide an optimal learning environment and to provide accredited professional qualifications in architecture, planning and related interdisciplinary urban and urban design (SoAP, 2020). The aim is to influence policy through advocacy and research, particularly in urban spatial transformation, sustainable development, affordable housing, social justice, and citizens' right to access the city (SoAP, 2020).

The School of Architecture and Planning, **Figure 2**, has played an essential role in the planning and development of the Wits campus architecture. *"The growth of the [School of Architecture and Planning] coincided with the development of [Wits], which began in the 1920s with the neo-classical building of the Central Block, which dominates the symmetrically placed central axis of the Eastern Campus"* (Keeling & Leuven, 2014:5). The University planned and developed new buildings on campus for the next 30 years. The Architects of the University led the projects for the first 20 years of campus planning and development. Professor of Architecture in South Africa, Geoffrey Eastcott Pearse, Head of the School of Architecture at Wits, played a supporting role.

Wits University placed its trust in the School of Architecture and Planning only in the late 1930s (SoAP). To carry out the planning and development functions for the campus. And entrusted Duncan Howie with the *"design [of] the Hillman Building in 1939 and Pearse and Cowin with the design of the Dental School and Hospital in 1941"* (Keeling & Leuven, 2014:5).



Figure 2: Perspective watercolour of the Old John Moffat Building (J. Fassler circa 1955).

One example building, **Figure 2** above, stands as an exhibit on the Wits' School of Architecture and Planning (SoAP). In the past, it played a critical role in the planning and development of campus architecture; an example is the construction of a new building for the John Moffat Building School of Architecture and Planning in 1957. *"The building was designed by Prof. J. Fassler in association with W.D. Howie, G. Herbert, J. Morgenstern, J. Shunn, U. Tomaselli, all of whom were staff members (jointly called Studio Seven) of the Department of Architecture at the time"* (Fisher, 2014:58). Studio Seven was a university 'architectural living lab' in the planning and development of Wits University campus architecture. This hints at the idea that an architect-led green campus living lab at the Wits School of Architecture and Planning can play a leading role in the green campus initiative on campuses.

1.5 Problem statement

Global warming is a cause for concern for climate change. We have universities that also add a great deal of pressure and demand for energy and water use. The issue is that the universities generate knowledge about addressing sustainability issues through their research outputs (student and staff research reports). Nonetheless, the universities fail to capitalize on these reports and the expertise and possible solutions to numerous problems. There is an opportunity to integrate and assess this information within the University. We have incidences where schools such as the Wits School of Architecture and Planning (SoAP) have identified ways to resolve these issues through climate change mitigation reports. These initiatives have

remained unimplemented. Staff and students at the School of Architecture and Planning develop research reports as part of their studies. Instead of testing the proposals from many of these research reports (produced by staff and students), they are easily overlooked, archived or forgotten.

These reports recommended the changes needed to address campus environmental challenges and develop an integrated ecological sustainability strategy. However, little progress has been made in coordinating and implementing the recommendations. These numerous attempts do not seem to have been effective.

1.6 Research rationale

Thus, the problem has been stated, and as a result, this paper will research the following reasons:

- (a) Because of the reason that there is insufficient research to see if Wits University has a green campus initiative or not,
- (b) The limited available research on the examination of current pathways and barriers to holistic green campus initiatives at Wits University,
- (c) There is not enough evidence if anyone has identified whether or not Wits has challenges to implementing these reports,
- (d) Lack of evidence if anyone has identified whether or not Wits has an integrated environmental sustainable strategy.

1.7 Research aims and objectives

1.7.1 Aims

This research explores the concept of a living laboratory as an effective and efficient method of testing ideas generated by the University's research.

1.7.2 Objectives

This research paper will examine the current status of integrated management approach system or policy papers. Review campus planning, identify the existing pathways, if there are any, and barriers to embrace holistic green campus initiatives at Wits University from multiple key stakeholder views and propose a possible approach to these common barriers. The focuses on the following areas to meet the objective(s):

- To show how a university can use its study to test sustainability principles and how these concepts can be scaled up at a city level. Since a university is comparable to a city,
- Ascertain the most successful means by which Wits University can create an integrated and sustainable university framework,
- Consider how the Schools of Architecture and Planning (SoAP) could create a living laboratory institute and lead the teaching process through green building practices on campus.

1.8 Research question and Sub-questions

The global emergence of living labs is projected as a successful strategy for integrating green campus policies based on academic output. Given this great potential (to integrate) of such a living lab, as cited by many scholars and researchers worldwide, the study area prioritises a narrative driven by the importance of protecting the environment. This research, therefore, has two parts or aspects that are connected. Research wants the University to be a green campus, but it says it wants the University to be a living lab. As a result, these two-fold events can occur in conjunction with the curriculum. These two components are mutually exclusive, but they can operate as a single entity or as distinct entities depending on the operating conditions.

1.8.1 Research question

What current paths, if any and barriers exist to Wits University implementing its research outputs on its campus land and buildings?

1.8.2 Sub-questions

Does the University have a policy and strategy for using and implementing its research outputs to enhance its sustainability?

What would be the ideal organisational structure for implementing this policy?

What are the views of Wits staff on the Green Campus Initiatives led by the Living Laboratory Strategy?

1.9 Structure of the research report

There are five chapters in this research report to follow, and they include. **Chapter 2** examines research-related literature, whereas **Chapter 3** discusses methodology and ethics. **Chapters 4** reflect on the data that is collected and deepen the analysis and findings of the data. The final chapter, **Chapter 5**, examines the results, recommends and concludes the study.

CHAPTER 2: Literature review

2.1 Introduction

This section consolidates the existing literature that forms the basis of the theoretical framework concepts in addressing the research question and the sub-questions mentioned above. The literature review will focus on the following areas of studies:

- a) Concept of green campus initiatives;
- b) Green campus based on the architectural perspective;
- c) Concept of the living laboratory;
- d) Barriers towards living laboratory;
- e) Case studies of green campus initiatives and living laboratories;
- f) Academic outputs and their potential implementation within universities;
- g) Organisational knowledge sharing;
- h) Current Wits organisation structure and governing system;
- i) Governance and business models for sustainability;
- j) Sustainable University;
- k) Barriers to the adoption of an integrated environmental sustainability strategy;
- l) Governance and business models and;
- m) Management of sustainable transitions.

2.2 African universities' participation in the ranking

This part assesses and presents the current status of African universities concerning global green campus initiatives. There is compelling evidence that universities are committed to their sustainability goals by improving the carbon footprint of their activities and operations. However, in the World University Ranking 2019 Sustainable Development Goals (SDGs): the number of participating universities in climate action is much lower than in the global academic rankings (Zuma and Parusnath, cited in Curiosity 9: # ClimateEmergency, 2020). This questions the relevance of the Sustainability of Higher Education declaration (SHE).

“The Talloires Declaration (TD) is a ten-point action plan for integrating sustainability and environmental literacy into college and university teaching, research, operations, and outreach. It was signed by more than 500 university heads from

more than 50 nations. Composed in 1990 during an international conference in Talloires, France, this is the first public statement of a commitment to environmental sustainability in higher education by university presidents, chancellors, and rectors” (ULSF, 2015).

TD has probably been the most comprehensive international regulatory document on the role of universities in the field of sustainable development to date.

A recent study on sustainability (Ali & Anufriev, 2020) looked at the performance of African higher education institutions on the ranking table (World University Ranking 2019 Sustainable Development Goals) and the impact they had on their respective countries. To measure each University's sustainability performance, the World University Rankings utilizes the UI GreenMetric tool. Their research compared the World University Ranking 2019 Sustainable Development Goals results obtained between participating universities, trends in carbon dioxide (CO₂) emissions, and developments in renewable energy (RE). While there has been some moderate reduction in CO₂ emissions and greater usage of renewable Energy in some participating nations, their study found that overall performance in each area evaluated using the UI GreenMetric ranking is unsatisfactory (see **Table 1** below). The GreenMetric UI standard contains six categories, i.e. Energy and climate change, waste, water, transport, research and education, development and infrastructure (Lourrinx *et al.*, 2019).

Table 1: UI GreenMetric ranking categories and indicators (Lourrinx *et al.*, 2019).

Categories	Description
Energy and climate change	• Identification of several indicators for specific areas of interest such as the use of energy-saving tools, smart building implementation, renewable energy policy, total energy consumption, energy conservation programs, green building elements, adaptation to climate change and mitigation, reduction policies in the use of greenhouse gases and carbon content.
Waste	• Recycling and waste management programs should be one of the Universities' concerns, for example, a program of recycling, recycling of toxic waste, organic waste processing, inorganic waste treatment, waste disposal, policy on reducing the use of paper and plastics on campus.
Water	• The goal is to promote campuses to reduce water use, enhance conservation programs and protect habitats. The criteria include water conservation programs, water recycling programmes, water efficiency and the application of treated water.
Transport	• Transportation policy will encourage a healthier environment by using the campus bus and bicycle to limit vehicles. Students and staff will be encouraged to walk around the campus and avoid private cars.
Research and education	• Environmental education creates a learning process to shape the personality of environmentally conscious students who understand the concept of environment-friendly and eco-friendly lifestyles.

Overall, a study by Ali and Anufriev (2020) showed that the participation of African universities in the ranking, **Table 2** below, was meagre. In Africa, only 18 out of 507 signatory countries to the 1990 Talloires Declaration (Ali & Anufriev, 2020) include the following universities from the following African countries:

Table 2: African HEIs on the ranking table (Ali & Anufriev, 2020).

Countries	Universities
Ghana	University of Ghana, Legon, and Valley View University, Accra.
Kenya	Kenya Marine and Fisheries Institute, Moi University, Eldoret, and the University of Nairobi, Nairobi.
Malawi	University of Malawi System: Bunda College of Agriculture, Chancellor College, Zomba, Kamuzu College of Nursing, Medical College, and Polytechnic Institute.
Nigeria	Ahmadu Bello University, Zaria, and University of Ibadan, Ibadan
South Africa	Rhodes University, Eastern Cape Province, University of Cape Town, Cape Town, University of Natal, Durban, University of the Western Cape, Bellville, and University of Witwatersrand, Johannesburg.
Zimbabwe	University of Zimbabwe, Harare.

Ali and Anufriev's (2020) report recommended that, by making it mandatory for HEIs to implement these strategies, Africa's government should be obliged to institutionalise green campus initiatives. Second, the study recommended that African countries and their universities increase their support for green technology research, methods and practices in awareness and education on green campus initiatives (Ali & Anufriev, 2020).

In the following section, we will begin to identify the rationale behind the barriers to adopting an integrated environmental sustainability strategy/policies, outline and propose possible solutions needed to address the challenges of green campus initiatives. The low ranking of Higher Education Institutions in Africa on addressing sustainability issues demonstrates that African universities lack the awareness, support, drive, and knowledge to lead by example and influence environmental sustainability issues faced in their local communities/societies. This approach will set an excellent model for our cities to transform cities into resilient and sustainable environments successfully and efficiently. The paper by Gholami *et al.*, (2020) describes these barriers as a lack of knowledge and understanding of innovation and

systemic change within the institution between faculties and administration regarding sustainable development. In addition, they describe lack of awareness as "*a limited environmental awareness of how to act sustainably among university communities*" (Gholami *et al.*, 2020:4).

The study (Ali & Anufriev, 2020) is highly critical of African universities for their low implementation rate. For example, it found that African universities face significant challenges in implementing integrated environmental sustainability. This is when we begin to witness the government's involvement in the green campus initiative approach, with calls for policies to be implemented to regulate higher education institutions' performance to minimize campus CO₂ emissions. Through the Higher Education Department, the Government of South Africa contributes a significant amount of funding in Infrastructure Earmarked Grant (IEG) for the development, maintenance and refurbishment of HEI buildings and infrastructure. Thus, the regulation of universities will be fair and just. Currently, the Higher Education Act (No. 101 of 1997) governs the governance of South African universities.

2.3 Concept of green campus initiatives

HEIs have a significant role in designing and implementing creative education policies and sustainable development strategies. Thus, policy definition includes critical components, including its purpose, vision and objectives, operational structure, and approach, including how a university should foster sustainability, reflecting the sustainability mechanism that promotes university development. Therefore, the sustainable university initiative should be based on the environmental objectives and targets of the universities, including how they manage the concept of a sustainable university (Alshuwaikhat & Abubakar, 2008). Achieving sustainable university initiatives, together with the benefits of social responsibility, will lead universities to promote the inclusion of environmental justice, equality of all races and gender groups, vulnerable and needy social groups and people living with disabilities. Alshuwaikhat and Abubakar (2008) agree that the advantage of public participation is that it is an integrated strategy that promotes sustainability through various methods. This includes public participation and partnership, community services and social justice. As a result, sustainability methodologies must be included in university-level

conferences, seminars, workshops, sustainability courses and curricula, and research and development (R&D) (Alshuwaikhat & Abubakar, 2008).

We can see substantial evidence that while global green campus initiative trends are on the rise and new standards have been set since the SHE declaration began, there are critical challenges and solutions for championing sustainable development policy. These declarations are identified as a regulatory document regarding the clarification of the role of universities in sustainable development matters. Thus, the Higher Education Sustainability Declaration (SHE) can be seen as part of the international environmental sustainability framework/instrument for green campus initiatives. As a result, this emphasizes the role of universities as a sustainable university.

2.4 Green campus concept based on architect perspective

In the context of the global vision of a sustainable future, architecture schools have adapted their thinking in line with the Sustainable Development Goals (SDGs) to keep global temperatures below 2°C. Keeping global temperatures as low as 2°C as possible will help avoid climate change's dangerous and terrible impact (World Energy Revolution, 2012). Architects, planners and communities involved in the planning and developing buildings and cities, both in their personal and professional capacity, are responsible for the planning and designing healthy buildings, campuses and cities with an awareness of climate change in mind. Shi and Yang (2013) agreed that the green building had gradually become a high-tech architectural machine. Thus, Green Building literature describes the position of Architects as the leading discipline of the project team, an essential function in directing and implementing a performance-driven concept.

Green building is part of a sustainable idea, and, throughout this time, universities are trying to adopt the sustainability philosophy on campus and its surroundings. The incorporation of the green campus philosophy into buildings is, therefore, a pivotal aspect to adopt. The development of green campuses can help promote regional economic and social development (Fachrudin, 2020). The universities also contribute to the Sustainable Development Goals by focusing on the transition to cleaner energy technology, aligning with SDG 7 on sustainable Energy and SDG 13 on climate change. SDG 15, which aims to conserve forests and biodiversity and manage them

effectively, complements SDG 11 on sustainable cities and communities and SDG 4 on promoting excellent education by encouraging students to build an environmental awareness culture.

2.5 Concept of Living Laboratory

2.5.1 Definition(s)

According to a research report (a thesis) by Save (2014), the Georgia Institute of Technology group established the first documented reference to the term "Living Laboratory" for technological development in 1999. However, a paper by Mulvenna *et al.*, (2010) states that William J. Mitchell, the architect and academic, created the concept of living laboratories. Based at the Massachusetts Institute of Technology (MIT), Mitchell was interested in ways urban residents could be more active in urban planning and urban development. However, this concept of 'living lab' can be defined and understood in several ways. Including the following definitions:

- Callaghan and Herselman (2015:22) define the living lab as a paradigm that “creates inter-disciplinary spaces where participants or stakeholders can co-create solutions to challenges”.
- Evans *et al.* (2015:1) write, “Living labs and co-production are increasingly popular strategies for universities to address sustainability challenges, and yet the links between them remain largely implicit”.
- The living labs process is a collaborative process that enables innovation in various areas, including (Hua, 2013:49) “planning, building performance, transportation, procurement, technology and policies”.
- Concerning Save (2014:29), “Living labs are a venue for societal, environmental, and economic benefits to be explored through development and demonstration of projects”.
- The definition of Living Lab given by the European Network of Living Labs is that “a Living Lab is an open innovation environment in real-life settings in which user-driven innovation is the co-creation process for new services, products, and societal infrastructures” (Bergvall-Kåreborn & Ståhlbröst, 2009: 2)

2.5.2 University as a living laboratory

This section of the literature study explores the efficacy of the University as a living laboratory concept. Universities can transform into living laboratories by implementing research outputs conducted by staff and students in their own spaces or areas of study in collaboration with operational employees. The benefits of this for the University in terms of produce highly qualifies and competitive graduates include: Graduate students who can overcome this larger, pervasive form of learning, the educational experience of graduates must reflect an intimate connection among curricula and research. Secondly, they will understand and reduce any negative ecological and carbon footprint of the institution. They also improve local and regional communities to be healthier, socially vibrant, stable, economically secure, and environmentally sustainable (Cortese: 2003). The campus experience and learning is a complex web of activities that students learn from the campus environment around them (Cortese, 2003).

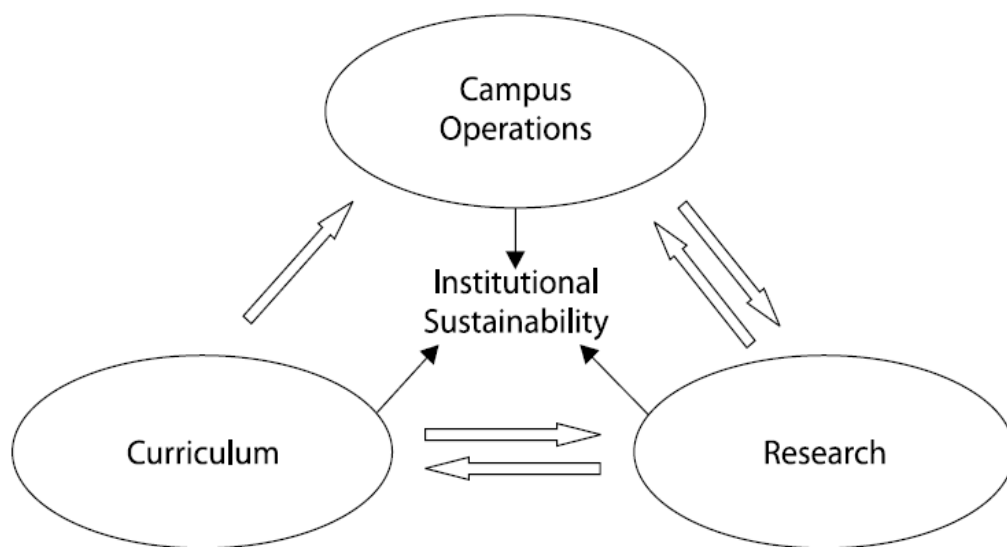


Figure 3: A whole-of-university approach to sustainability (McMillin & Dyball, 2009:57).

Based on the above **Figure 3**, all parts of the University are critical, and they have to function as a whole. “*This approach seeks to break down currently existing barriers between functional units of the institution*” (McMillin & Dyball, 2009: 57). For example, Ball State University uses a 'whole-system approach' with a long history of integrating facility management, operational and academic activities and covering all issues related to green-campus initiatives (Koester *et al.*, 2006). 'Whole-system approach' means that the University recognizes that any higher education institution consists of

activities and operations that simulate a complex ecosystem (Koester *et al.*, 2006). However, the 'whole-system approach' requires the University to pay attention to the campus's planning and development and the University's growth (Koester *et al.*, 2006). The whole-system approach embraces the strategy of public participation and social responsibility as the most appropriate means of ensuring broad stakeholder engagement. Therefore the employment of public involvement and social responsibility as a process requires the involvement of university stakeholders, and this approach to sustainable university initiatives is at the centre of the institution's strategy.

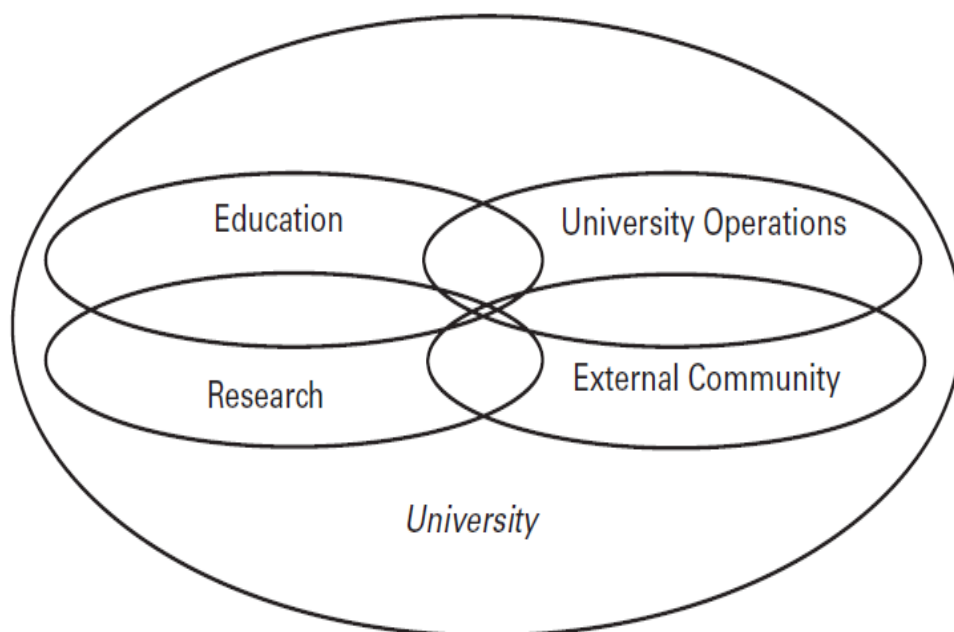


Figure 4: General practice of higher education (Cortese, 2003:17).

Figure 4 above describes a higher education system that treats “*teaching, research, operations, and relations with local communities as separate activities*” (Cortese. 2003:17).

While Cortese (2003) argues in **Figure 5** below that these are not completely different things and that all aspects of the university system are crucial to producing transformative change that can occur only through integrating the whole system (head, heart, and hand). Tan and Chen (2013) confirm this theory and state that the development of energy-efficiency and sustainable development integrated with operations and facility management, the introduction of the concept of living

laboratories, and the promotion of closer cooperation between all main stakeholders in universities (including students, academics, and staff) is essential. It aligns with SGDs in mitigating climate change. For example, as soon as the living lab becomes a group of students, then it becomes not only something that shows that there is effective teaching happening. But it's also something that can be used to place the University at the centre of developing an initiative that addresses climate.

