# Campus as a Living Lab for Sustainability

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#### Sustainable Campus in the South African context

- As African universities, we operate locally but live in a globally connected world, competing globally
- We have a very different background and context that we operate in compared to most of our global competitors
- In this context, how do we can we make our campus a living lab for sustainably?





#### Contents

- What is a Campus as a Living Lab for Sustainability
- Examples
- Green Buildings are critical
- Engagement
- Leadership



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#### UCT's Environmental Sustainability Strategy

Revision 0 of the strategy was approved by the UCT Executive in 2020 and published on UCT's website.





#### The Strategy has Shades of Green & Long Term Goals



Underpinned by decisions based on good social return & good financial return for UCT.

The strategy allows for shades of green and has long term goals.

# How is UCT doing in terms of its Net Zero Carbon by 2050 Target?

If you don't measure it, you can't manage it. Start by measuring your carbon footprint as an institution.



#### What is a Campus as