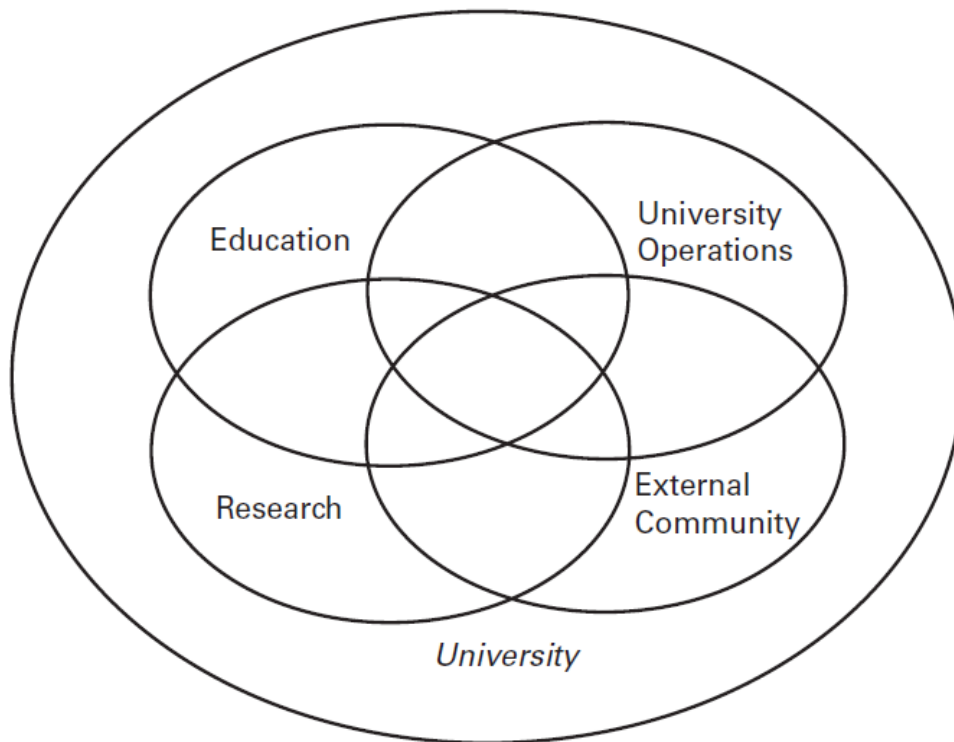


Figure 5: Higher education modelling sustainability as a fully integrated system (Cortese, 2003:18).

According to living lab concepts, the model is ideal for establishing an integrated, environmentally sustainable university. Three key concepts of a living lab promote sustainable growth. The concepts include the theory of interdisciplinary, co-production and collaboration as measures to facilitate the sustainable development of the institution. As a result, campus as a living lab provides universities with the benefits of planning and developing green campus-led. These live laboratory projects integrate all components of the University, including operational activities, research and education, with the collaboration of all stakeholders. The method calls for an integrated strategy see **Table 3** below. An integrated system will ensure that critical stakeholders are strongly involved in sustainable university initiatives, discussions, planning and development. Therefore, the concept of living labs will serve the purpose of addressing

environmental impacts and the challenges of the carbon footprint on campus, from improving energy use in buildings to reducing campus pollution. Living Labs will further serve as a space for developing scenarios (innovations) to define sustainability needs and develop ways to achieve goals. By adopting the living lab concept, universities can affect their society in various ways, including addressing complex issues such as transforming cities into resilient, healthy, and sustainable environments.

Table 3: Concepts of green campus and living lab.

Concepts	Concepts of living and their related text
Inter-disciplinary	Interlinking disciplines explore society's challenges and integrate academic activities, campus planning, development, operating, and management.
Co-production	Refers to co-production of knowledge.
Collaboration	The collaboration will ensure that the all-key stakeholders strongly feature universities' sustainable initiatives, discussions, planning, and development.
Cooperation	Cooperation of a university refers to openness, practice, and sustainable growth, fostering university policy.

Baletić and Samsøe write in their 2013 paper and agree that when looking at the future of our cities and their development, campus planning should be seen as a driving force. The University as a living laboratory is a methodological paradigm that provides methodology with direction for identifying the worth of innovation rather than prescribing what to accomplish. Value innovation as a tool in a program that encourages a shared goal and cooperation between all stakeholders to achieve their objectives. The term "*university cooperation*" refers to the openness, engagement, and long-term growth of universities, as well as the promotion of university policy (Lukman & Glavic, 2007). An open framework/policy for exchanging ideas, resources, and knowledge reduces entropy and increases originality and efficiency (Lukman & Glavic, 2007).

The University is the ideal place to study sustainability challenges. Scholars emphasize the desire for universities to have sound alternative strategies that will serve them by playing an essential role in bringing much-needed change to future

sustainability and sustainability leaders. In South Africa, universities are challenged to provide limited resources for effective management, 35 per cent of the total university expenditure of R56.6 billion in 2014 was spent on goods and services, and 10 per cent of that total expenditure was spent on non-financial assets amounting to 5.5 billion (Dlamini, 2016, StatSA, 2015). The development of higher education institutions as living laboratories will therefore be relevant, as living laboratories call on universities to employ 'efficient procurement processes that have the potential to save costs and increase the overall revenue of the organisation' (Dlamini, 2016:21). The critical point is that a living laboratory may indeed unlock an organisation's innovation potential. For example, we will see a massive shift toward knowledge-based productivity within organisations in terms of innovation due to living labs.

2.6 Barriers toward living laboratory

In terms of barriers to living laboratories, *"the lack of consensus among players in a complex system is one of the greatest barriers to innovation"* (Kanter cited in Schaffers & Turkama, 2012:25). Innovation of one sub-group is a loss of control of another sub-group (Kanter cited in Schaffers & Turkama, 2012). Another barrier in the paper by Schaffers and Turkama (2012) is that there is a risk that the value proposition will not be communicable since the word "living lab" can mean different things in different contexts and target groups. In addition, the living laboratory approach itself faces several risks, including a lack of standardisation and inadequate methodology and performance criteria for living laboratories (Schaffers & Turkama, 2012). Most living laboratories do not have sustainable business models because they are funded on a project basis or as part of universities or regional development agencies (Schaffers & Turkama, 2012). Living laboratories promote innovation. Business models are a critical component of our analysis since they affect innovation. There must be an innovation mindset within the organisation and an appetite on the part of the executive and board, particularly in the green campus initiative space. Innovation is about expanding organisations, trying new things, introducing new ideas and in certain conditions, altering a product, a service, or a process that will impact social change. It increases emphasis on incremental innovation. In other words, disruptive innovation. Business models that integrate disruptive innovation evolve to meet future needs—in other terms, setting an example and maintaining a competitive edge. Mulvenna *et al.*, (2010) agree that Living Laboratories do not have strong, explicit,

precise business models and models that make it easier for all stakeholders to resolve profitable partnerships. In addition, Mulvenna *et al.*, (2010) write that living laboratories face challenges linked to potential problems in each area of infrastructure, methods, tools and policies. Throughout, Mulvenna *et al.*, (2010) continue to agree with Schaffers and Turkman's (2012) by identifying additional challenges related to standardization, collaboration and efficiency. Concerning these challenges of standardisation, *"each of these issues is a matter of living lab standardization, and the presence of a governance organisation means that living labs should have access to the harmonization and standardization roadmap"* (Mulvenna *et al.*, 2010:7).

2.7 Case studies of green campus initiatives and living laboratories

2.7.1 Case study: Green campus initiatives - Tongji University

Challenges

With the future prediction of severe climate change, increase in energy globally, in 2003 among Chinese University the Tongji University took the leading role to initiate its sustainable campus construction to demonstrate sustainable university concept in China (Tan & Chen, 2013).

Pathways

Tongji University employed a 'campus building energy management system' that supervises the behaviour and campus facilities performance to achieve this goal. For example, one of the projects by the Tongji University - Retrofitting of students' bathrooms, employed energy-efficient technology (Solar water heating system; water reuse system; and heat recovery from the water system) that had significant financial savings benefits (Tan & Chen, 2013).

The impact of green campus initiatives

Since the launch of this program, Tongji University has completed a range of projects in efficiency and renewable Energy uses, including recycling water resources and improving existing stock and heritage buildings (Tan & Chen, 2013). The purpose of campus sustainable development for Tongji University focused on-campus Energy and water consumption. This initiative has resulted in monetary incentives with evidence of a large amount of energy savings with financial benefits (Tan & Chen, 2013).

The improvement of energy-efficient, adopting the concept of living lab and sustainable development that integrates operation, facilities management and advocates for stronger collaborations between all university key stakeholders (including student, academics and professional support staff) is essential. Thus, on this basis, Tongji University will therefore continue to strive for higher sustainability, especially in terms of university infrastructure, construction and new campus planning and to develop a more sustainable society (Tan & Chen, 2013).

2.7.2 Case study: Green campus initiatives - University of Luxembourg

Challenges

The University of Luxembourg (UL) is noted as the one and only Grand Duchy of Luxembourg and was established to promote sustainable development and promote interdisciplinary and critical organisational principles (König, 2013). Interlinking disciplines explore society's challenges and integrate academic activities, campus planning, development, operating, and management.

Pathways

Between 2010 and 2013, UL, with over 50 members, developed UL Strategic Action Plan on Sustainable Development. The purpose of UL's Strategic Action Plan on Sustainable Development is to create the capacity to put in place solutions that can deal with challenges of environmental impact and improve social strength by different interlinking disciplines (König, 2013).

The impact of green campus initiatives

In terms of campus operations, management and planning, UL improves energy efficiency to reduce environmental impact on campus. And cost-saving the University's Services Infrastructure, and the university Logistic department is working non-stop procuring cleaning products that are right and prioritising food from within the region in season and affordable products (König, 2013).

2.7.3 Case study: Green campus initiatives - Rhodes University

Challenges

Rhodes Institution is a South African university with a student population of 7,931 students as of 2016, and it continues to grow, with 52 university student dormitories housing half of the student population (Bulunga & Thondhlana, 2018). Furthermore,

Rhodes University is planning to expand its physical residences to accommodate more students. Secondly, the university electricity bill per year is about US1.2m dollars (Bulunga & Thondhlana, 2018) and the university leaders pass this cost to student through student fee annual increases.

Pathways

As a signature member of the Talloires Declaration that employs the concept of sustainable university initiatives, Rhodes University, in line with its commitment towards environmental sustainability, in 2015, the University developed and approved its first Environmental Policy. The policy's objective is to have “*environmental and financial benefits of investing in interventions for promoting pro-environmental behaviour*” (Bulunga & Thondhlana, 2018:776); under energy sustainability, the university policy developed programmes to promote pro-environmental behaviour.

The impact of green campus initiatives

Bulunga and Thondhlana (2018) have indicated that the purpose of pro-environmental behaviour is to put in place ‘self-reported energy-use behaviour of students in residences’ to foster ‘pro-environmental energy-use behaviour’ and promote ‘pro-environmental behaviour in shared spaces such as university residences’. Arguably, promoting pro-environmental behaviour will achieve sustainability goals, and behavioural change is a relatively cheap way to achieve a sustainable future (Bulunga & Thondhlana, 2018). And Rhodes University to promote energy-savings in the residences will go a long way in achieving its sustainable university initiatives.

2.7.4 Case study: Living lab architecture - ETSAV School of Architecture

Challenges

In his recent paper, Masseck (2017:383) makes an argument that “*Living Labs in Higher educations can be seen as social ecosystems or Innovation Arenas with the link to the surrounding socio-economic context, fostering the creations of transversal educational communities*”. For example, with the focus on the issues and challenges of renewable energy in housing and livelihood, the research on Living Labs Architecture has proven its importance as an alternative way or tool for an all-inclusive Education of Sustainable Development (ESD) (Masseck, 2017).

The impact of Architect led living laboratory

Masseck (2017) has found that in Sant Cugat del Valles, their ETSAV School of Architecture can be considered a ground-breaking institution of higher education in understanding its campus and buildings as a Living Lab to learn about energy efficiency in buildings.

2.7.5 Case study: Universities living lab - University of Manchester

Challenges

The University of Manchester has about 247 buildings of different ages and types situated across 290 hectares of land and includes 850,000 M² of learning and supporting space and host space for 9000 student residences (Evans *et al.*, 2015).

Pathways

To transform the University of Manchester into a campus for teaching and learning in sustainability, in 2012, the University launched its University Living Lab initiative. Living labs harness university intellectual capacity to address the challenges of sustainable development. The launch of the living lab provides an ideal opportunity for student and academic to collaborate with and engage with the University of Manchester Estate staff and their environmental consultants on applied sustainability challenges that are real-world and exist with campus boundaries and the surroundings (Evans *et al.*, 2015).

The University of Manchester incorporated the living lab approach into the University's sustainability policy and is developing projects that can be applied on campus. Evans *et al.*, (2015) highlight that the University Living Lab funded by a central university grant has forged links between people and projects. This initiative has help students, academics, and professional support staff find each other. For example, in the School of Electrical and Electronics, a group of Masters students from the Renewable Energy and Clean Technology Master's degree participated in a project that the investigated barriers to renewable energy, including in heritage buildings (Evans *et al.*, 2015).

The impact of living laboratory

The purpose of the University Living Lab is to package real projects to feed into the University of Manchester's sustainable academic courses. The study by Evans *et al.*,

(2015) found that this initiative benefited the University of Manchester financial department and professional environmental consultants positively. They work on the campus planning and development projects with convincing feasible proposals that are robust enough for interventions to construct new building or refurbishment of the existing building stock.

2.8 Academic outputs and their potential implementation within universities

Universities serve as places of creativity and educational benefit as well as play prominent roles in environmental matters. Universities have been described as critical hubs for innovation (living labs) and environmental education within cities, representing a valuable opportunity to accelerate generational behavioural change toward more sustainable attitudes in daily life (Sonetti *et al.*, 2015). Universities are not only centres of environmental education and innovation; they are also major players in communities, addressing important concerns such as environmental success and political, economic, social, and ethical issues. To be credible in this guidance position, the University must first act responsibly and prudently in responding to sustainability concerns about the campus's Energy and human resource management (Sonetti *et al.*, 2015). For example, the University's community (faculties and schools, students and staff, and operational, technical departments) is a critical stakeholder group in developing sustainable campus communities. The role of sustainable campus communities is to actively involve the university community in tackling environmental and social concerns. Academic outputs on environmental challenges and their future use on university campuses to manage energy consumption and human resource management remain critical approaches. Thus, through proper understanding and implementing research outputs on universities' campuses and facilities, sustainable campus communities can also play a significant role in resolving sustainability issues. In this way, the University can effectively fulfil its mission of teaching, research, collaboration, and guidance by assisting cities and society in responding to climate change and how climate change responses can assist in transitioning to a sustainable future lifestyle. As a result, organisational information sharing is critical to a practical living lab strategy.

2.9 Organisational knowledge sharing

To ensure awareness promotion occurs within the organisation and knowledge is shared among the people, it must be a high priority to promote behavioural change within the organisational structures. Looking through the lenses of Chow and Chan (2008), behavioural change is underpinned by three sets of social values. These social values include a social network, social trust and shared goal; see **Figure 6** below.

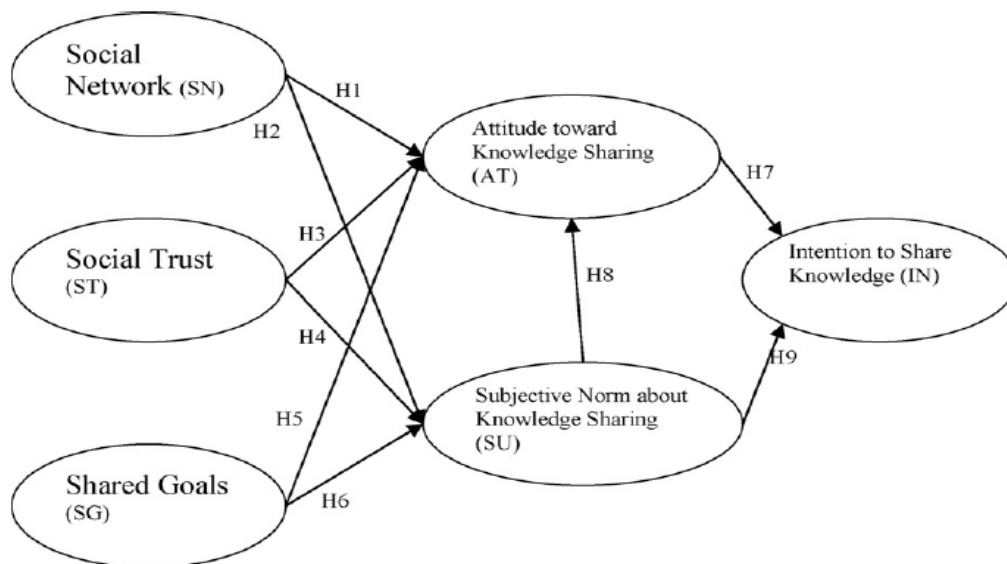


Figure 6: Social value framework (Chow & Chan, 2008).

Social network and good relationship between people is the most crucial tool, more than technology. A good relationship results in high expectations among colleagues, including positive actions (Chow & Chan, 2008).

Social trust in an organisation enhances connections between colleagues; people do not only want to learn and share their expertise (Chow & Chan, 2008).

“The lack of trust in the social networks goes against their vision of connecting like-minded people, as members may not feel comfortable to express their opinions and share ideas” (Sherchan *et al.*, 2013: 14)

The concept of social network is multidisciplinary, and therefore coordinating and exchanging information may achieve shared organisational goals. According to the paper by Sherchan *et al.*, (2013), the trustworthy source of power and growth for every

community is users trusting, working and interacting. Trust, therefore, plays a vital role in the success of these communities (Sherchan *et al.*, 2013)

2.10 Governance and business models for sustainability

To ensure that sustainability is integrated into any institution, it must be a high priority at the top of the hierarchy. Governance and business models address the organisational structure and function of the line. Good governance of sustainability requires accountability. *"Governance and sustainability are widely accepted to go hand in hand, even though the nature of their inter-relationship is far from being fully analysed and understood"* (Joss, 2010:408).

There are three modes of governance for sustainability, and they include:

- Participatory planning;
- Deliberative assessment
- New forms of public-private relationships.

These governance modes have been introduced to encourage cooperation with various actors from the state, civil society, and the public sphere; mobilizing diverse information and expertise; sharing (financial) risks and responsibilities; and promoting socio-technological growth (Joss, 2010). It aligns with the concept of an integrated environmental sustainability strategy/policy and a living lab system/framework concept. It is more difficult to properly scrutinize and hold policy makers accountable for their decisions without direct accountability. Sustainability advances, therefore, calls for better-integrated thinking and the reconfiguration of several aspects of business: stakeholder relations, capabilities, knowledge management, culture and leadership (Adams *et al.*, 2012 cited in Evans *et al.*, 2017). Phases of university approaches to campus sustainability include a visionary campus leader (Krizek, 2011). An innovative campus leader should encourage the idea of elevating sustainability professionals to the executive level – or at least reporting to the executive level from the mid-level coordination role (Krizek, 2011).

"The integration of sustainability at the network level and the achievement of common and individual goals within the network could be then enhanced by new governance mechanisms" (Evans *et al.*, 2017:602)

The above statement is consistent with the principles of good governance. The principles of good governance, **Table 4**, that can assist in addressing governance challenges (Graham *et al.*, 2003) include legitimacy and voice; management; performance; accountability and fairness.

“To realize an integrated and balanced system, deliberate interaction, partnering, networking, learning from multiple and diverse stakeholders is critical” (Winn and Kirchgeorg, 2005 cited in Evans *et al.*, 2017: 602).

The above statement is consistent with Graham *et al.*, (2003) principles of good governance, **Table 4** below, which are primary base on participation, strategic vision, responsive, transparent, equity and the rule of law. Elements of participation encourage social trust and social networking. Looking through the lenses of Chow and Chan (2008), social trust and social network values promotes knowledge sharing, vision sharing and goal sharing. When a goal is shared with others, participants are more likely to develop more promotional behaviours than when the same plan is shared with others (Shteynberg & Galinsky, 2011). Shared objectives foster mutual understanding and sharing of ideas (Chow & Chan, 2008). The development of mutual understanding between participants requires effective communication (Tan, 1994). Thus, communication requires the participation of all people. Secondly, mutual understanding facilitates coordination and cooperation (Tan, 1994). “*Meaningful public participation leads to decisions that put affected societies on the path to sustainability*” (Doelle & Sinclair, 2006:185). Thus, good governance, **Table 4** below, working hand-in-hand with sustainability values, promotes cooperation and consensus sustainability goals.

Table 4: Five principles of good governance (Graham *et al.*, 2003).

	The UNDP principles and related UNDP text on which they are based
Legitimacy and Voice	Participation – all men and women should have a voice in decision-making either directly or through legitimate intermediate institutions representing their intention. Such broad participation is built on freedom of association and speech and capacities to participate constructively. Consensus orientation – good governance mediates differing interests to reach a broad consensus on what is in the group's best interest and, where possible, on policies and procedures.
Direction	Strategic vision – leaders and the public have a broad and long-term perspective on good governance and human development, along with a sense of what is needed for such development. There is also an understanding of the historical, cultural and social complexities in which that perspective is grounded.
Performance	Responsiveness - institutions and process try to serve all stakeholders. Effectiveness and Efficiency - processes and institutions produce results that meet needs while making the best use of resources.
Accountability	Accountability – decision-makers in government, the private sector and civil society organisation are accountable to the public. This accountability differs depending on the organisations and whether the decision is internal or external. Transparency – Transparency is built on the free flow of information. Processes, institutions and information are directly accessible to those concerned with them, and enough information is provided to understand and monitor them.
Fairness	Equity – all man and women have opportunities to improve or maintain well-being Rule of Law – legal framework should be fair and enforced impartially, particularly the laws on human rights

Thus, good governance for sustainability requires business model innovation for sustainability. Changes to business models are regarded as an absolute path to sustainable innovation (Evans *et al.*, 2017). Effective and efficient sustainable university strategy calls for innovative business models contributing to improved economic, environmental and social organisational performance. Innovations can be studies and created more effectively by building upon the business models framework (Boons *et al.*, 2012). We know that actors, networks, and institutions are emphasized in a systemic approach to innovation. Thus, Boons *et al.*, (2012) say innovation systems are seen as systems that produce knowledge or technology. We also know that lack of knowledge, awareness, capital funding and so forth are barriers for

universities to adopt integrated green campus strategy and change campuses into green living labs.

In a sustainable university, a “Central Sustainability Office” or “Chief Sustainability Officer” (CSO) must be established as a member of the Executive Management Team of the Organisation (TMT) (Henry *et al.*, 2019) and must be a key priority in the hierarchy. It is essential to incorporate sustainability into all organisational structures fully. Henry *et al.*, (2019) follows 22 global energy companies in the Corporate Knight “Global100” Sustainability Index in an 11-year study and finds that the presence of the CSO does not boost the social, environmental and economic performance targets. As a result, this approach provides a comprehensive corporate structure for searching and implementing a sustainable university framework. In Henry's *et al.*, (2019) paper, this is the framework for corporate sustainability and management capabilities. Corporate sustainability refers to how organisations effectively balance economic, social and environmental dimensions (Henry *et al.*, 2019). *“This approach may prove useful in creating multiple champions of sustainable development policy”* (Hopkins, 2016: 347). While the crucial role of the sustainability department is to implement successful sustainable policies and encourage, organise and communicate best practices among university administrators, academic departments, other universities, governments and the local community (Lukman & Glavic, 2007). It is vital to bear in mind the following factors:

- The structures accountable for the sustainability assessment are managed differently around organisations, including senior administration, non-academic departments such as infrastructure or operations, and divisions of student governments (Matson, 2008).
- Campus sustainability initiatives commonly identify governance as “top-down” or “bottom-up,” which overlooks the leadership position of the institutional “middle” – the faculty and administrative staff (Brinkhurst *et al.*, 2010).
- The principles of good governance recommend that a “sustainability council shall include staff members, students, administrators and local authorities, to strengthen its role within the community” (Lukman & Glavic, 2007: 108).

Authors observe that there are generally two approaches or pathways to green campus initiatives in universities, including top-down and bottom-up. According to the

Handbook on Theory and Practice of Sustainable Development in Higher Education by Filho *et al.*, (2017) chapter 4 by Katiliūtė *et al.*, (2017), citing Brinkhurst *et al.*, (2011), several top-down projects have been successful in planning, policy-making and regular sustainability assessments because management resources have supported them.

On the other hand, Katiliūtė *et al.*, (2017) all write that the bottom-up management approach to green campus development involves coordinating and innovating all campus operations and management departments, requiring academics and students' participation if necessary awareness-raising. Indeed, campus dissemination of knowledge production will shift from incremental to drastic and disruptive, indicating a massive shift toward knowledge productive for cities addressing climate change issues.

2.11 Bureaucracy

“The Senior Executive Team (SET) oversees the allocation of resources for the university ensuring that governance processes are followed to promote the attainment of the goals, strategies and objectives of the institution including medium and long sustainability” (Wits Annual Report, 2019).

On an annual basis, Wits University must submit yearly progress reports on their earmarked grants allocations to the Department of Higher Education (DHET). According to the Ministerial Statement on University Funding (MSoUF): 2020/21 (2019), reporting on finances (e.g. expenditure data) within progress reports is required.

Infrastructure planning is vital for the sustainable development of the university. Accordingly, DHET allocates the Infrastructure and Efficiency Grant to the universities, including Wits University, as part of the earmarked grants.

“The Infrastructure and Efficiency Grant (IEG) has been allocated over five distinct cycles (2007/08 to 2009/10; 2010/11 to 2011/12; 2012/13 to 2014/15; 2015/16 to 2017/18; and 2018/19 to 2020/21). The sixth cycle will commence in 2021/22. Planning for the sixth cycle will be undertaken early 2020” (Ministerial Statement on University Funding: 2020/21, 2019).

Both block and progress reports and grant calculations on the allocated funds depend primarily on the credible audited information system for higher education management (HEMIS), which universities send annually to the Department.

The purpose of the infrastructure and efficiency grant is to ensure:

- The synergy between the availability of infrastructure within the university sector and the range of requirements associated with the system's expansion in terms of enrollment planning processes,
- Equity in the quality of infrastructure at all universities; and
- Equity in the distribution of state funds amongst universities (MSoUF,2019)

Wits University source of infrastructure funding includes primary four methods or options (Wits Annual report, 2019):

- Infrastructure and Efficiency Grant from DHET
- Infrastructure funding from student's fees
- Infrastructure funding from private donors
- Infrastructure funding from Wits Higher investment income

To enable the School of Architecture and Planning to participate in any of the above infrastructure funding methods, its departmental spatial development framework is expected to form part of the university's overall campus development framework on an annual basis. It is the process to follow if a school needs to install solar panels in its John Moffat building or implement its green building development plans. The Senior Executive Team (SET), as amended from 1997 to the Higher Education Act, oversees the allocation of university resources following the university policies and procedures (governance principles) and the institutional statute as amended from February 2018 (Wits Annual Report, 2019). Therefore, the John Moffat green construction development framework is most likely to comply with the following requirements as approved by DHET.

- HEMIS Space – data
- Framework Agreements for Professional Services & Construction Works
- Proposals for the IEG should be embedded within a spatial development framework (university)

- Progress reports and audited financial statements
- Earmarked grants require annual progress reports to be submitted to the Department. Reporting on finances (e.g. expenditure data) within progress reports is needed.

PIMD and CPD, led by the COO and VC, are responsible leaders and officials in preparing and managing the infrastructure financing requirements set out above. In terms of infrastructure planning and development, PIMD and CPD have the following business units supporting faculty and other Wits University departments, such as the School of Architecture and Planning:

- Space planning and management unit;
- Project Office units (one at CPD and one at PIMD);
- Campus planning and development unit (CPD)
- Finance units (one at CPD and one at PIMD);
- Energy Office (PIMD);
- Campus Facilities Management units (PIMD).

2.12 Current Wits organisation structure and business model

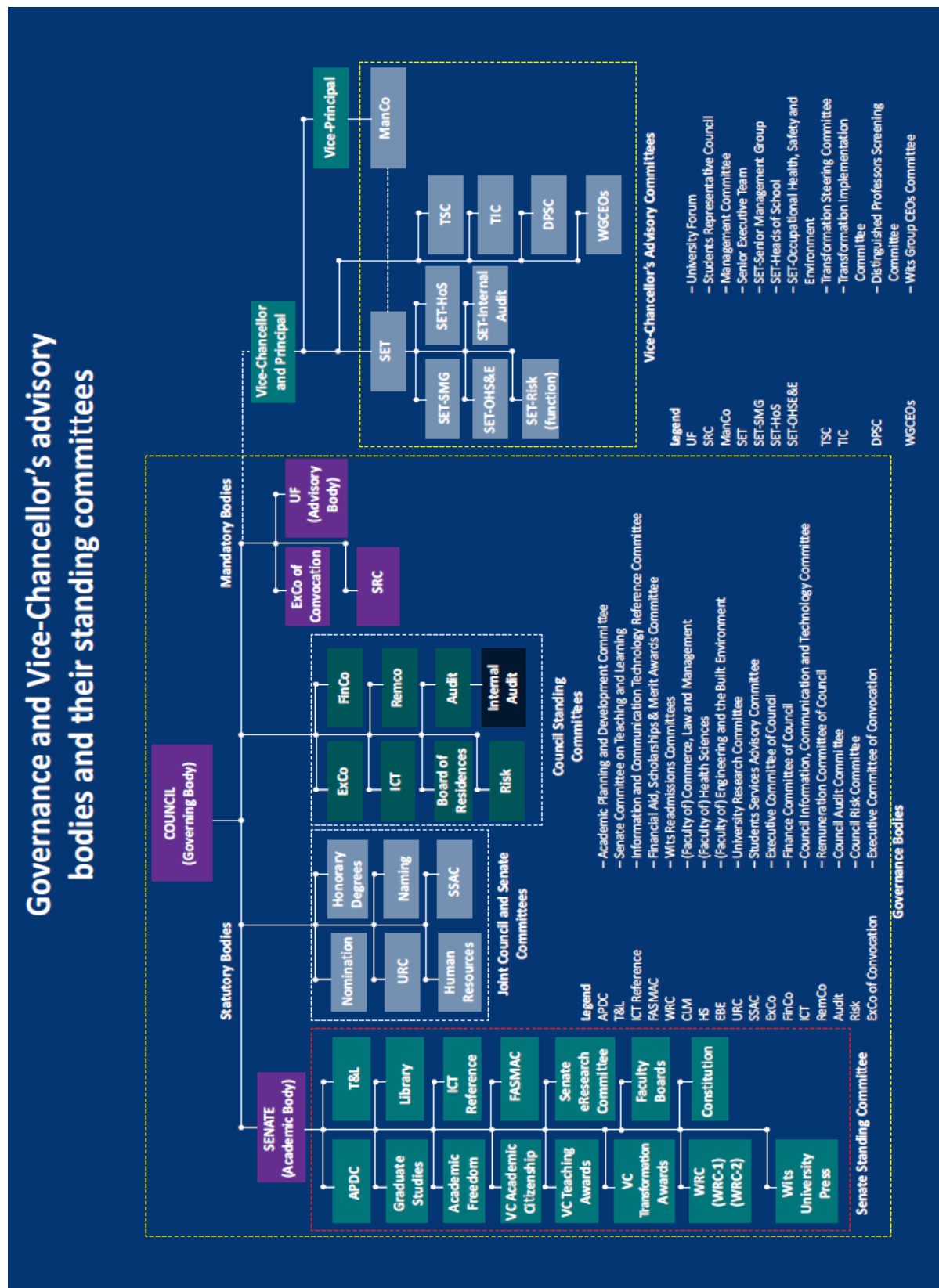


Figure 7: Wits University Governance and Vice Chancellor's advisory bodies and their standing committees (Wits Annual Report, 2019).

According to Wits University's governing structures, **Figure 7** above, these are structures of institutional governance with distinctive roles that can be summed up as follows:

- **Council:** The Council is responsible for the continuing strategic direction of the University of Wits, approving key developments and receiving regular executive reports on the day-to-day business of the University. Academics and non-academics appointed under the Statute of the University of Witwatersrand are included in the council of the University of Witwatersrand, the majority being non-executives.
- **Senate:** The Senate is mainly accountable to the Council to regulate all the University's teaching, training, research and academic functions, and all other tasks that the Council delegates or assigns to it.
- **Convocation Exco:** This is a statutory body and the name given to the most significant constituency of the University – its alumni. Its role is to discuss and comment on all matters concerning the university.
- **University Forum:** The University Forum advises the University Council on issues that affect the university, including promoting an institutional culture that promotes tolerance and respect for fundamental human rights and creates an appropriate environment for learning, research and learning.
- **Student Representative Council:** SRC is a vital stakeholder within Wits University and the highest decision-making structure in the Student Governance at Wits University, providing various services to individual students and student groups and exercising political, economic, and administrative authority to manage the activities of student life.

Wits University has not established a central sustainability office based on the current structure, **Figure 7** above. The absence of such an office has a detrimental impact on how the university's sustainable campus community collaborates, incorporating systemic and cross-disciplinary approaches that test and implement all aspects of sustainability and their interrelationships. Other universities have a central sustainability office that reports to an officer similar to the vice-chancellor since they are involved in any university's operations.

The literature identifies the above fact as one of the key barriers to adopting an integrated sustainable green campus strategy and living lab approach. Secondly, the above statement presents a lack of leadership and capacity. The lack of leadership and capacity negatively affects the implementation of sustainable policies and promotes knowledge and awareness among university administrators, academic departments, other universities, governments and local communities.

2.12.1 Overview of Wits facilities management operations

Decisions regulating municipal services and resources such as electricity, water and waste are complex and highly important in an ecosystem such as Johannesburg municipality. To maintain sustainable university Wits' academic and operational needs, the campus must be work with limited resources. Thus, appropriate management of these services and resources is essential. To manage these resources more responsible way, effectively and efficiently, in 2016, Wits established the new position of the Chief Operating Officer (COO). Amongst other operational functions such as Computer and Network Services, Business Intelligence Services and Campus Security, the COO provides strategic leadership and direction for the following portfolios (Wits University, 2019):

Management and development of property and Infrastructure under the directorate of Property and Infrastructure Management Division (PIMD) as the property owner of the buildings and responsible for maintaining the facilities and infrastructure, including utility bills. PIMD is also accountable for campus waste management, space management, outdoor green spaces, and water use. PIMD maintains all university facilities and common areas.

Campus planning and development under the directorate of Campus Planning and Development (CPD) responsible for campus planning and execution of capital developments. The CDP's internal organisational structure is relatively lean and depends heavily on external service providers (architects, engineers, and QS, among others). CPD is effectively an infrastructure advisory and delivery service provider to the internal university as clients. All the major construction works come via this department (Senior Planner A, CPD, 2020). They do all the new builds; all the major construction works. In addition, the Department monitors the university's capital work

programme, financed by the Higher Education and Training Department, but Wits also invests its own money (Senior Planner A, CPD, 2020).

Grounds and waste management under the directorate of Services responsible for maintaining greenery or soft landscaping, including sports fields on all campuses, includes East and West campus in Braamfontein Campus, education campus, business school, and medical school all in Parktown Campus.

In terms of the principle of good governance, in particular accountability, the COO accounts to the Vice-Chancellor/ DVC. The COO is also responsible for developing relationships and implementing business plans and related projects in the divisions.

Concerning senior executive and administrators, the office bearers consisting of the Chancellor, Chair of the Council and Vice-Chancellor and Principal. Below is the table of the management committee (Wits University, 2020)

Table 5: Wits University executive management committee (Wits University, 2020).

Management Committee
Vice-Chancellor and Principal
Vice-Principal and Vice-Chancellor (Designate)
Acting Deputy Vice-Chancellor: Research and Postgraduate Affairs
Deputy Vice-Chancellor: Academic
Chief Operating Officer
University Registrar
Dean: Student Affairs
Chief Financial Officer

Table 5 above, all these governance structures responsible for assessing and managing Wits issues are all administered differently within Wits university, including the senior administration; the non-academic departments, infrastructure or operations; and the student governments' divisions. Analysing the above statement through the lenses of Prof C's response. Wits governance structure lacks balance between centralisation and decentralisation managerial controls.

“Wits University, in my experience, centralise structures and in some respects, but managerial control is decentralized. So it hasn't got a pleasing balance between centralisation and decentralization. Some things need to be held on a tight rein. Some things need a looser rein, depending on their particular roles within the university and within Society. So Wits like many big institutions has pretty much one-size-fits-all approach” (Professor C, 2020).

The above governance method and business model system lacks a systemic to realise innovation for sustainability. To adapt to climate change, we need expertise and cable leaders in a variety of positions. There are many approaches to climate change, and we must be known to make transitional sound and sustainable decisions. Indeed, for an effective Living Lab strategy to thrive in any organisation, a pleasing balance (effective coordination) between centralized and decentralized leadership frameworks is needed. Professor C says that many other institutions and universities only need coordination to implement a successful management strategy. This remark is reflected in his subsequent response, in which he states the following:

“...we only need three things coordination; coordination; coordination of the silos. Those are the only three things we need” (Professor C, 2020).

In line with Evans' *et al.*, (2017), overall, the study found that Wits University's organisational structure and business model lacks cooperation and faces limitations on integrating environmental sustainability strategies or policies due to lack of coordination of silos. According to Professor C, part of the cause of these challenges lies in the fact that Wits has no sense of responsibility and accountability.

2.13 Sustainable university

“As a leading university in Africa, Wits must lead by example and use its influence to transform society through its leadership, education, and research. The Talloires Declaration of 1990 – the first official statement made by university leaders of a commitment to environmental sustainability in higher education – recognises this responsibility” (Professor Zeblon Vilakazi cited in Curiosity 9: #ClimateEmergency, 2020:4).

In line with the benefits of the declaration, Prof Zeblon Vilakazi's view inspires and motivates environmental and sustainable initiatives on campus and inspires Wits University's comprehensive framework that is steadily progressing towards sustainable development. Thus, the statement referred to above is consistent with the objectives of the Talloires Declaration (TD) ten-point action plan. According to scholars in sustainable university studies, the sustainability of the declaration on higher education is essential. (a) The relevance of higher education policies has helped to build an agreement on the position and responsibilities of universities in terms of economic growth. (b) The longevity of the resolutions on higher education has been affected by the regulations of the State. (c) The universities are now pioneers in the success of sustainable campuses. *"The key role of higher education institutions in the transition to a more sustainable society has been recognised and highlighted for almost three decades"* (Sonetti, 2015: 1).

The first declaration on higher education sustainability, the Higher Education Sustainability Initiative (HESI), came from the United Nations Conference on the Human Environment, held in Stockholm in 1972 (Ragazzi and Ghidini, 2017). The Declaration should be seen as a strategic regulatory document on the positions and responsibilities of universities in the field of sustainable development. Sustainability of higher education declarations is mainly used to find ways to address the problems of balance between the human desire for wealth and technological development without affecting the environment of universities, their staff and their students.

More than 1,400 universities worldwide have signed a declaration on the sustainability of higher education (Grindsted, 2011). The University Leaders' Association for a Sustainable Future (ULSF) acts as a secretariat for the signatory of the Talloires Declaration. **Table 6** below, according to which the Talloires Declaration (TD) is a ten-point action plan to incorporate environmental literacy and sustainability into teaching, research, operation and education in colleges and universities (ULSF, 2015). Accordingly, university leaders concurred to take the following action (ULSF, 2015):

Table 6: Talloires Declaration (TD) ten-point action plan (ULSF, 2015).

Action plan	Description
Increase Awareness of Environmentally Sustainable Development	Use every opportunity to raise awareness among the public, government, industry, foundations and the university by openly addressing the need to move to an environmentally sustainable future.
Create an Institutional Culture of Sustainability	Encourage all universities to engage in education, research, policy development and information exchange on population, environment and development to move towards global sustainability.
Educate for Environmentally Responsible Citizenship	Set up programs to develop expertise in environmental management, sustainable economic development, population and related fields to ensure that all university graduates are environmentally informed and aware and understand that they are citizens with ecological responsibility.
Foster Environmental Literacy For All	Creates programs to develop the capacity for university faculty to teach all undergraduates, graduates and professional students environmental literacy.
Practice Institutional Ecology	Exemplify environmental responsibility by developing institutional ecological policies and practices for conserving resources, recycling, waste reduction and environmentally sound operations.
Involve All Stakeholder	Encourage government, foundations and industry to support interdisciplinary research, education, policy development and information sharing in environmentally sustainable development. Increase work with community and NGOs to help find solutions to environmental problems.
Collaborate for Interdisciplinary Approaches	University faculty and environmental administrators convene to develop interdisciplinary approaches for curricula, research initiatives, operations, and outreach activities supporting an environmentally sustainable future.
Enhance Capacity of Primary and Secondary Schools	Develop partnerships with primary and secondary schools to enable people, the environment and sustainable development to develop capacity for interdisciplinary learning.
Broaden Service and Outreach Nationally and Internationally	Work with national and international organisations to foster a sustainable future for universities throughout the world.
Maintain the Movement	Establish a Secretariat and Steering Committee that will continue this drive, inform, and support one another in implementing this declaration.

While individuals interested in sustainable university initiatives understand what sustainable development is and what makes a sustainable university. A few studies have explored the degree of sustainability awareness/knowledge among the main stakeholders in universities, assessing their views and feelings about the university's role in universities developing their environment. This lack of sustainable university initiatives stems from misconceptions. For instance, sustainability is regarded as a too abstract concept. It is too vague for staff not to be in charge of sustainable development (Filho, 2011 cited in Aleixo *et al.*, 2018). Many scholars and professionals seem to be more focused on the environmental dimensions of sustainability than on the social and economic aspects of sustainable development. This dilemma is evident

from the Wright (2009) study. Accordingly, this research argues for a more holistic approach. The importance of adopting an integrated sustainable university strategy is therefore essential.

2.13.1 Definition of a sustainable university

The idea of a sustainable university is all about "environmental problems" that must be converted into socio-economic principles. The concept of 'sustainable universities' can be defined and understood in several ways:

- Sonetti *et al.*, (2016:1) have defined the sustainable university "as a higher education institution that addresses, involves and promotes, on a regional or global level, the minimisation of negative environmental, economic, societal, and health effects generated in the use of their resources to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyle".
- A study (Ragazzi and Ghidini, 2017:112 citing Alshuwaikhat & Abubakar, 2008) definition says, "a sustainable university campus should be a healthy campus environment, with a prosperous economy through energy and resource conservation, waste reduction and efficient environmental management, and promotes equity and social justice in its affairs and exports these values to the community".
- A recent study (Riyadi *et al.*, 2018:32 citing Hordijk, 2014) define sustainable universities "as institutions of higher education that address, engage, and promote at regional and global levels, resources to meet needs by helping communities to achieve sustainable lifestyle".

The above definitions strongly suggest that universities are the right place for developing the principles of sustainability. This argument is confirmed below in **Figure 8** linkages between sustainable development and the Green University framework.

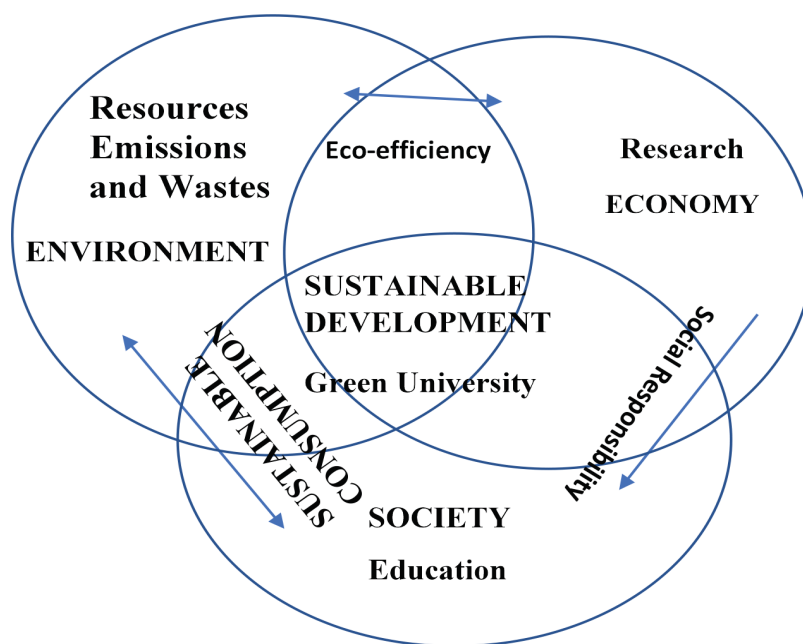


Figure 8: The linkages between sustainable development and Green University (Suwartha & Sari [12] cited in Ali & Anufriev, 2020).

2.13.2 Conceptualisations of an integrated sustainable university

The conceptualization of integrated sustainable universities should consider the vision of universities and their mission strategies; potential challenges facing universities in the future. Wright and Wilton (2010) on the issue of sustainable universities in Canadian universities, most of the participants in their study said that reducing or not receiving government funding is one of the most challenging financial hurdles. The sustainability of the campus was another matter. They noted that several participants specifically mentioned how their desire to adopt environmental strategies was harmed by the lack of funding for the facility department. Wright and Wilton (2010) found from the analysis that financial challenges are perceived to be linked to another major issue of deferred maintenance of campus buildings. This research is to examine the subject mentioned above within the context of HEIs in South Africa. More Specific at Wits University.

Previous study Wright (2009) indicated that the cohorts of its participants' understanding of a sustainable university emphasized greening campus physical operations as the primary indicator. Thus, this study examines the concept of integrated sustainable development of the university. In that way, teaching and

research function as possible key tools that the university could use to build sustainable campus communities. (Filho 2017:14) state, "*Universities can reorganise their curricula, management and policy making, and student activists and faculty supporters can become partners in this process*". In addition, the campus is a form of service-learning, a method of education in which students participate in organised community service activities as part of academic learning (Savanick *et al.*, 2008).

Therefore, universities should explore the idea of a living lab strategy to fully implement the principles set out in the Talloires Declaration of their campus. This method can help universities gain insight into sustainable university challenges. Savanick *et al.*, (2008), in their paper, all agree that campus sustainability programs offer a rare opportunity to link and directly contribute to campus operations with this academic goal. However, many campuses do not use sustainability as an educational resource. This issue noted in Savanick *et al.*, (2008) paper.

"Even on campuses with numerous sustainability projects underway, often the administrative and operational sections work in isolation exploring sustainability issues on campus" (Savanick *et al.*, 2008: 668).

Therefore, based on the above arguments and statements, it is crucial that all players within the university commonly understand the idea if universities are to take a leading position in sustainability. Thus living lab is indeed an appropriate university platform to action integrated sustainable universities framework.

2.14 Barriers to adopt integrated environmental sustainability strategy

Suppose the university is entrusted with the challenge of creating a sustainable future. In that case, all stakeholders at the university must share a common understanding of the barriers to implementing an integrated environmental sustainability strategy/policy. Environmental incentives from a practical and sustainable building policy of more than 4,000 universities can be significant (Hopkins, 2016) in addressing these challenges of creating a sustainable future. Therefore, due to this potential importance, it is critical to consider, among other initiatives, the barriers to green building policies. This section discusses the barriers to adopting an integrated environmental sustainability strategy from both the global north and south. Comparing

the global north and south seeks to highlight global problems in implementing an integrated environmental protection strategy.

2.14.1 Global North barriers

Hopkins' paper (2016), particularly regarding green construction at universities, looks deeper at barriers to green-building policies at universities. The report deals more closely with protecting the environment. His case study on Canadian universities has shown explicitly that campus sustainable development programs face several barriers to adoption. These barriers involve the lack of awareness, incentive, leadership, financial reckoning and satisfaction amongst many stakeholders (Hopkins, 2016). Secondly, lack of awareness can be because the management of the facilities is not fully aware of the benefits of working with academics (Savanick, 2008). However, in a recent paper, Fachrudin (2020) argued that a sustainable campus could provide students, faculties and staff with resources and incentives. Awareness, community engagement, natural exhibits, reporting, economic development, program partnerships, community mobilisation, and workers mobilisation include resources and incentives for campus greening (Fachrudin, 2020).

2.14.2 Global South barriers

Since 2012 after the Green Campus Initiative (GCI) launch in South Africa, campus sustainability remains a critical issue that seems to be ignored (Mafongosi *et al.*, 2018). Most HEIs are struggling to enforce the GCI solely because of the impediments they face (Rwelamila and Purushottam, 2015, cited in Mafongosi *et al.*, 2018). These impediments include lack of financial capital, lack of awareness, and information about the GCI, which has led to a reluctance among HEI stakeholders to support the sustainable transformation of their institutions (Mafongosi *et al.*, 2018, citing Katiliūtė *et al.*, 201). The ambiguity and complexity of the real notion of sustainability are cited as one reason why most higher education institutions have not yet implemented sustainability practices viewed as abstract and complex. (Aleixo *et al.*, 2018).

The Global South and Global North studies on barriers affecting HEIs to enforce campus sustainable development programs have come to the same conclusion. When students, faculty and staff are actively engaged in building a sustainable university campus, this could be influential transformational forces with far-reaching impacts (Fachrudin, 2020). Scholars identify critical challenges in the

adoption of an integrated strategy for environmental sustainability, **Table 7** below. They shall include barriers:

Table 7: Summary Barriers to adopting integrated sustainable university strategy

Authors	Barriers
Hopkins (2016)	• Lack of Awareness, Incentives, Leadership, Financial consequences and Occupants' satisfaction.
Mafongosi <i>et al.</i> , (2018)	• Lack of financial capital, awareness and information/knowledge, Ambiguity and complexity, support, drive and relevant expertise.
Evans <i>et al.</i> , (2015)	• Barriers to renewable energy in heritage buildings.

The 2015 paper Barriers to Green Buildings in two Brazilian Engineering Schools by Kasai and Jabbour defines and summarizes the above barriers in Table 4 as financial and organisational barriers. According to Kasai and Jabbour (2014), financial and administrative barriers include a misconception that green buildings incur more significant initial investment. A lack of incentive for long-term water reductions, energy consumption and maintenance. And a lack of communication between stakeholders and decision-makers, such as lack of leadership in top institutions. Thus, studies, **Table 8** below, by Hopkins (2016), Mafongosi *et al.*, (2018) and other key cohorts of scholars in the field of this study have all shown that such challenges can be overcome, among other initiatives. Promoting awareness-raising at the wealthier HEIs, organising campuses, providing financial incentives, hiring a sustainable campus officer and selling green campus building initiatives.

Table 8: Summary of the fundamental solution to overcome the barriers (Hopkins, 2016) and (Mafongosi *et al.*, 2018).

Barriers	Approach
Awareness	• They are promoting awareness, Encouragement, Organising campuses, and marketing green campus building initiatives. Have a desire to encourage pro-sustainability actions on campuses and address environmental concerns such as water and energy use. Promote pro-environmental behaviour. • lack of management / academic integration may be that facilities management staff are not aware of the benefits of working together with academic staff (Savanick, 2008)
Financial capital	• The use of sustainable and passive approaches to reduce energy demand to reduce operational cost. Including incentive for long-term reductions in water, energy consumption, and maintenance. • Change the misconception that green buildings are incurring greater initial investment.
Leadership	• Hiring a campus sustainability officer. • Form partnerships. • They are regulating universities. • Development of strategic action plan. • Harness university academic capacity.
Incentives	• Resources and incentives for greening the campus include awareness, community engagement, nature exhibits, reporting, economic development, program partnership, community mobilization, and workers mobilization. • They provide financial incentives in monetary incentives with evidence of a large amount of energy savings with economic benefits. • Procurement processes that have the potential to save cost and increase the total income of the organisation. These savings can be passed on to student fees and other socio-economic issues. • It procures cleaning products that are right and prioritises food from within the region in season and reasonable products.
Knowledge/ information	• Generate and distribute reports and data. • Promote awareness gains at larger, wealthier HEIs, organising campuses.

2.15 Management of sustainable transitions

Barriers to implementing effective and efficient green campus policy include challenges of technological change, radical institutional and behavioural change. Looking through the Sarkis (2019) Lens for successful sustainable development plans for universities, a sustainable transition to a carbon-free society is needed to preserve the Earth for future generations.

“Sustainable and green supply-chain management is complex” (Sarkis, 2019: 48).

Literature shows that universities are (Loorbach and Rotmans, 2006) more and more facing persistent social, environmental and economic problems that cannot be solved through existing policies based solely on traditional approaches.

“To resolve persistent societal problems, structural transformations or transitions are necessary” (Loorbach & Rotmans, 2006).

According to the preceding argument, transitions cannot be managed using conventional methods. Because they result from interactions between many different processes, many of which are far beyond control, such as cultural change, which can be seen as an autonomous process (Loorbach & Rotmans, 2006). However, in line with the paper by Loorbach and Rotmans (2006), different types of steering and coordination can influence the direction and speed of sustainable transitions. Transitional management is possible through coordination mechanisms (direct and indirect). Through Loorbach and Rotmans (2006) lenses, HEIs can manage the sustainable transition, see **Figure 9** below, by using an institutional coordination mechanism.

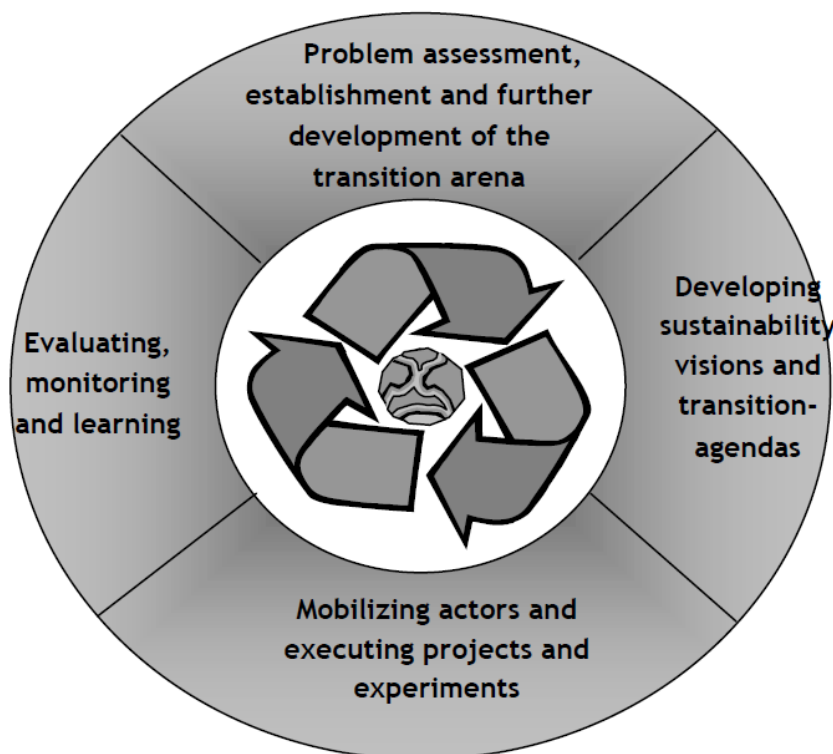


Figure 9: Activity clusters in transition management (Loorbach and Rotmans, 2006).

Institutional coordination includes new policy models, the promotion of new networks, the development of transition areas, **Figure 9** above, agendas and objectives and the focus on learning processes (Loorbach & Rotmans, 2006). However, social, behavioural, and consumption transformations (technological change) must be considered when looking at sustainability transitions through Sarkis' lenses (2019).

In terms of technological change, to implement the concept of sustainable university (Sarkis, 2019), unfortunately, there will usually be natural limits to access to materials, processes and other resources.

Concerning radical institutional and behavioural change, there will be (Chow & Chan, 2008) social network, social trust and goal sharing barriers. Lack of social network values discourages organisational knowledge sharing values and system thinking among the people; see **Table 9** below.

Table 9: Key elements of transition management (Loorbach & Rotmans, 2006).

Vital aspects of transition management
• Systems-thinking in terms of more than one domain (multi-domain) and different actors (multi-actor) at different scale levels (multi-level); analysing how developments in one domain or level gel with developments in other domains or levels; trying to change the strategic orientation of regime actors;
• Long-term thinking (at least 25 years) as a framework for shaping short term policy;
• Back- and fore-casting: the setting of short-term and longer-term goals based on long-term sustainability visions, scenario studies, trend-analyses and short-term possibilities;
• A focus on learning and the use of a special learning philosophy of learning-by-doing and doing-by-learning;
• An orientation towards system innovation and experimentation;
• Learning about a variety of options (which requires a wide playing field);
• Participation from and interaction between stakeholders.

2.16 Theoretical framework

The theoretical structure provides a solid foundation for undertaking the research necessary to grasp the report's perspective. It validates that the proposed study is based on established theory and empirical evidence derived from credible sources. The literature in question has demonstrated that a problem exists and has justified the proposed research. As a result, this theoretical framework provides a solid foundation for performing the study and helps in comprehending the provided perspectives. The theoretical framework's purpose should be construed in terms of addressing the problems and dilemma. The issue is that the university generates awareness about sustainability issues through its research outputs (student and faculty research reports). As part of their studies, faculty and students at the School of Architecture and Planning produce study papers. Rather than evaluating the ideas contained in a large number of these research papers (authored by faculty and students), they are often ignored or forgotten.

This framework will define the methodological approach taken regarding how the analysis views the problems, analyses the data, and concludes it. The framework is based on addressing the main question of research. For example, (a) how do we address the challenges and (b) what the barriers are? The first part of the framework, **Table 10 and 11**, seeks to understand the pathways towards green campus policies and living laboratories. The second part of the framework, **Table 12 and 13**, aims to understand the barriers to green campus policies and living laboratories. In terms of pathways to green campus policies, I am going to study and analyse data through the following theoretical framework:

Table 10: Pathways towards green campus policies.

Authors	Primary theoretical framework	Conceptual, theoretical framework
Brinkhurst <i>et al.</i> , (2010), Katiliūtė <i>et al.</i> , (2017)	Organisational structure	Top down or bottom up and middle managerial controls
Lukman and Glavic (2007)	Good Governance	- The principles of good governance - Establishment of a sustainability department - Accountable organisational structures
Evans <i>et al.</i> , (2017)	Business Model	Sustainable business models
Alshuwaikhat and Abubakar (2008)	Green Buildings	- Green buildings development program - Promoting green transportation - Promoting campus preservation - Waste reduction and efficient environmental management system
Tan and Chen (2013)		- Existing building stock and heritage buildings strategic plan - Campus building energy management system - Energy-efficient technology(Solar water heating system; water reuse system; and heat recovery from the water system)
König (2013)		Strategic Action Plan on Sustainable Development
Harry (2000).	Principles of sustainable universities	Economically, Environmentally sustainable system, Socially sustainable system

As far as pathways to a living laboratory are concerned, this research will study and analyse data through the following theoretical framework.

Table 11: Pathways towards living laboratory.

Authors	Primary theoretical framework	Conceptual theoretical framework
Masseck (2017)	Sustainability Method	- Education of Sustainable Development (ESD) – School of Architecture lead green campus initiatives - Schools/Colleges of Engineering should lead the process for teaching and adopting green building practices ((Kasai and Jabbour, 2014)
Masseck (2017)	Living lab architecture	Social ecosystems or Innovation Arenas (action-research).
Koester <i>et al.</i> , (2006)	Whole-systems approach	- Inter-disciplinary (Callaghan and Herselman, 2015) - The concept of co-production and concept of collaboration Evans <i>et al.</i>, (2015). - Cooperation (Lukman and Glavic, 2007)

Table 12: Theoretical framework barriers to adopting green campus policies.

Authors	Primary theoretical framework	Conceptual, theoretical framework
Kasai and Jabbour (2014 citing Richardson and Lynes, 2007)	Financial barriers	- Lack of incentive (Hopkins, 2016) for long-term reductions in water, energy consumption, and maintenance (Kasai and Jabbour, 2014) - Lack of capital finance (Mafongosi <i>et al.</i>, (2018) Financial consequences (Hopkins, 2016)
Kasai and Jabbour (2014 citing Richardson and Lynes, 2007)	Organisational barriers	- Lack of leadership (Hopkins, 2016) - Lack of occupants' s satisfaction (Hopkins, 2016) - Lack of awareness and information/knowledge (Mafongosi <i>et al.</i>, 2018) - Lack of responsibilities (Gholami <i>et al.</i>,2020)

Concerning barriers to adopting the living laboratory systems approach, this research will study and analyse data in the following theoretical framework.

Table 13: Theoretical framework barriers to adopting living laboratory system approach.

Authors	Primary Theoretical framework	Conceptual, theoretical framework
(Kanter cited in Schaffers and Turkama, 2012)	Lack of consensus among players	Barriers to innovation and lack of innovation.
Schaffers and Turkama, 2012)	Lack of clear definition of the concept of living lab	The risk that the value proposition will not be communicable.
	No sustainable business models	- Lack of funding. - Do not have strong, explicit, clear business models (Mulvenna <i>et al.</i>, 2010)
	Risk	- Lack of standardisation and insufficient criteria for methodology and performance for living laboratories. - Challenges as relating to standardisation, collaboration and efficiency (Mulvenna <i>et al.</i>, 2010)

2.17 Conclusion

In terms of green campus policies, the study found that the universities had good intentions to adopt green campus initiatives. Looking at the literature through the lenses of relevant scholars in the field of study, the significant barriers to green campus policy and initiative include lack of leadership, lack of incentives, lack of accountability, and capital funding. The study found relevant case studies in the field about the architect's green campus initiatives and adopting a living laboratory.

The chapter sets out the frameworks used to address the research issue in the relevant existing literature. There are different theories in the study that are consistent with the problem of investigation. These include sustainable university literature, university barriers to implementing an integrated environmental sustainability strategy, green campus policies, the concept of green campus literature based on architectural perspectives, the role of living laboratories in the development of sustainable universities, and the principles of good governance and others.

This research generates subjects for study and questions to be answered. In other words, it is the frame of reference "lens through" in which the researcher views the analysis. As a result, this theoretical framework serves as a conceptual foundation for this research. This research derived the sets of theoretical assumptions from the literature, which describe the pathways and barriers that can be identified and assessed.

The paths are, therefore, the following pathways:

- Living lab pathways are sustainability, living lab architecture, and system-wide approaches;
- The pathways to green campus policies are organisational structure, good governance, business model and the promotion of green building development;
- The barriers to the adoption of green campus policies include financial barriers, organisational barriers, retrofitting of existing buildings and barriers to heritage buildings;
- Regarding barriers to living laboratories, issues include the lack of consensus among stakeholders, the lack of a clear definition of the concept of a living

lab, the lack of sustainable business models and the high risk of lack of standardization of the concept of a living lab.

This review process developed the theoretical framework of integrated theory from the literature to serve as lenses through which different conceptual, theoretical frameworks are used to study problems and respond to research questions:—more precise descriptions of how this will be done methodologically presented in the following chapter.

CHAPTER 3: Research methodology

3.1 Introduction

This chapter details the methods used to test the theoretical framework introduced in Chapter 2 and generate the findings in Chapters 4, 5, and 6. The following section discusses the rationale for choosing the case study and the qualitative approaches used to collect data. The sections detail the sampling methods, Wits University's John Moffat building, and a case study of the Wits School of Architecture and Planning.

3.2 Research method and design

This research study employed a case study research method. The case study method is the best for this study because it provides a more comprehensive perspective. Qualitative research is sensitive to the research environment and specifics and has a "humanistic focus" (Gephart, 2004: 455) and thus aims to comprehend a limited number of participants. The theories of Kasai and Jabbour (2014) and other relevant scholars such as Hopkins' (2016) was used as lenses to identify pathways and barriers such as whether or not Wits has a sustainability office/policy.

Expanding on Kasai and Jabbour's (2014) techniques, the barriers to green building in HEIs were identified, and interviews and data collection were done. It was done through site analysis and question script interviews.

For Hopkins (2016), the theory of barriers identified in implementing green building initiatives and the literature review methodology used by Hopkins (2016) has been developed to understand the state-of-the-art green building research at the Wits University Braamfontein campus. More specific John Moffat Building (JMB).

The study took a deductive approach, relying on pre-existing theory for interpretation. Using the category of topics as an example, a base list of concerns posed to the research questions is compiled from the literature.

Following the establishment of data clusters through deductive analysis, inductive analysis was carried by engaging in detailed data readings to gain a comprehensive understanding of what was said and ensure that study captures all significant aspects of the data.

To achieve this specific goal of this research, understand barriers and consider the perception that Schools of Architecture and Planning (SoAP) should lead the teaching process through green building practices on campus; this study looked at Wits University's integrated environmental sustainability policy green initiatives.

The methodology used in this study follows the steps that were consistent with the literature review, **Chapter 2**, which identified pathways and barriers to green campus policies and pathways and barriers to adopting living laboratory in the HEIs, such as Wits University. I selected and conducted a study on Wits University. To identify the pathways and barriers faced by these institutions in implementing integrated green campus policy and a mini case study on Wits School of Architecture and Planning (SoAP) to determine the concept of an Architect led living laboratory at the university.

3.3 Case study selection

The approach used in this case study is qualitative, based on three primary data sources: documentation, direct field observation, and interview.

Since several other Wits University schools may be generating green campus initiative output reports, this study will expand on Shi and Yang's (2013) assertion that green buildings have evolved into high-tech architectural machines. Wits Thus, Green Building literature defines architects as the project team's leading discipline, playing a critical role in directing and executing a performance-driven design. These views support the rationale behind the notion of making Wits SoAP a key stakeholder in leading Wits University campus-wide green initiatives. Therefore, this research will assess Wits' staff's opinion on the approach to the system led by Architects.

In terms of the JMB as a building, the study will analyse and respond to the John Moffat green construction development framework questions.

Wits University and, more specifically, the Wits University School of Architecture and Planning (SoAP) and JMB as a building were selected as probable case studies. In which the key stakeholders' perspectives would be gathered. The selection of Wits University and SoAP was based on its status as one of the best HEIs in South Africa and the world. Its values and what they represent in terms of socioeconomic values, both locally and globally. Includes SoAP academic values, processes and elements. Other universities, such as the Technology University of Tshwane and Rhodes

University, may not rely on the same methods, as situations are very different. The University of Wits is a top university in the middle class. Opportunities and barriers may differ concerning the fundamental priorities and needs of individual universities. The main reasons that underpin the selection criteria include the followings elements, **Table 14** below.

Table 14: case study selection criteria.

Main reasons that underpin the selection criteria
The university had to have a campus planning and management department
The university had to have a School of Architecture
The University had to have Energy, Water and Waste management plan
The University had to have a sustainability plan or policy
The University had to have a green campus program on campus
The University had to have a department that contributes to living lab
The University had to be located in an urban area, with high density
The University has to be connected to various public services, like ESKOM, Municipal bulk services etc.

According to the literature, organisational structure and business models are important. Therefore, one of the things this study aimed to achieve was to do is to find out how Wits University's organisational structure and business model works to see if Wits University's organisational structures are in line with what is needed for green campus initiatives.

On the other hand, whether or not they can be identified within the organisation and business model as to whether or not they have integrated a sustainable green campus strategy and do not have one way to plan. This is because it has been identified in the literature that organisation is one of the key aspects of sustainable green campus transition.

3.4 Limitations

This section discusses the limitations that were significant and occurred and were beyond the researcher's control. Due to various factors, including time constraints and lockdown regulations imposed in response to the COVID19 pandemic, the study encountered some difficulties gaining access to some individuals at the university. Additionally, the report encountered problems obtaining certain records and data pertinent to the study due to their lack. These were the limitations. Despite these

limitations, with the help of a qualitative delimitation approach, the study conducted constructive research and responded to the problem and research questions. Qualitative analysis is a method by which this report has been able to study the research topic, the key concept, ask specific, general questions of the participants and gather meaningful words and images from the participants' perceptions. The exploratory nature of the study problem, the research questions and the form of the data examined explained the use of the qualitative method.

3.5 Data collection tools and analysis

The case study employed a variety of data collection techniques. This study chose a sampling method. According to Martínez-Mesa (2016), the advantages of sampling include estimating sample size, identifying the sample frame, and selecting the sampling system to use. Expanding on the work of Kasai and Jabbour (2014) and other key scholars such as Brinkhurst (2010) and Hopkins (2016), data collection and analysis were conducted at the Schools of Architecture and Planning (SoAP), the Wits Global Change Institute (GCI), Wits Business School African Energy Leadership Centre (AELC) and the Wits Facilities Management Departments: PIMD and Services and Planning Department.

Concerning academic works, the study examines academic and student intellectual outputs concerning Wits' green campus initiatives from the school of architecture and other academic departments, such as the Global Change Institute at Wits.

In terms of university reports and records, the study gathered and analysed Wits Annual Reports, Wits Strategic Documents and conducted interviews using pre-written questions.

The interviews were performed to elicit data and were semi-structured. A questionnaire was used to recruit research experts, senior executives, and senior university staff from different departments, including SoAP; GCI; PIMD, Services, and CPD, who are considered cohorts of the university sustainability group. The following is a brief profile of the study participants/respondents, **Table 15**:

Table 15: Brief profile of study participants/ respondents.

Respondents	School of Architecture and Planning (SoAP) and Global Change Institute (GCI)
Academics/ Professor	• One Senior Lecture of Architecture and Planning from SoAP. • Two Lecture on Architecture, Planning and Heritage studies. • Two Professors of Ecosystems, Environment and Sustainability Studies from Global Change Institute. • One Professor of School of Architecture and Planning
	• One Professor of African Energy Leadership Centre, Wits Business School.
	PIMD, Services and CPD
Employees	• Three support staff of buildings, energy, water, grounds and waste management. • One Planner of infrastructure planning, development, and green campus initiatives.
	• An official from the planning and development of campus buildings and infrastructure department.
Respondents	External professional and experts in the area Architecture/ green buildings and Living laboratory
Academics/ Professor	• One professor of concept living laboratory
Professional consultant	• One Architect was responsible for Wits campus planning and development projects.

To ensure representativeness. The primary staff interviewed in these departments included those responsible for design, development, and maintenance of new buildings and facilities at Wits University; senior planning, development, and maintenance management at Wits University; and academics/professors focused on sustainability and architecture and planning studies at Wits University. Other interviewees included an external consultant(s) responsible for designing and constructing the Wits campus and an authority on living laboratories (s). The matching criteria specified by the sample study were used to choose these individuals from diverse departments.

The data collection method was structured, and the data analysis technique was explicitly used to guide the data processing, which included pattern interpretation, coding, and, most importantly, data interpretation. Using the theoretical framework described in **Chapter 2**, this thesis extracted and interpreted data in the following manner: all the recordings were listened to only after the transcription was completed.

The aim was to learn the specifics, to categorize the meanings of the spoken words in the sample.

Each recorded interview was transcribed subsequently. Additionally, I used a semantic scheme to categorize text and phrases (transcriptions). The protocol was created to ensure that the communication is transparent and that no information is misconstrued or suppressed. Thirdly, following the repeated classification of codes, the method for interpreting codes at a higher level of abstraction needed to be specific and transparent. This is referred to as data classification (Othman & Rahman, 2014: 264).

An observational study of the physical campus planning and development status was performed to establish a reliable sampling study. Campus field work was conducted. The infrastructure was inspected. In addition, the approval from the university administration was obtained to take photographs as evidence.

3.6 Sampling

To sample according to the study, a “sample matching” (Martínez-Mesa, 2016: 239) was used to select research experts, middle management, support staff, senior leaders and senior university staff conveniently from the Wits university sustainability community. The study aimed to understand better the barriers, opportunities, pathways, and incentives these people see as sustainable institutions. Information on sustainable campus universities was collected through SoAP lectures, the planner, PIMD, Campus Planning and Development officials, ground and maintenance officials, living lab experts and other senior university officials. The purposeful method of snowballing has been used (Mafongosi *et al.*, 2018). This method was developed to give the researcher the privilege of selecting interviewees selectively based on their ability to answer the questions asked in the interview (Saunders *et al.*, 2009 cited in Mafongosi *et al.*, 2018). A questionnaire (see **Appendix A**) was prepared, and detailed interviews were conducted.

3.7 Ethical issues and consideration

There have been no ethical issues. The study's subject or procedures had no adverse effect on the participants, and they were treated with dignity.

Participants were informed of the anonymity and hostility of their comments. Following the steps taken by Wright (2012) in the sampling frame for this study. All of the names in the study are fictitious. While participants read a declaration of consent, verbal and signed consents were received, and participants listened to, answered and decided to participate. Prior to the questionnaires being sent to participants, the subjects were determined. To carry out a case study, to identify the location of the study, my research report used photographs, and I, therefore, obtained the consent of the person concerned to use the photographs.

3.8 Delimitation of scope

There are several challenges that have arisen with this research. The research required semi-formal physical interviews; due to time limits, the scope of the selection of participants had to be narrowed.

Although the data is rich in carrying out a sustainability audit study, this research report did not intend to audit. This research aimed to analyse current pathways and barriers affecting implementation staff, and students output research green campus initiative at Wits University. To explain why many of these efforts did not contribute to developing an integrated environmental sustainability strategy or policy document and studying the living laboratory concept.

Chapter 4: Result - interviews

4.1 Introduction

The conversation is focused on the university. The primary goal of this approach is to identify which barriers affect the implementation of green campus initiatives resulting from the staff and student's research output to resolve climate change issues and achieve sustainable university. The study examines the university as a Living Lab - which implements its research outputs to achieve sustainability. Thus, second, from the primary goal, there is the issue of testing the feasibility of implementing a living laboratory at the university across the institution. This is done to advance the living lab as a mitigation strategy for reimagining future universities. A single round of interviews was performed, and many themes emerged.

4.2 Themes

4.2.1 Organisational structure and strategy

a) Wits University's integrated environmental sustainability policy

The first sub-topic of the research issue was Wits University's integrated environmental sustainability policy, covered under the organisational structure and strategy theme. The participants, including Professor C from African Energy Leadership Centre, Wits Business School, were concerned about the lack of innovation to develop the university strategy to make the university's integrated environmental sustainability strategy the centre focus of the institution's policy. Policies are "*poorly written*" (Professor C, AELC, 2020) and result in laminations regarding clearly defining and delegating roles and responsibility within the organisation. This observation is one of the primary challenges with Wits University's policy, and having read several of Wits' policies and rules, Professor C concludes his views by saying:

"They leave pertinent issues unanswered. In that respect, that particular policy document they are flowery academic terms that do not pinpoint responsibility and the way I characterize it is lack of accountability that I have encountered in Wits and other places in South Africa too" (Professor C, AELC, 2020).

During interviews, some participants, for example; Professor A from Wits Global Change Institute (GCI), indicated they are not aware of any "*green sustainability*

strategy or policy", including any pathways at Wits towards adopting integrated environmental sustainability strategy:

"As the institution, we have done a lot of policies we have many policies that we can fall back on. But I am yet to see the green policy sustainability strategy or policy for Wits, you know, it's been in the pipeline for a long time ..." (Prof. A, Wits Global Change Institute, 2020).

He is continuing on the same issue of the non-establishment of sustainability policy at Wits University. The Senior Facilities Manager B of PIMD states in his reply that there is no approved university policy as far as he knows. And He asserts that if the university had to implement it, he would have been informed if policies were in place.

On the same theme of the research question, Professor A (GCI, 2020) and Senior Planner A (CPD, 2020) both agreed that, at the moment, the institution does not have such policies in place. However, Wits University is in the process to establish this sustainability policy. This is illustrated in an extract from Senior Planner A's (CPD, 2020), who explained opportunities of integrated environmental sustainability strategy at Wits in terms of Wits university's plan as follows:

"We have a sustainability policy for the University as a whole that's being developed at the moment. The department called Global Change Institute (GCI) is handling it. So, they are tasked or have been tasked in the past to put together a sustainability policy. This policy is not just operational, and it is academic and operational, everything all under one. So now it has not quite filtered down to us per se to in terms of specific plan and goal and what not" (Senior Planner A, CPD, 2020).

During the interview, it was discovered that currently, Global Change Institute leads the process. This was confirmed by Professor A (GCI, 2020) and Senior Planner A (CPD, 2020). In 2011, Wits University established Global Change Institute (GCI) "*as an enabling research platform of global significance and local impact, fostering informed action for adaptation and innovation in the rapidly changing Southern African region*" (Wits, 2019). The GCI is part of Wits and is one of several multidisciplinary

research institutes that address global change, climate change and sustainability in a multidisciplinary and transdisciplinary manner (Wits, 2019).

The new policy aims to adopt an integrated sustainability strategy. Putting in place an integrated sustainability strategy where it is academic and operational (Senior Planner A, CPD, 2020)—in other words, adopting a plan that is inclusive of organisational structures. Furthermore, we know some of the key stakeholders have not yet been included in the process. However, we have established that Wits University is facing barriers to adopt integrated environmental sustainability strategies.

b) Institutional leadership

The next sub-topic in organisational structure and strategy theme was institutional leadership to drive climate change issues on campus. The respondent strongly felt that the university lacks leadership in promoting climate change mitigation factors on campus. In terms of institutional leadership deficiencies Professor C note the following observations:

“We have management weakness” (Professor C, 2020)

Linking this challenge with the first sub-theme (bullet “a” above) responses during the interviews raised cause for concern about Wits University’s handling of climate change issues on campus.

The first evidence *“is that there is a lack of leadership within the university to promote sustainability and to get the theory of what we are doing to input it into the operational side”* (Professor A, Wits Global Change Institute, 2020). This lack is attributed to the *“lack of strong leadership in the term”* (Professor A, GCI, 2020) of promoting climate change issues on campus. This can be attributed to a “lack of interest amongst organisational structures from the top management to the bottom” (Professor B, GCI, 2020). Top management levels include Senior Executive Team (SET), the Dean’s office, and the Senate, while middle and bottom management includes operational managers, supervisors and planners. During the interview, Professor B responded by saying that:

“For sustainability to embed itself within an institution, it requires to be made an issue of high focus at the top of the hierarchy. Currently, everyone at the top gives

lip service to sustainability. It has not been one of their top priorities ... they intervened as and when they feel ... Student environmental activism on campus is close to invisible and was much higher when I was an undergraduate 40 years ago” (Professor B, 2020)

Lack of leadership to promote climate change issues on campus can be further associated with the “*lack of sustainability office or officer*” (Senior Planner A). Senior Planner A associates these barriers with lack of sustainability offices by saying that:

“Other universities have a Central Sustainability Officers that reports to like the vice-chancellors officer. Because they play an overarching role in all spheres of the University's operations” (Senior Planner A, CPD, 2020).

The above statements point to “*weak management*” (Professor C, 2020) across all organisational structures, governance and business models for sustainability. From the literature review, we know that good governance for sustainability requires accountability. Professor B highlighted that the sustainability agenda is seldom discussed at the top level and rarely comes up on any management level, including the Council level. Hopkins (2016) attributes this to gaps in awareness, knowledge, and incentives in this emerging field, with many stakeholders, have not yet advocated green construction policies. This can be linked back to Senior Facilities Manager A's views about the lack of understanding of the sustainable university, an issue discussed in detail under the sub-theme “*sustainable development knowledge*” (bulletin “c” below).

Wits University's organisational departments are not coordinated and “*work in silos*” (Professor A, GCI, 2020). During the interviews, Professor A from Wits Global Change Institute emphasised the importance of breaking this silo and work in teams and the significance of strong leadership in the area of sustainable university at Wits:

“My understanding is that we need to first of all break the silo of working in isolation of each other and with each other. We need to start working more as a team. Once you start working as a team as academics then work together with

operational support staff, then we will be able to translate some of what we are into practice, but secondly, we need strong leadership” (Professor A, Wits Global Change Institute, 2020)

The above quote Professor A resonate well with substantial evidence. We see that while trends are increasing and new standards have been set in the global green campus initiative since the Sustainability of Higher Education declaration declarations (SHE) was initiated. Both challenges and solutions to champion sustainable development policies are critical. This observation is well captured and explained below by Professor A.

“Therefore, we need to have strong leadership within the institution, and within Wits. We need Champions. We need to have an office that champions sustainability” (Prof A, Wits Global Change Institute, 2020).

Professor A's views emphasise the fundamental role of the sustainability department at Wits to enforce successful sustainable policies and encourage, organise, and communicate best practices among university administrators and academic departments.

c) Sustainable development knowledge

During the interviews, the need for sustainable development knowledge emerged as an essential theme. Lack of sustainable development knowledge and awareness at Wits University was confirmed by one of the responses in an interview with Senior Planner A from Campus Planning and Development (CPD), as quoted below.

“So we don't formally have a sustainability development plan or goals or targets for that matter” (Senior Planner A, CPD, 2020).

Again, the absence of a university-wide sustainable development strategy or goals is linked to the absence of a designated sustainability department. It is well illustrated in an extract 2020 by Senior Planner A as follows:

“So the challenge particularly for Wits university, we don't have a sustainability department” (Senior Planner A, Campus Planning and Development, 2020).

Based on the above explanation, why Wits University does not have this policy in place in terms of barriers, Senior Planner A (CPD, 2020) attributes these challenges, amongst other things, to the lack of accountability and leadership in the area of the sustainable university. In 2020, quoted below by Senior Facilities Manager A continues on the same study and attributes these challenges to the lack of awareness, knowledge and information, and says:

“So I was a bit disappointed by the University’s strategy, in that it showed a lack of understanding of sustainability or not a lack of understanding in an immature way of understanding sustainability” (Senior Facilities Manager A, 2020).

These words or text is in concurrence in *Wits Green Students Projects* report, Akoob *et al.*, (2012) all making a compelling argument against the university. A study by Akoob *et al.*, (2012) found that *Wits’ Vision 2022 Strategic Framework* focuses on the areas of Finance Strategy, Academic Planning and Research Planning, which will see the university improve the quality of education, and become an excellent institution globally. However, the strategy shows little or no evidence at all that it addresses environmental challenges.

Secondly, this quote of text from Senior Facilities Manager A indicates a lack of understanding of the sustainable university as a barrier to adopting an integrated environmental sustainable strategy. This resonates well with the study of the sustainable university that found ambiguity and complexity of the actual concept of sustainability as identified as one of the barriers that have led to reluctance among HEI stakeholders to adopt GCI and to support their institutions' sustainable transformation. In literature, lack of understating sustainable university can be attributed to lack of information, lack of knowledge, lack of awareness and lack of incentives.

d) Coordination

Another problematic sub-topic that emerged was the notion of working in silos. This brings us to the issue of coordination or collaboration. The is minimal or lack of coordination or collaboration at Wits between students, academics, operational divisions and Wits staff interviewed; who felt that academics and students are under-utilised. It also emerged during the interviews that one of the

challenges is that the *“institution struggles with collaboration”* (Facilities Manager A, 2020), and *“there is a very big or there is a very specific fence between operations and academics”* (Facilities Manager A, 2020). This made no sense to Facilities Manager A. we can observe that the crisis management degree at Wits University is an issue.

Wits University is failing to utilise its internal expertise and knowledgeable capacity. *“It is very difficult for a single department or individual to be tasked with developing the sustainability policy of the University when it is not quite their day-to-day work, and it is not what they are doing in full time”* (Senior Planner A, CPD, 2020). In terms of good governance principles, collaboration emphasises legitimacy and voice, where all key stakeholders have a say in decision-making either directly or through intermediate institutions that represent their intentions (Graham *et al.*, 2003).

e) Capacity

Another sub-theme that emerged during the interviews was the notion of lack of capacity at Wits University. Here, Lack of capacity refers to human resource and financial capital as well as direct accountability. Senior Lecturer A, from the School of Architecture and Planning, shares these views as illustrated below when he says:

“The biggest challenge is budget” (Senior Lecture A, 2020)

Senior Lecturer A further notes a lack of financial incentive and capacity amongst operations staff to contribute. He is cited in his response saying:

“I do have some sympathy for them because I am sure that they are overworked and probably underpaid and probably under resource” (Senior Lecture A, 2020)

Overall from the interview, we observe a trend of deficiencies in the availability of sustainable policies. And the siloed approach is at the centre of the problems of why this is the case at Wits.

4.2.2 University’s climate change mitigation options

a) Wits green campus initiatives

We see the Wits Green Campus initiative's take up, see **Table 16 and 17** below, and emerges without a sound policy document guiding their implementation plan. The study issue's first sub-topic was Wits' green campus activities, which fell under the university's alternatives to mitigating climate change mitigation.

Table 16: Wits University green campus initiatives.

Authors	Green Campus Initiatives and Projects
Wits Research Report (2011)	Establishment of Wits Energy Forum
Wits Services, 2020	Wits waste management initiative
Paschini (2015)	Wits Built Environment Precinct project
Wits 2017 Annual Report	Rooftop Photovoltaic (PV) Systems Rollout, Braamfontein West Campus
Wits 2019 Annual Report	Rooftop Photovoltaic (PV) System on Robert Sobukwe Block
Wits 2017 Annual Report	Building Management System (BMS) Pilot Recommissioning, Braamfontein West Campus
Wits 2017 Annual Report	South West Engineering, HVAC building audit
Wits 2017 Annual Report	Medium Voltage (MV) Cable Replacement, Braamfontein West Campus
Arnoldi (May 2019)	Wits Junction district heating project which combines solar, cogeneration and gas heating technologies to service 14 student residence buildings with hot water from one centralised hot water plant room

Table 17: Wits University environmental sustainable academic programmes.

Authors	Academic programmes
Wits Research Report (2011)	Establishment of Global Change and Sustainability Research Institute (GCSRI)
Wits Research Report (2011)	Establishment of Wits City Institute
Wits Business School, 2020	Wits Business School launched the African Energy Leadership Centre (AELC) in 2017

According to the Wits 2019 annual report, the University made strides on greening campuses. Professor C from African Energy Centre at Wits University argues that the university is on the right trajectory regarding environmental sustainability goals on campus.

“I think Wits is probably better off than many other campuses given the average age of its architecture which is old by comparison to other universities in South Africa” (Professor C, 2020).

It is increasingly clear that Wits University intends to promote green campus initiatives. It is evident in a new paper article, Wits Vuvuzela, by Ortal Hahad (2019). Citing the Director of Services at Wits, Israel Mogomotsi stating that over the years, the university has engaged in a variety of interventions, such as the use of solar energy and sustainable resource campaigns to reduce its carbon footprint. This exhibit was confirmed by interview responses from an official at the Wits Services Grounds and Waste department, as shown below.

“The opportunity for environmental sustainability is quite high... especially on this campus” (Senior Facilities Manager A, 2020).

b) Water usage at Wits University

During the interviews and observation stage, it became clear that water usage at Wits University is an issue. However, according to Senior Facilities Manager A, Wits University is hugely fortunate enough to have a very high water table. Wits sit on a lake, and the soil is easily penetrable, as parts of the Braamfontein Campus used to be the dumping site of the Joburg Municipality. As a result, in Wits University green campus initiatives, the university has set up a program to turn some of the gardens water-wise and implement an irrigation system, **Figure 10 and 11**, throughout the campus.



Figure 10: White elephant boreholes not in use or connected to a water storage system (Rodney Matentshi, 2020).



Figure 11: Borehole system at Wits Sturrock Park, west campus, connected to eight of Jojo water tanks storing 80 000 litres for watering Wits Sturrock Park Stadium soccer field (Rodney Matentshi, 2020).

This observation is further supported by interview responses from Senior Facilities Manager A, as seen below.

“and we have five to seven boreholes on site that we can use as well” (Senior Facilities Manager A, 2020).

In line with the above statement, according to the spreadsheet, **Table 18** below, of the Wits Services Department, Wits has 12 boreholes on the Braamfontein campus

(East and West campus), and almost eight of them are connected and used to water the grounds and the sports fields.

Table 18: Spreadsheet for the boreholes within the Wits Campuses (Wits Services Department, 2020).

Borehole Number	Area/ Campus	Status/ condition
Borehole number 1	WEC sports field	Operating
Borehole number 2	Marks Park	Operating
Borehole number 3	East Campus Ithemba Labs	Operating
Borehole number 4	Muslim Facility Prayer	Operating
Borehole number 5	East Campus Olympic Swimming Pool	Operating
Borehole number 6	Dig Field	Operating
Borehole number 7	Barnato Hall	Operating
Borehole number 8	Golf Driving Range	Not Working
Borehole number 9	Sturrock Park Staff Quarters	Not Working
Borehole number 10	Sturrock Park stadium	Not Working
Borehole number 11	Sturrock Park Bowls	Operating
Borehole number 12	Wits Plus, Science Stadium and surrounding areas	Operating

According to the Senior Lecture A from the School of Architecture and Planning (SoAP), South Africa is a water-scarce country, and Johannesburg itself has not been particularly water scarce. However, that is not because of the environment Joburg finds its self in. That is because we pump in most of Gauteng water from Lesotho, which is a temporary solution for a permanent problem. Gauteng gets water from somewhere else and brings it into Johannesburg to survive, creating an incredibly unsustainable issue in dealing with water scarcity (Senior Lecture A, 2020).

Not only does Senior Lecture A agree with the above statement that a sustainable university would deal with water management. But he also notes that a green campus would be one that would reduce consumption. This goal can be achieved by collecting, harvesting, reusing rainwater. Treating greywater and reusing it, including the treatment of black water—and releasing it on campus rather than sending it to the municipal sewer system and the retention of stormwater on campus by landscaping to be able to do so.



Figure 12: Borehole system at Wits Sturrock Park, west campus, leaking due to lack of water management system and capital funding (Rodney Matentshi, 2020).

Wits University does not have an effective and efficient water metering and management system to support green buildings and services (**Figure 12** above). In addition to the fact that at Wits University, the main water system is old, and the rapidly ageing infrastructure is highly complicated by multiple entry points of water pipes into campuses. The lack of a university management system and the lack of human resources in terms of the water management system negatively affect the accuracy of Wits University's reliable water use data collection. These findings are set out in the statements below from the participant:

“Water is a slightly more complicated issue...it does not have a single point of entry...At the moment City of Johannesburg (COJ) is busy investigating and identifying all the pipes that come on all our campuses and busy installing new water metres.”(Senior Facilities Manager B, 2020)

“We do not have many resources in terms of people. Ideally, we would like to have all these water metres read electronically, remotely...so if we read the water metres remotely, through a wireless device, then at least the accuracy level would be much higher” (Senior Facilities Manager B, 2020).

The above statements state that Wits University is currently aware of its waste and water use and is aware of the benefits of promoting environmental management systems. However, while the university is on its way to improving the green campus

initiative to enhance the water metering system, the university currently lacks a water management system.

To address issues related to water infrastructure on campus, the university has taken the initiative in line with its green campus initiative program to assess water infrastructure status. In 2019, Wits University invited to appoint consultants to investigate all campuses' water infrastructure and find out where the infrastructure was, how deep the pipes were, and whether or not there was an overflow from the actual points (Senior Facilities Manager B, 2020).

The purpose of this investigation is to identify the water leakage and condition of the water pipes and the infrastructure and to recommend solutions, including the most appropriate water management system to Wits University (Senior Facilities Manager B, 2020).

One of the main reasons for Wits University's failure to adopt a green campus policy is the lack of data or knowledge and awareness of infrastructure, such as water infrastructure, on all of its campuses. Wits University seems to be aware that they are losing water due to leaks, but they have no idea how much water is being wasted due to these leaks on all campuses. The following statement contains the proof.

“We know for a fact, like with any other institutions in other places, that there are leaks underground...” (Senior Facilities Manager B, 2020).

c) Waste management at Wits University

Waste management is another key aspect of the green campus initiative at Wits University and is considered a major component of the grounds, landscaping and maintenance portfolio. Waste management at Wits University includes recycling and pest control. According to Senior Facilities Manager A, pest control is related to biodiversity management. The concept of biodiversity management as a green campus initiative ensures that poisons do not adversely affect the environment. (Senior Facilities Manager A, 2020). Accordingly, Wits University, led by the waste management department of the university, introduced a hazardous poison.

We will see birdlife start dying, and some of the mammals we have on-site because we have some dassies and have some geese will see them begin dying (Senior Facilities Manager A, 2020).

Some 400 indoor recycle bins have been purchased by Wits University as part of the recycling program, but these bins have not been rolled out due to a lack of human resources to empty bins (Senior Facilities Manager A, 2020). In addition, Wits rolled out new colour-coded bins, **Figure 13**, as part of the recycling program in August 2019, which were placed around campuses to separate waste for more environmentally efficient disposal (Ortal Hahad, 2019).



Figure 13: Colour coded waste stationed at west campus student's residence (Rodney Matentshi, 2020).



Figure 14: Operational recycling station– where all recyclable items are separated into groups of materials of plastics, metal etc., from non-recyclable items (Rodney Matentshi, 2020).

The waste from these bins is collected from the various campuses to the university's recycling station, **Figure 14**, located at the East Campus, Braamfontein.

The above statement is confirmed and included in the following quote from an official, where the Senior Facilities Manager says:

“We have a team that sorts waste from the various campuses” (Senior Facilities Manager A, 2020).

This operational recycling plant, which has been operating since the early 2000s, was discharged in 2017 with external service providers phased out as a result of insourcing, and it will be back in operation only now in 2020 (Head of Wits Services, Israel Mogomotsi cited in Zuma, 2020). Wits receive financial credit from the service provider for waste collection services for every recyclable load collected by the external services (Official of Wits Services, 2020).

In addition to the parallel operational recycling plant, Wits Services is responsible for the compost soil recycling station, **Figure 15 and 16**, which has faded due to insourcing, lack of capacity and capital funding.



Figure 15: Wits Services’ compost site turning into a garden waste-dumping site (Rodney Matentshi, 2020).



Figure 16: External services transport garden waste from across the campuses to Wits Service's compost site (Rodney Matentshi, 2020).

d) Green building and Energy at Wits University

In terms of energy use as part of the university's green campus initiatives, Wits University has launched the Energy Efficiency Program through the establishment of the Energy Forum. The objective of this program was to promote awareness of energy use, energy management, the implementation and development of sustainable projects, and to ensure that the university reduces energy waste. In contrast, the purpose of the Energy Forum was to monitor all energy-related projects and approve all projects. They were ensuring that no new buildings, new hardware installations, no changes to either electrical or Heating, ventilation, and air conditioning (HVAC) infrastructure would be made without the approval of the Energy Forum. The study found that the Energy Forum at Wits University failed due to a lack of leadership. In his responses, the Senior Facilities Manager mentions the following statement:

"The person running that or the chairperson of that forum left, and then it sort of faded away" (Senior Facilities Manager A, 2020).

The lack of leadership in sustainability policy is evident in Wits. In addition, this is further supported by the fact that following the failure of the Energy Forum, a second attempt to formalize the sustainability program on campus was initiated by the establishment of a sustainability forum that was to fade away. Arguable this kind of

programs also demand the ability to collect data and to conduct research. To collect data and to drive research demand time and capital funding. According to Professor C's responses, research is very costly, and arguably, there is not a lot of money to do it. Secondly, it is about what the university prioritises the most. Looking at the failure of Wits University pathways to establish formal sustainability programs on campus through the Hopkins' (2016) lenses, we can argue that pathways to establish formal green building campus initiatives at Wits University lack incentives.

Moreover, in line with Hopkins' (2016) findings, one of the key challenges is that Wits University prioritises other objectives over green buildings. Hence, there is no reason for the university to consider energy efficiency. The statement in the response of the participant confirms these findings.

"Then three or four years ago, there was a thing called sustainability forum"
(Senior Facilities Manager A, 2020).

Wits University has likely failed to prioritise green buildings despite spending a large amount of capital on new buildings. Further evidence that Wits University is probably prioritising other goals over green buildings programs is found in a statement below from Professor C.

"Our primary job was to do what all business schools do concentrate on the revenue side of the balance sheet of the income statement, and that translates in simple terms to put bums on seats. So we are, our programs to get degrees running as quickly as possible and get students in fee-paying students into the centre as quickly as possible to try and bring to the point of sustainability. We have not had time to raise our views above the parapet to look wider at University issues"
(Professor C, 2020).

The University of Wits currently has a PIMD Energy Office. According to Senior Manager B, the university's energy office is responsible for the stock of 280 to 300 buildings. The Energy Efficiency Program at Wits University is sitting between PIMD and CPD in the absence of the Central Sustainability Office. CPD plays the role of Planning Advisor, while PIMD plays the role of Energy Management for the entire

university. These also show a lack of accountability when it comes to the energy issue at Wits University. Senior Planner A is correct to say the following statement:

“Energy is not the concern of anyone else at the moment, But also we are resource-constrained as well” (Senior Planner A, 2020)

It is surprising that an institution the size of Wits University, with all its experience and expertise on energy issues, a critical point in the fight against climate change, is not a priority.

In terms of energy demand or use, the university currently has about 5.5 MVA at East Campus and about 2.5 MVA at West Campus, all of which come from Eskom, which produces 99 per cent of coal and hydro. The statement below supports the findings set out above.

“So whatever comes from Eskom goes through Joburg City Power, which then comes to us” (Senior Facilities Manager B, 2020).

The above statement states that there is a need at Wits University to improve energy efficiency to reduce the environmental impact on campus and start to purchase clean energy products that are good for the environment. However, although the university lacks a sustainability policy, the university has installed solar PV arrays throughout the various buildings over the last few years.

Wits University clean and efficient energy mitigation options are lean. In response, the Senior Facilities Manager stated that the university had installed these solar PV arrays on the roofs of the following buildings: the New John Moffat building, the Roberts Sobukwe building, the Origins Centre and the Math Science building. The university is “*generating nothing less than 40 percent worth of energy from the sun*” (Senior Facilities Manager B, 2020) which is directly integrated into the grid of these individual buildings.

For several years, South Africa has experienced a high level of load shedding. Over the same period, Wits University has taken initiatives to install a standby generator as an emergency backup and reduce energy costs by running generators during peak time when Joburg City Power charges the university the most. According to Senior

Facilities Manager B, the university generator farm covers the entire campus. These comments are found in the statement below.

“It covers everything from air condition; to lighting to charge your phone, to the fridge, to microwaves, whatever is connected in a building, in campus, it powers up everything”(Senior Facilities Manager B,2020).

The above statement shows a lack of commitment to environmental sustainability at Wits University. The generator uses diesel, diesel releases carbon air and is produced from crude oil, oil is bad for the environment. It is evident that trends in carbon dioxide (CO₂) emissions are still very high at the University of Wits and that developments in the use of renewable energy are modest.



Figure 17: East Campus Generator Farm, 28 000 litres of diesel tank capacity, to power the entire East Campus infrastructure, with 5.5 MVA energy demand (Rodney Matentshi, 2020).

Investing in the above-mentioned, **Figure 17** above, interventions lack environmental and financial benefits. Financial benefits are one of the critical incentives highlighted in the literature. Literature defines lack of incentive and points out that HEIs has failed to engage in sustainability-friendly initiatives such as campus

electricity, water use and other green campus initiatives /programs with significant savings and financial benefits. In his paper, Hopkins (2016) highlights lack of incentives as one of the primary financial barriers to long-term water, energy and maintenance cuts. We can say that the financial barrier is one of the primary barriers at Wits University to green campus policies. Apart from financial barriers, some of the respondents strongly argued that in South Africa, technology is not quite ready yet, and where it is ready, it is much more costly than petrol and diesel. This response explains part of the rationale why Wits University is investing in diesel generator farms and not in solar technology.

However, looking through the Hopkins lenses (2016) for clear reasons why Wits University does not invest in solar technology includes lack of incentives and awareness. According to Prof. C, the African Energy Centre at the Wits Business School, solar technology and renewable energy issues may not be a high priority. Accordingly, the study found that Wits University had not prioritised clean energy on campus. Wits University's lack of commitment to environmental sustainability regarding renewable energy, waste management, water usage and other green building initiatives is due to lack of technology, lack of knowledge and bad governance. Apart from a lack of technology, many tasks are easily accomplished at a low cost, yet they remain unaddressed owing to a lack of information, awareness, and poor management.

To address water and energy consumption on campus at Wits University and to manage the university's carbon footprint, in 2018, the university piloted a solar thermal hot water system, **Figure 18** below, to meet the hot water demands of the residence complex, which houses 1 100 students in 14 buildings (Buhle Zuma, 2020).



Figure 18: Wits university solar thermal hot water system to meet the demand of hot water of the student residence (Buhle Zuma, 2020).

Fachrudin (2020) lenses, this initiative is consistent with green campus principles, namely water; waste; environmental impact; energy, and human health. These principles foster the concept of green building and NetZero.

About green building and NetZero, the interviewees strongly argued that it would be incredibly difficult for any university, such as Wits, to achieve NetZero with a kind of resource constraint. This exhibit is well illustrated below, where Senior Planner A, Campus Planning and Development, says:

“As an example, our combined energy demand in terms of electricity is sitting at about 16 megawatts peak. Sixteen megawatts is a huge amount. We just revised the energy plan for the next five years like last year as well. But if we look at all of the available rooftop space that I can stick on across our five campuses, we can probably implement about four to five megawatts. That’s just about a quarter of the university's energy demand” (Senior Planner A, CPD, 2020).

The Senior Facilities Manager, who argues that Architects in South Africa have not yet figured the concept of NetZero and that Engineers on campus at the PIMD department may not be aware of what NetZero is doing, backs the above statement. Looking through the lenses of relevant scholars, such as Hopkins, these arguments

demonstrate the lack the knowledge and understanding of NetZero operations at the Wits Operations department.

In addition, the statements mentioned above highlight the lack of capacity as a barrier for Wits University to offset renewable and clean energy. According to Senior Planner A, there is no way to achieve NetZero at Wits University, given the concentration or demand and energy consumption that the university is experiencing. However, continuing on the same issue as NetZero in his response to the Senior Lecture A from the School of Architecture and Planning, for Wits University to be a 100% carbon neutral sustainable campus. It is better to set a target that you are unlikely to meet and get halfway there than to form a highly realistic target. His argument is captured below, where he says:

“So if the university said that we want to have the entire campus be carbon neutral. By 2030, is that unlikely to happen now? But suppose you set that as the target, and you do everything you can to move towards it even if you only get halfway there. In that case, that's still 50% better than where we are now, but if the target is we want to improve our Energy Efficiency by 5% in the next ten years, you might achieve that target, but it's not a major impact” (Senior Lecture A, 2020).

The above statement and argument of Senior Lecture A can be defined as the setting of ambitious targets that expect perfection to settle for greatness. Although change can be difficult for a very large academic institution such as Wits University, issues are always present in such organisational structures, so changing how things are done can be disruptive. According to Senior Lecturer A's response, there are healthy disruptions and negative disruptions; he believes that people are so afraid of negative disruptions that even beneficial disruptions tend to be blocked. This statement can be analysed as a lack of knowledge and awareness.

Senior Lecturer A from the School of Architecture and Planning says that the university does not lack capacity, but institutional change is complicated. Unlike the other participant, he firmly believes that Wits University, as an academic institution, has many experts who can do things better. The observation is well captured below, where he says the following:

“...because if an institution with the resources that Wits University has does not get it right, what is the chance that the average person on the street is going to get it right” (Senior Lecture A, 2020).

The above statement strongly says Wits University continues to rely on the goodwill of the external Architect and their competence to produce something that will help convey the things that academics would like to teach. In terms of teaching content, whatever degree program in any discipline, according to the Senior Lecture A, there would have to be somewhat content that deals with sustainability ethics. The strategy used by Wits University in experimenting with the concept of a living laboratory will be addressed in greater detail below.

4.2.3 Retrofitting existing building stocks and heritage buildings barriers

When Wits turns 100 in 2022, some of its buildings will become heritage icons under the South African Heritage Act. “The university has many buildings and places of heritage value. The highest order of these is the Great Hall and the large forecourt space that announces it; the ridgeline is the great watershed divide and the Tower of Light. All aspects of heritage should be respected (Wits SDF 2020 Review – Initial Draft, 2020). Thus, existing buildings, especially heritage buildings on campus, were identified as a barrier to transforming the campus into a sustainable and green university during the interviews.

The revised 2020 framework articulates the issue of sustainability and quality of the environment. Furthermore, the Spatial Development Framework’s review in 2020 improves the focus by highlighting the significance of preserving Wits’ heritage. Unfortunately, within the revised framework, there is a failure to use heritage building preservation with sustainable design principles. Implementation of sustainable design principles would contribute to creating the desired quality environment on campus, ensuring that the university attracts and retains global scholars and students. In other words, the framework fails to articulate how it is planning to unlock heritage spaces for the new community of diverse scholars.

Concerning the above issue of heritage, Senior Official A (a participant from Campus Planning and Development) said that heritage preservation does not attract contemporary students worldwide. “Campus environments that produce feelings of

alienation, hostility, social isolation, and invisibility, can hinder the recruitment of new students, their social adjustment and retention, as well as satisfaction levels and graduation rates” (Cross & Johnson, 2008:303).

“The underprivileged could come in to clean, to serve food, or work in the garden, and then leave” (Senior Official A, 2020).

From the above statement, the concept of heritage is a preservation for the privileged, and the underprivileged would not enjoy it. Senior Lecturer A (a participant from the School of Architecture and Planning) insisted that heritage buildings are essential and must be managed sustainably. However, looking through Evans's (et al., 2015) lenses in terms of retrofitting existing building stocks and heritage buildings barriers and barriers to renewable energy in heritage buildings, Wits University must generate a sustainability strategy with guiding design principles for future alterations and modifications of facilities. Establish principles for how alterations and additions can be made using a modern approach aligned with the original team of architects' original vision (Keeling & Leuven, 2014). However, Senior Official A argued that where heritage buildings have outlived their purpose, repurposing with smaller interventions is no longer possible, and a case must be made for demolition.

4.3 Case Study: Architect led living lab – Wits SoAP and JMB as a living lab building

The case study of the “Architect led” living lab at Wits University is divided into two sections: the SoAP and JMB are listed as key areas of the case study – the SoAP's position as the leader of the university's living lab and the JMB as the building of the living lab.

4.3.1 Views of staff at Wits University on green campus initiatives led by Wits SoAP to achieve a sustainable university

a) Pathways

During the interviews, it emerged that as part of the re-imagination of the Built Environment Precinct. The School of Architecture and Planning, led by the Head of School, Prof. Nnamdi Elleh, has conceptualized an innovation hub. In collaboration with Campus Planning and Development and under the leadership of Emmanuel Prinsloo, Director: Campus Planning and Development. An innovation hub is similar

to or the same as a living lab. A living lab can be "*considered an environment for innovation and development*" (Adam *et al.*, 2011:1). An innovation hub allows diverse groups to collaborate and test best innovations in the "different phases of the research, development and innovation (RDI) process" (Herselman *et al.*, 2009:196).

b) Challenges

According to Mr Emmanuel Prinsloo, Director of Campus Planning and Development, it was surprisingly easy to set up this innovation hub because the concept came from the right people. The Dean of the Faculty of Engineering and Built Environment at the University of Witwatersrand is very enthusiastic about the innovation hub, and Prof. Elleh, whose idea was to set up an innovation hub. The project also involves individuals who have worked for the Department of Higher Education (DHED). The project has the support of individuals from a wide range of backgrounds and relevant expertise in Construction Infrastructure Delivery Projects (CIDP).

c) Purpose

Research is the primary objective of this innovation hub, according to Prof. Elleh. The hub will be located in the Old John Moffat Building. Emmanuel Prinsloo says that Wits University and the Higher Education Department have successfully delivered several projects through their Infrastructure Delivery Programme (IDP). As such, they have an extensive portfolio of finished works. However, the outcomes are not digitally archived for future reference purposes. Digitalized infrastructure documentation must be created to make it accessible to prospective students, act as a study resource, and provide a reference for new users. This idea complements well with the primary objective of this innovation hub. According to Director of Campus Planning and Development Emmanuel Prinsloo, one of the main outputs for setting up this innovation hub is producing graduate professionals with a broader outlook than just their discipline. The idea of a more comprehensive outlook is best defined in terms of living laboratory concepts. This includes multidisciplinary concepts such as collaboration, interdisciplinary and transdisciplinary.

4.3.2 JMB as a living laboratory

As soon as the living lab becomes a group of students, then it becomes not only something that shows that there is effective teaching happening, but it's also

something that can be used to market the university. According to Senior Lecturer A, students who go through a programme affect institutional change within the university. Although the School of Architecture and Planning has a core purpose of teaching and research, to effect institutional change. The Old John Moffat building itself can be a centre of learning, teaching, and research in urban studies and sustainability studies and be the living lab instead of building a lab. According to Senior Facilities Manager, this effect can be achieved by installing green building technology at the John Moffat building.

“Technologically provided reliable data would go far in terms of mitigating the challenges of the sustainability assessment system” (Senior Facilities Manager b, 2020).

Since there is a lack of collaboration within the university and a lot of work in silos, a living lab should address such barriers. Senior Planner A recommends that a school such as the School of Architecture and Planning at Wits University set up a Living Lab. The actual participants in its structure should include a research group for learning and a committee. The hub must be open to the public and operate as a governance structure.

“If I have a project, I approve it at that committee before it serves at the executive level or whatever it is or maybe project ideas come out of that committee and then get refined into an actual implementation” (Senior Planner A, 2020).

The above quotation from the Senior Planner A response states that Wits University should consider Living Lab for sustainable campus planning and development purposes. According to the argument and statement of the Senior Lecture A, this will require Wits University to use the university as a living laboratory to experiment with solutions that could be scaled up in society at large.

Other participants recommended that the living lab consider the structural limits to be transdisciplinary. Transdisciplinary is free from academic structural issues that are challenges in universities. Through a transdisciplinary approach, the living lab will bring more than a kind of token of things from an environment other than the core

offerings in the built environment. Quoting one of the participants' answers where they say:

“The School of Architecture sits within a particular faculty, and it can only award degrees in their faculty...that then constrains the degree to which they can offer transdisciplinary offerings” (Professor B, 2020).

The Living Lab is a platform that explores innovation in various ways through user-centric, multidisciplinary research methods. Multidisciplinary research approaches relate to many other concepts within different interpretations, including the notion of interdisciplinary and transdisciplinary, among others (Van der Besselaar and Heimeriks, 2001 citing Thompson, 1990, 1995).

Professor A is not entirely sold on the concept of interdisciplinary. However, he agrees that bringing diverse individuals from various disciplines together is the right path to bring together university sustainability clusters. Professor A worries that participants should be able to keep their own identity and prefer the transdisciplinary idea, as working across disciplines.

As far as collaborating with internal and external communities is concerned, there is an entirely green building industry where a living laboratory can lead people to experts that will analyse buildings and systems and advise the university on improving the efficiency of green buildings on campus. According to Professor C, by collaborating in this way, Wits University's cost curve can come down because there is much greater collaboration in collecting data on water and energy use issues. For example:

“There is a centre at CSIR that does this where they found, for example, some factories over there had three pumps going with the installation of sensors they have two pumps going so they reduce their energy consumption by 1/3 simply by measuring” (Professor C, 2020)

According to Professor A, the interdisciplinary does not give participants the framework to find solutions. Interdisciplinary experts guide their interests. Therefore, he prefers that participants meet in an interdisciplinary way – but they engage from a transdisciplinary perspective.

Professor A finds education monistic, making individuals find it difficult to function properly when trying to understand or engage with other disciplines. The single focus could be a contributing factor for why individuals continue to work in isolation from others at the University of the Witwatersrand. Therefore, if Wits University produces the kind of graduate with a broader view, the type of awareness includes understanding the context. Otherwise, we will be dealing with increasingly highly specialised and skilled people. Prinsloo argues that highly specialised people will still tend to be space illiterate.

4.4 A Summary of results

The questionnaire obtained data about the understanding and experiences of Wits university workers. The findings indicated that pockets of sections across various departments at Wits share a common interest in climate change, sustainability, and green campus initiatives. The staff viewed a leadership vacuum in sustainability on campus and a lack of commitment from university management.

Below is a summary **Table 19** of the barriers to green campus policy and living laboratory adoption, highlighting the challenges of why Wits University does not have a sustainable development plan, aims and goals. Green campus initiatives are implemented haphazardly or on an ad hoc basis in silos by various departments and operational divisions.

Table 19: Summary of barriers to adopting green campus policy and living laboratory.

Primary Barriers	Secondary Barriers	Source
Lack of accountability and strong leadership	- Lack of Sustainability Officer or Central Sustainability Office - Lack of champions for sustainable development policy on campus	
Lack of awareness, knowledge and information	- Lack of interest amongst organisational structures from the top the bottom management - Lack of understanding of the actual concept of sustainability - Lack of understanding sustainable university - Lack of student environmental activism on campus	
Lack of collaboration	- Wits organisational structures face huge challenges of office politics: various departments within Wits University are working in silos - The institution is struggling with collaboration	

Environmental sustainability opportunities at Wits University, see **Table 20** below, are quite high in addressing campus water scarcity and usage; effective and efficient waste management programme, green building and energy efficiency programme, and environmental and energy-efficient studies.

Table 20: Summary of environmental sustainability opportunities at Wits University.

Environmental sustainability opportunities
• Campus scarcity and usage: The fact that Wits University has a high water table with the clear possibility to install a borehole,, therefore, presents Wits University with the opportunity to save water.
• Effective and efficient waste management programme: The fact that Wits University, with more than 40 000 students, many thousands of staff and seven campuses, is a small town, generates a large amount of solid waste which is drained into the municipal system, which can be converted into fertilizer or used to generate energy and produce recyclable waste materials, makes it an ideal place with plenty of opportunities to be effective and efficient. Wits University has established a waste management program, operate recycling facilities on campus, and has a compost site.
• Green building and energy-efficient programme: Wits University owns thousands of hectares of land and a large amount of building stock. Plans to build more facilities to accommodate an increasing number of students allow the university to implement an effective and efficient green campus programme. This will be achieved through the leadership of the new Innovation Hub, Living lab, at the School of Architecture and Planning, working with the overall representation of the key structures of the university.
• Environmental and energy-efficient studies: Wits University offers postgraduate academic programs in energy leadership, environmental studies, sustainable energy efficient studies and green building studies.

Although the opportunity is relatively high, this study has identified modest samples of green building initiatives undertaken at Wits University to minimize the impact of campus development on the environment.

Chapter 5: Conclusions and recommendation

5.1 Introduction

Wits University has sought to integrate ethical values into its core activities in light of the climate change and sustainability agenda. Failure to run and maintain the lifecycle green campus planning is not sustainable for any institution and society.

Green campus initiatives and an integrated environmental sustainability strategy or policy can be effective if supported by a university's vision and supported by all key stakeholders in their implementation. Lectures, students, and support staff must contribute to the performance of the green campus. Living labs as a concept underpinned by the principles of open innovation will promote the notion of collaboration.

Studying the concept of living laboratories is critical for any institution, but especially for those engaged in teaching, learning, and research, such as universities. Implementing universities' green campus initiatives and research output mitigation strategies provides social, cultural, and economic benefits to universities. Included are cost-cutting opportunities in fields such as energy consumption and other operating expenses. Universities cannot escape their duties of modelling society's image by their status as a beacon of hope. It is this responsibility that enables them to act as agents of social change. They must ensure climate change adaptation and mitigation are met by a realistic and practical plan of action.

It ensured the research aims to voice the views of the various critical players at Wits University about barriers and reasons failing to address climate change issues on campus. Several themes came up with answers to the questions. Participants discussed governance issues, sustainability issues, leadership and skills-related issues, coordination values, working in silos, green campus initiatives, environmental management systems concept, and the idea of living lab and innovation hub. All of these subjects are consistent, detailed, and interconnected.

From a methodological standpoint, the study employed a mixture of approaches, including qualitative analysis, deductive analysis, and inductive analysis, to achieve a "humanistic emphasis." The methodology used in this study was consistent with the literature review, **Chapter 2**, which established pathways and barriers to green

campus policies and paths and barriers to the adoption of living laboratories in higher education institutions (HEIs), such as Wits University. Using Wits University as a case study, this was demonstrated with the Wits School of Architecture proposal as the most suitable university structure to lead the university's living lab and JMB as the living lab building being tested. A qualitative approach was chosen for conducting sample interviews and surveying campus locations. Conversations with participants revealed the pathways and impediments. In general, the mixed-method approach chosen was able to answer research questions by penetrating all aspects of the university.

5.2 Summary of findings into research questions

This section is presented in four topics that are responding to the research questions.

a) Paths and barriers

This section responds to the primary research quest: What current paths if any, and barriers exist at Wits University in implementing its research outputs on its campus land and buildings?

The main research question and the objectives of **Chapter 4** were met. During interviews, several barriers to implementing the university's staff and students own research output to achieve sustainability were identified: Working in silos and a lack of collaboration or coordination and the failure of various departments to share knowledge and expertise became apparent as the main challenges. Problems were presented about Wits operational staff members' lack of knowledge and awareness about the concept of sustainable development. Concerns were made regarding a budget shortfall for green campus efforts.

The barriers outlined above demonstrate unequivocally that the University of Wits lacks appropriate structures to support sustainability initiatives on its campuses. The study found that Wits University's organisational structures lack trust with mutual benefits and long-lasting relationships with stakeholders. This issue demonstrates that the lack of appropriate systems to aid sustainability underpins the inadequate cohesion of the university's sustainable community and siloed work at Wits University. Working in silos presents a lack of coordination. In other words, Wits University's

organisational structure and business model lack effective and efficient coordination methods.

It is painfully clear that the current state of affairs in tackling climate change on campus makes the NetZero principle an impossible goal for Wits University to achieve. During the interviews, it was revealed that the Campus Planning and Development operational division, in collaboration with the Wits School of Architecture and Planning academic division, has embarked on a project to create the institution's innovation hub, which SoAP will host. Living Lab has evolved into an umbrella concept for a diverse array of innovation environments.

b) University policy and strategy

This part responds to the sub-question: Does the university have a policy and strategy for using and implementing its research outputs to enhance its sustainability?

The research question on university policy and strategy was met. Green campus initiatives and an integrated environmental sustainability strategy or policies at Wits University face various barriers to adoption. Wits University can indeed address these barriers in several ways including, the improvements of operation staff and faculties' perceptions of the importance of sustainable university, promotion of knowledge and awareness, by establishing a more affluent HEIs, campus planning, by introducing financial motivation plan, the use of a campus sustainability officer, and the fostering of green campus initiatives.

Although strategies to improve waste management, water, and energy efficiency are ongoing. Initiatives to reduce the carbon footprint of Wits University has suffered setbacks. Should the status quo remain unaltered, the university's path to achieving a 100% carbon neutral sustainable campus will face more setbacks and fade away. There are apparent gaps, a lack of continuity, and insincerity concerning environmental impact issues on campus. Hence, the School of Architecture and Planning should reimagine the Old John Moffat Building as part of the Built Environment Precinct eco-campus project to understand that the building should be a sustainability example to the rest of the university.

Wits University's continuity to invest in non-renewable and non-green building projects demonstrates their disinterest in investing in such interventions. A resource

such as water and energy bill for the university will remain high and not financially viable if sustainability interventions are not adopted. The university leadership can pass these costs on to the students through an annual student fee increase.

c) Organisational structure

The organisational structure responds to the research question about the ideal organisational structure when implementing sustainability policy. The study was able to respond to the research question. From the data analysis, it is clear that Wits University lacks an appetite for green campus initiatives. Wits University's lack of commitment is partly due to a lack of technology and knowledge, leading to toxic and destructive political structural management. A lack of knowledge and awareness causes a lack of interest among top-down organisational structures at Wits University. Overall, Wits University's failure to adopt an integrated environmental sustainability strategy, **Figure 19** below, and effective and efficient green campus program are caused by a centralized and decentralized approach to governance, including the separation of activities, lack of top-down and middle-level management controls, and a lack of adherence to the principles of good governance underpinning sustainable business model. Good governance works hand-in-hand with a sustainability concept that is based on a "Value Network".

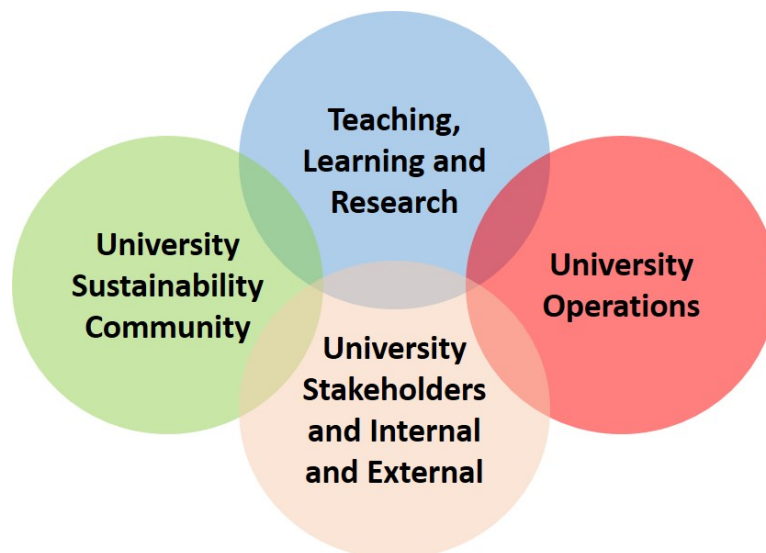


Figure 19: Proposed Integrated environmental sustainability strategy – for Wits University.

d) Green Campus Initiatives led by the Living Laboratory Strategy

This segment responds to the following sub-question: What are the views of Wits staff on the Green Campus Initiatives led by the Living Laboratory Strategy?

This study was able to achieve the goal of responding to the research question effectively. In line with the university green campus initiative strategy, the concept of a living laboratory will promote innovation on campus. In particular, the living laboratory includes coordination values. Coordination is mainly based on the principle of good governance. The study finds that Wits University has the problem of not adhering to the principles of good governance in sustainable universities. This problem creates a barrier for the university to adopt the concept of a living lab and make the university a living lab.

Beyond the fact that the notion living lab employs some of the most trusted technical systems, it has the potential to reach the expectation to develop efficient and low-carbon-building projects with a cost-savings perspective. In this case, the initiatives can form part of new ways to introduce green funding. For example, if Wits University were to initiate a project to construct a new building on campus that serves as either student accommodation, space for public discourse, or even integrated natural and built environment facilities for multidiscipline studies. A living lab would be a perfect vehicle to drive such activities. This living lab approach would be a viable collaborating platform that will ensure the institution delivers products that address climate change directly and the benefit efforts of conducting research output. Through collaboration, the School of Architecture's innovation hub, and creating living lab spaces within academic activities, the university can positively reflect its performance concerning its sustainable issues. If the School of Architecture and Planning is to create a living laboratory, it does not have to be a physical building structure. That is because the physical structure limits the space in which you can brainstorm, push the limits and come up with innovative ideas. Wits University should broaden its institute into organic virtual, a virtual institute that seems invisible. For example, make it invisible of boundaries to holistically conceptualize the idea of sustainability without leaving anyone behind, addressing the issue of exclusivity/inequality.

The study identified that the sustainability issue we are dealing with is a wicked problem with visible problems; hence we need to be invisible when dealing with these issues. The concept of invisible refers to the hidden virus with its ever-changing symptoms. This concept of the invisible can be defined as a living organic system. Therefore an organic system requires complex management integrated systems. For this reason, Wits University, through the lenses of the School of Architecture and Planning, must institute establishes the core of this university as a Virtual Institute. But it must be represented from all over the university to deal with the invisible needs of sustainability problems: virtual institute where you need staff members to see clearly and a balanced representation of all key stakeholders. For example, where you have a director sitting in a School of Architecture and Planning school, a deputy director sitting in a law school, a lecturer or a health researcher, and a place where you can see them (Prof. A, 2020).

While the school of architecture and planning mainly aims at teaching and research, to make an institutional change, the building itself of the Old John Moffat can be a centre for green building study, teaching and study, and a living laboratory instead of constructing a physical lab. In the opinion of Senior Facilities Manager A, the JMB building must install a built system where the consumption of water, electricity, and other resources used in the building are displayed in the foyer to showing the performance of the building and continue talking about this type of innovation. This initiative will increase awareness and information, which was identified as a barrier during the analysis.

5.3 Solution to problems

This section presents several mitigation options to address climate change issues at Wits University adequately. These mitigation options consider the problems of establishing a living lab at Wits; the implementation of green campus initiatives; organisational business model; green campus policy; and the establishment of Sustainability Lekgotla at the University.

a) Establishment of living lab at Wits University

To resolve Wits University's structural barriers and collaborate and coordinate activities and share knowledge, expertise, and experiences, Wits University must establish a Living Lab. Each stakeholder must be encouraged to collaborate and assist

in overcoming these barriers. Living labs allow diverse groups of participants to join forces by sharing knowledge, experience, skills, and creative ideas. Living labs see users as co-creators of innovations.

In other words, the university, researchers at the university and university managers collaborate when making decisions. The university can decide if it is too risky to invest in something demanded by the campus community. Living lab participants decide whether the investment is too much of a risk. Users will have the opportunity to make informed decisions. Therefore, living labs are a fundamental methodology.

Wits University should establish an Architect-led living laboratory that will allow planning and developments based on win-win strategies to mark the path for actions and facilitate an eco-campus. This type of living lab enables a platform to explore opportunities in various areas, such as energy and water use, transport systems, waste management, and other operational support resources. The concept has tools and different interdisciplinary methods to ensure Wits University overcomes its limitations under the current organisational business model to adopt an effective and efficient green campus policy. This is because living labs encourage efficient project outcomes, ensure alignment of policies, and provide procurement policy and energy policy forums. Furthermore, living labs at Wits University will promote collaboration by establishing students, academic staff and professional staff engagement forums. Living labs allow multidisciplinary research to benefit users. In other words, a multidisciplinary research method centred on the user. A multidisciplinary research approach is inclusive of notions such as transdisciplinary and interdisciplinary.

In the transdisciplinary, everyone arrives with their approaches and methodologies and is open to the practices of others. In this case, the notions will complement each other. When participants meet in an interdisciplinary way, they engage from a transdisciplinary perspective.

b) To achieve green campus initiative at Wits University

The literature strongly argues for higher education institutions to employ an integrated approach to achieve green campus initiative. From the literature, we found that indeed there is a strong linkage between sustainable development and Green University. Within the context of integrated systems established within the principles

of the living lab, Wits University will be able to plan for growth systemically and develop sustainable campuses. In addition, the integrated system of the sustainable university and living lab will link all university stakeholders and design, package, and implement real projects. Projects that are robust enough as alternatives in mitigating environmental impact on campuses. Two improve water usage, waste management and energy efficiency, and other transportation and healthy buildings and spaces.

Institutions of higher education are central to the development of a more sustainable society. Therefore, the integration of academic activities, campus planning, management and operation will improve university energy consumption and reduce the impact of campuses on the environment. Which can result in the university saving operational costs that can be extended to funding tuition fees, accommodation, food, transport and other needs for poor, academically deserving students. In line with the definition of a sustainable university, the initiative will ensure that campus life is sustainable.

For a successful sustainable university initiative, an integrated approach is essential. Three prominent and recommendable strategies for implementing a thriving, sustainable campus include integrated teaching, learning, research on sustainability, environmental management systems, and a climate change responsive to open innovation.

c) Organisational business model

The university will have to look at its organisational business model and adopt a sustained business model to establish an integrated environment to create a living lab to achieve a sustainable university. The process of adopting a sustainable university business model must work together with sound governance principles. In terms of the successful sustainable university strategy, Wits University needs to adopt the principles of good governance, which includes accountability and strong leadership that are currently lacking at Wit University. Wits University will address its organisational barriers to adopting green campus policy by following these practices.

d) Green campus policy

Green campus policies at Wits University will help re-align the departments, their functions and how each participant promotes green campus initiatives on campus for the common objective.

To overcome Wits University's organisational barriers, all stakeholders need to be part of the partnership and supported by the university. In addition, Wits University is struggling with collaboration, faced with challenges from the political bureaus, and various departments within the institution are working in silos. Collaboration is one of the conceptual frameworks of a green campus and a living lab for establishing an effective integrated sustainable environmental strategy. The participants agree that selecting an effective and successful method for Wits University will transform its stakeholders into multiple objectives from a narrow objective approach into a whole system approach. Therefore, the principles of good governance are very explicit in that collaboration and coordination play a crucial role in legitimising all key stakeholders' views in making decisions that represent their wishes. The study, therefore, recommends the concept of sustainable value, **Figure 20** below, to address the underlying issues of silos work, including the Lack of appropriate structures to aid sustainability between Wits University's management structures

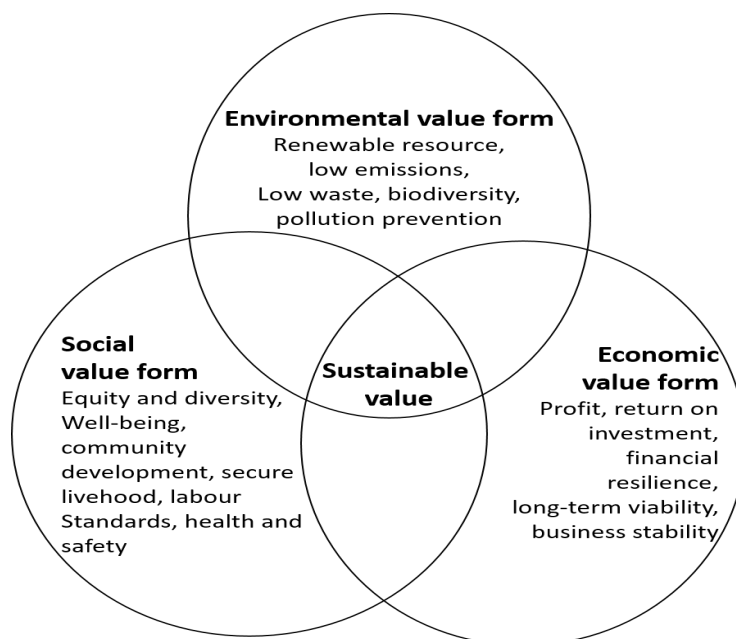


Figure 20: Sustainable Value (Lukman & Glavic, 2007).

Sustainable value provides a long-term sustainable business model that will address Wits University's organisational barriers, mainly lack of accountability and leadership. Sustainable value includes environmental, economic and social values. Wits University's opportunities face challenges to limitations. Therefore, by identifying all flows of values between stakeholders, including the natural environment and society, opening up to innovative opportunities for their business model.

To address the challenges of why Wits University does not have a sustainable development plan, aims and goals, the university must engage in sustainable university plan, provided in **Figure 21**.



Figure 21: Process and elements of a sustainable university (Lukman & Glavic, 2007).

Wits University has no integrated sustainable policy on the environment. Lack of appropriate structures to aid sustainability, lack of a long-term sustainable business model, and lack of environmental management systems underpins its disintegrated operational structure. Accordingly, the framework mentioned above of a sustainable university, **Figure 21**, will put Wits University on a path to address why a university does not have a long-term sustainable green campus policy and integrated policies. The process and elements of a sustainable university include policy, operations and

evaluation, and optimisation values currently lacking at Wits University in terms of adopting an integrated sustainable environmental policy.

Overall, Wits University should formally establish a process for the adoption of sustainable values. Following the adoption of sustainable values, it is necessary to create sustainable business models. The procedure referred to above (**Figure 21**) should be followed by adopting an integrated sustainable environmental policy framework. Following the adoption of the policy framework, the School of Architecture should set up a living laboratory on campus in partnership with all internal and external key stakeholders. Following the development of the living lab, specific milestones and delivery targets should be established for the identified areas and the respective university departments. Partnership policies and the appointment of a Chief Sustainability Officer should be established where necessary, including redesigning organisational structures. On-campus, a strategy must be devised for growing awareness of and support for green campus projects. All Wits university departments, including faculties and administrative and support departments, should be encouraged to follow practices related to the policy framework's goals, with due appreciation for exemplary practice implementation. This framework for sustainable values can be viewed as a first step towards extending the principle of sustainability to the university's core work.

Wits University should be aware that the sustainability evaluation institutions vary according to the organisation, including senior administration, non-academic departments like infrastructure and operations, and student government divisions.

Second, campus sustainability programs often refer to governance as "top-down" or "bottom-up," omitting the institutional "middle" – faculty and administrative staff – into the leadership role. Most importantly, the principle of good governance recommends that a *"sustainability council shall include staff members, students, administrators and local authorities, in order to strengthen its role within the community"*.

Number three, there needs to be another report specifically examining the mapping of all sustainability projects at Wits University. Mapping them properly, who are the people who lead them? Who are the people responsible for them? Where is all the

funding coming from? Consequently, once all of this is collected and consolidated into one descriptive facts and data report, this may be the beginning of the policy discussion. Followed by analysing the facts and identifying the key and relevant leaders of this transition process. What is missing is that the Wits University coordinates the process with all its efforts; it is primarily coordination that is lacking. Thus, in John Moffat Building, reports with green building recommendations are in place, and nothing is happening about these reports. Nothing is happening about them because, independently of the central vision of the university, they are not informed by any policy framework and may not necessarily be a priority for CPD or PIMD. Therefore, if we could only bring these people into one room or space of engagement, they could see each other. There could be trust-building, networking, sharing of goals and implementation of projects addressing sustainability.

e) Establishment of Campus Sustainability Lekgotla

The research identified working in silos as the primary challenge. One of the key ways to resolve this challenge, drawing from the literature, is Lekgotla's concept. In Africa, the notion of Lekgotla has been for centuries an effective and sustainable stakeholder engagements approach in addressing silos. Therefore, Campus Sustainability Lekgotla is indeed a unique way in which siloed can be resolved. To adopt several resolutions, Wits University needs to establish Sustainability Lekgotla at the University, which now brings together all stakeholders; internal and external stakeholders, including students, SRCs, administrators, faculties and support staff. This means that these people can communicate and hear each other and try to find each other. Collaboration or coordination is the centre of innovation and any successful business model of any institution. If there is not enough communication or trust, it will be difficult for the university to move forward with the sustainability transition process.

Higher Education Act regulates Wits University's governance policy (No. 101 of 1997). Two, they account to the DHET in terms of financial expenditure; number three, in terms of the DHET co-funding of the university's space development plan implementation programme, the regulation of the universities will be fair in terms of sustainability policy.

This can be accomplished by incorporating a green campus policy into environmental development plans and mandating that higher educational institutions green their campuses. It means that green campuses can be integrated into environmental development strategies by making university greening mandatory. This followed by encouraging Faculties and Administrators to adopt their sustainability framework policies. They are then encouraging schools and various university departments such as SoAP, Services, PIMD and CPD to developed departmental sustainability policies that they can put into practice among students, lectures, and support staff.

a) Collecting data

The study has established a need for collecting data for the university to be more sustainable. For example, there is hardly any sustainability improving technology data in the Old John Moffat Building. It is advised that monitoring devices, such as data collection on how many people enter and exit the facility be incorporated in the infrastructure modifications to support sustainability. So that if someone were working alone in an area, the lights in that area would be on, or when people leave the area, the lights can dim.

It is also recommended that the university conduct further research in the following areas:

Surveying existing infrastructure data in case of water, energy, waste and transport, and so forth. The purpose would be to establish firm, relevant, and reliable data to implement effective university environmental management systems. In addition, the data would be used to implement ecological practice and regulations systemically, help universities reduce the impact on the environment, and improve operational performance.

Studies of feasibility on how the university might save money through green campus initiatives spearheaded by the living lab. For example, “Wits consumes a large amount of electricity, costing in the tens of millions of Rands for the period 2008, 2009” (Abdullah *et al.*, 2020:1). The feasibility study highlights the financial benefits of a sustainable university. Hence, there is also a needs to bring on board more realistic studies which will study the financial aspects of sustainable university.

5.4 The University of the future

Through this research, it has been firmly established that the ability of the university to collect relevant data using the Environmental and Social Responsibility Index monitoring and the ranking tool is imperative. Wits University currently has no means to determine the consumption of electricity in each building. Wits University also does not have an effective water metering system. In other words, Wits University does not have an effective environmental management system in place. These challenges limited the study.

As a contributing factor, the study discovered a dearth of research on the role of students in promoting sustainable transition on college campuses.

Second, there has not been research done about leadership and sustainability at the university again regarding sustainable transition.

Thirdly, the study shows that there has not been researching done in terms of the role of the university sustainability community, including the School of Architecture, African Energy Leadership Centre from Wits Business School, Wits Global Change Institute, Ground and Waste from Wits Services Department, CPD and many others.

Observations from the study recommend that extensive research take place. This approach will facilitate a pathway that will enable the university to function as a complex system. As with human beings, universities are perhaps the most complex ecosystems. An ecosystem is a structure composed of various parts that work collaboratively to accomplish a common goal. The same can be said about the human organ system. The literature review outlines that the university is not long supposed to be a just living lab, but the institution itself is a living organ. How the energies are flowing, and operations are moving makes the university a complex emergent structure. Because of this complexity, the study recommends that the university should consider developing complex management integrated systems. Complexity needs to be in every part of the organisation's operations. This approach will optimise the intelligence of the university. Make it not only a living lab but a complex living organ that is resilient to change and adaptation. The current siloed scenario is not an intelligent smart system. 4IR is a complex system. As such, universities need to forgo their conventional heritage of teaching, learning and research and adopt new future

university system thinking that is more resilient and adaptable. If universities fail in transforming their institution sustainably, how then can we expect our cities to change? Effectively the university will have to adopt the whole-of-university approach to sustainability.

5.5 Opportunities of the University of the future

Through the lenses of the 17 United Nations Development Goals, **Figure 22**, Sustainability of Higher Education Talloires Declaration action plan, **Table 21**, and the Declaration and action plan of the African Higher Education Summit, **Table 22**. This section presents the opportunities by adopting the concept of living to impact the transition and remain a successful sustainable university of the future.



Figure 22: 17 United Nations Sustainable Development Goals (Corporate Citizenship, <https://corporate-citizenship.com>).

Table 21: Elements and themes of the Talloires Declarations - as highlighted from the work of Calder and Clugston (2003) and Wright (2004) (Lozano et al., 2011).

- Focus on environmental degradation, threats to society, and unsustainable consumption;
- Ethical or moral obligation of university leaders and faculties to work towards sustainable societies, including the inter-generational perspective;
- Inclusion of SD throughout the curricula in all disciplines;
- Encouragement of SD research;
- Move towards more sustainability orientated university operations;
- Collaboration⁴ with other universities;
- Stakeholder, e.g. public, governments, non-governmental organisations (NGOs) and businesses, collaboration, engagement and outreach; and
- Transdisciplinarity⁵ across the previous points.

Table 22: The Principles of the Declaration and Action plan of the 1st African Higher Education summit, on Revitalizing Higher Education for Africa's future (African Higher Education Summit, 2015).

1. Provision of high quality, pan-African and globally competitive education
2. Promotion of world class culture of research and innovation
3. Provision of adequate resources
4. Promotion of access, equity, and accountability
5. Promotion of institutional autonomy and academic freedom
6. Pursuit of operational excellence in institutional management
7. Pursuit of the engagement of African academic communities in higher education policymaking
8. Strengthening linkages to society, economy, and employers
9. Building inter-institutional collaborations
10. Pursuing mutually-beneficial internationalization initiatives

The study has identified the following opportunities:

The opportunity of the impact of green campus initiatives, aligned to SDGs 3 of good health and well-being, presents an opportunity in addressing the effects of climate change on food security issues and the use of land wisely. Linked with the living lab concept, this offers business opportunities of collaboration with students,

academic and operational staff to merge innovative technologies and skills in developing prevention and resilience measures and other things that affect food security and land use, which threatens sustainability. Global warming is an issue that requires immediate action on the part of humankind, and policies aligned with SDG 7 will identify opportunities for the university to transition to cleaner energy technologies, which will align with SDGs 7 and 13 on sustainable energy and climate change, respectively.

The opportunity of Architect-led green campus initiative living lab, aligned with the SHE declaration action plan of “Green Metrix” or Green Building principles, enable the Living Lab to demonstrate novel approaches to managing innovation processes. A Living Lab comprises critical structures that contribute to its operation and, hence, good governance principles. The Greats benefits of an Architect-led green campus is the notion of passive design. According to SDG 9 – “Build resilient infrastructure, promote inclusive and sustainable industrialization, and foster innovation”. And SDG 11 – “make cities and human settlements inclusive, safe, resilient, and sustainable” (United Nations). Architecture is an ideal primary health care tool for facilitating healthy, secure, and sustainable products and services.

The opportunity to transform toward an entrepreneurial university, aligned to SDG 12, is about mitigating the challenges of inequality and poverty. Future university presents the chance of university developed into a new campus that will disrupt cities eco-system. Development of student life, student housing, economic research hubs infrastructure is central to reimagining the architect landscape of our future sustainable cities. This innovation simultaneously addresses SDG 11 ‘sustainable cities and communities and transforming the future of African Higher Education. The initiative encourages cities' businesses to develop targeted social assistance programmes, thereby investing in the well-being of their local communities. The process supports Higher Education Africa’s future revitalization action plan.

With the opportunity to adopt a holistic approach to sustainability connected with the SHE declaration action plan, institutions should recognise the critical need to advance environmental education as a whole. Aligned to the United Nations Development Goals, this approach put future universities at the centre of driving innovative mitigations and technology to address climate change.

Aligned with SDG 7, cleaner energy technologies, and sustainable energy, this effort enables universities to build economic models that directly benefit social assistance programmes, thereby investing in the well-being of their students' education funding. This initiative is aligned to SDG 4, supporting quality education – “Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all” (United Nations).

In support of the objectives of the desired future university, all of the abovementioned opportunities will enhance the university's intelligence. Make it more than a living laboratory; make it a complex living organ that is adaptable and robust to change—making it an innovative University City precinct. Aligned with the declaration plan and SDGs, these opportunities address universities falling behind in their efforts to help societies become ecological and intelligent cities. Effectively these opportunities respond to the problem statement as outlined in **Chapter 1**, point 1.5. Like every other area of our life, universities are being called to connect to the more extraordinary intellect of our living systems and become a part of the earth's total organism.

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Appendix A: Research questions

1. Typical questions section A: Organisational structure

A1. Questions to the School of Architecture and Planning

- Tell me about yourself. Your department, from when you joined with school of architecture until to date. What has been your experience thus far? What are the obligations of the department in general? Do you think the department is achieving its commitments, is the department on a correct path?
- Briefly, explain your programme?
- In terms of students with interest in sustainable environmental studies?
- In terms of campus architecture?
- In terms of eco-campus initiatives?
- In terms of collaboration methods in projects?
- Could you give a brief history of your department from the beginning to date?
- What is the vision of your department in terms of achieving sustainability goals? How is your departmental vision aligned with the overall Wits vision?
- Does the department have a sustainability plan? If so, is it being implemented? How far is the implementation? Who are the key implementing agents of this plan? Why was it drafted? What was the incentive? If not, why not.

2. Typical question section B: Wits University campus spatial planning development and current building stock

B1. Questions to PIMD, CPD, GCI and School of Architecture and planning

- What is the department's involvement with the University in terms of campus infrastructure planning and development? Moreover, what input do you contribute?
- Is the School of Architecture and Planning represented at the strategic campus planning level of the University, and how do you participate in the campus planning decision of the University? Yes/No answer

- For promoting green campus initiative, what role can student with interest in environmental sustainability studies play in the planning and development of campus?
- What and how many building efficiencies and sustainable resources management experts do you have in your University property planning and development portfolio? If not, why not?
- Does your campus planning and development plan is aligned with the principles of sustainability goal? How is it aligned? If not, why not?
- Briefly explain the university spatial development framework (Macro)
- What is the role of the School of Architecture in terms of developing the university spatial development frameworks? If not, why not?
- How does your university spatial development framework package and implement real projects that are robust enough as interventions to address the issues and challenges of environmental impact on campuses and improve energy efficiency?
- To achieve the sustainability goals, what methods does your framework employ?
- Does your spatial development framework take into account the Sustainability of Higher Education declaration?
- What is your plan to meet net-zero greenhouse emission on campus?
- What is your plan about the challenges of cars on campus?
- In terms of your organisational structure, how do you relate to PIMD
- Your procurement strategy employs the concept of contract framework, and contract framework promotes collaborations, which seeks to promote cost-effective building construction ways.
- Who are the typical critical stakeholders in any of your contract framework project?
- Between design by client and design by supplier, which of the two is your most preferred method
- What is the role of the user-end in your projects?
- Arguably, within the context of envisioning a sustainable future, schools of architecture global have adapted their thinking in line with sustainable development goals to keep global temperature below 2°C.

- In any of your projects, do you make use of expertise from the School of Architecture and Planning?
- What does your policy say about involving students (as end-users) in participating in campus planning and development activities?

3. Typical questions section C: The concept of sustainable universities

C1. Questions to CPD, GCI, PIMD, School of Architecture and Planning

- How do you interpret or understand the concept of sustainable university?
- Are you aware of the Sustainability of Higher Education declaration, and how has it influence the universities?
- How does the University of the Witwatersrand effectively monitor environmental impact by campuses operations?
- Could you describe the University of the Witwatersrand policy on sustainability concerning your department's obligations?
- Must the economic downturn and fee fall (free education) affect university campus physical planning and development of its footprint regarding water and energy usage? If so, how?
- Does the University of Witwatersrand have a department with a focus on green university initiatives? When was its established? Why was established? Who are the key stakeholders? Outline its achievements?
- If not, why not?
- On average, how much is the University of the Witwatersrand spend on energy, water and waste per month?

4. Typical question section D: Available data (student research-driven intervention) about John Moffat building performance

D1. Question to the School of Architecture and planning, CPD, PMID, Lectures and HODs

- How would you assess your environmental/ sustainability studies in terms of the following items:
- Green campus programmes?

- Are you achieving net-zero greenhouse gas emission on campus?
- Are you maximising energy efficiency on campus?
- Waste management programme on campus
- Alternative water usage methods on campus?
- Alternative transport system on campus?
- What opportunities are there in Wits for students to study campus architecture and its local environmental problem?
- How do you offer students opportunities to conduct environmental audits of its (the institution's) practices?
- What is the involvement of your architectural student in the establishment and participating in campus water usage, energy efficiency, waste management programmes and other green campus programmes?
- Do you have a student environmental centre that supports students who seek environmentally responsible careers?
- How do you ensure that environmental sustainability studies remain a top priority in land use, transportation, and building planning?
- Many research reports have been conducted on John Moffat building performance in terms of water usage, energy, and waste. Moreover, how many of those reports have the department considered?
- What happened to the "green university" initiative projects done by students? Moreover, do you experience any type of barriers to implementing this project – explain them? Good

5. Typical Question E: John Moffat building performance (in terms of energy usage, water usage, waste generated and other green building performance indicators

E1. Questions to the School of Architecture and Planning, PIMD, CPD, Lectures and HODs

- Could you describe initiatives taken by your department in addressing the challenges of greenhouse gas emissions within the school and John Moffat building?
- How many students and staff does John Moffat building house?

- What is the peak time of the day (most used period) in this building?
- What activities do take place on a typical day?
- What are the challenges of using John Moffat's facilities?
- What role do you play, and how are maintenance or refurbishments carried out in the building?
- What are some of the problems being experienced with your facility management department (PIMD)?

E2. How would you assess the performance of John Moffat building on the following items?

- The performance led design principles?
- Performance blind design approach?
- What are the key performance indicators used to monitor the performance of this building in terms of water, energy and waste?
- What are the performance levels of the facilities in the offices/ lecture venues or studios?

E3. What are your plans to improve the performance levels of these facilities (OJMB)?

- Could you give a brief history of the John Moffat building?
- How would you describe the John Moffat building's architectural style?
- In terms of architectural passive design principles, how would you rate and describe the John Moffat building?
- Do you think the Architects responsible for designing John Moffat building, at the time (50s and 60s), planned and design this building with sustainability thinking in mind? If yes/no, why?
- Describe what can be defined as both poor and positive about John Moffat building in terms of environmentally sustainable principles?

E4. How would you assess your office space in terms of the following items?

- Your production/ output vs performance of your office space in terms of comfort (lighting quality, cooling and heating and any other factor that needs to be considered for relatively good comfortable production space)?
- Office performance relatively high hot temperature?
- Office performance relatively high cold temperature?
- What changes would you recommend to the school to improve the conditions of their facilities comfort levels?

- What bearers do you see preventing the school from improving the comfort performance levels of the building?

- How would you assess lecture rooms/ studios in terms of the following items?
 - Students' behaviour during the teaching and learning period (both in hot and extremely cold conditions)?

- The foyer is going through renovations; please elaborate on the purpose (why)?
 - What is the sustainable approach employed for this project
 - Where did they source the material? Did you consider alternative sustainable materials produce in a sustainable way? If not, why not?

6. Typical questions section F: Heritage building preservation vs sustainability:

F1. Questions to GCI, Lectures, Services, PIMD and CPD

- Briefly, describe what heritage building is? Your understating?

- Since its inception, has the Old John Moffat building been subjected to renovation? If yes, what was the purpose of renovating? What were the

outcomes? What elements or features of the building were renovated? What sustainability procurement strategy did the School consider during the process of renovations? What materials or features of the building were persevered or replaced? Did the renovation project consider using sustainable products or components, or features? If not, why not?

- How does the School preserve the architectural heritage of the building? Why is the heritage of the John Moffat building so important? What tools does the school have in place to protect the heritage of the building?
- What are the benefits of retaining an old building against the challenges of high greenhouse gas emissions?
- How is your department planning to deal with heritage elements against the needs to improve John Moffat building performance in terms of efficiency and sustainability?
- What kind of opportunities does Old John Moffat as a heritage building have to optimise water and energy use? If not why not?
- Within the concept of “heritage building sustainability”, how would you assess John Moffat building in terms of the following items?
 - Adaptive re-use concepts
 - Renovations for less energy use
 - Maintenance
 - The usage of the facilities (lecture rooms, offices, studios etc.)
- How would you assess John Moffat building materials in terms of the following issues? Give examples?
 - Low-energy performance?

- Amount of chemical contained in the material used to construct the building?
 - Amount of natural material used to construct the building?
 - How does the School plan to identify, assess, and manage the conflicts between heritage and sustainability? If not, why not?
7. Typical questions section G: Questions to PIMD and Service – operations and maintenance
- Does and how is your maintenance plan aligning with the principles of sustainability goals?
 - How much building stock do you manage?
 - What tool are you using to monitor and manage campus building stock performance indicators in terms of water, energy and waste?
 - How much energy and water do you use for the campus operations?
 - How many cars visit the university per day?
 - How much waste do you generate per day?
 - What plans have you put in place to attain net-zero greenhouse gas emission on campus?
 - What is the barrier that prevents you from achieving net-zero greenhouse gas emission on campus?

8. Typical questions section H

H1. PIMD – Old John Moffat building data (Qualitative) (Energy Manager and Waste Manager)

- How much energy used by John Moffat building is clean energy vs greenhouse gas emission energy?
- How would you assess John Moffat building in terms of the following items?
 - Energy and water efficiency measures,
 - Reduction of waste,
 - Renewable energy systems,

- Indoor experience for students, staff and visitors and utilisation of land to maximum efficiency
- How and what technology do you make use of to monitor the performance of the John Moffat building in terms of water usage, energy usage and waste?
- What barriers are you experiencing that limit you to improve existing building stock performance, such as the John Moffat building?

H2. Energy and water usage monitoring (Energy Manager)

- How do you use BMS to monitor energy and water usage?
- Are all building stocks connected to the system, and how many are they?
- What is benefiting of having and using BMS as a monitoring tool?
- Any plans to attain clean energy and alternative source of water?

H3. Waste management (Waste Manager)

- How do you manage waste on campus?
- What do you do with the waste collected?
- What types of waste do you collect?
- Any plans to reduce waste generated on campus?
-

9. Typical question section B: Wits organisational structure and sustainable business model

I1. Questions to African Energy Leadership Centre

- Tell me about your energy centre, its functions, aim and goals. What role does it play at Wits to foster green campus initiatives?
- How would you assess governance structures responsible for assessing and managing issues affecting Wits University's administration and operation functions?
- Currently, Wits University has not established a central sustainability office or sustainability policy. What do you think could be why Wits lacks such function – because almost in every faculty member there is a programme about sustainable environmental issues?

- Are you aware of any pathway to foster an integrated environmental sustainability strategy or policy? If not, why?
- Do you believe Wits organisational structures operate in a silo, and how would you assess their in-relations?
- What is your perception about the concept of the living lab and its approach?
- If the School of Architecture were to establish a living lab to lead it, what role can your centre and business school play to ensure an efficient and effective green campus program at Wits? And what type of business model would you recommend that will provide an efficient and effective integrated environmental sustainability strategy or policy?
- In terms of energy usage, Joburg Municipality sources its electricity from Eskom. The majority of it is from coal and not environmentally friendly. Wits source its energy on campus diesel generator plants, and diesel from Crude oil a negative impact on the environment. Developments in the use of renewable energy are modest, and trends in carbon dioxide (CO₂) emissions are still very high at Wits University. What do you think could be the challenges – of all this? And what kind of positive disruptive majors can be done at Wits to improve the trajectory from its status?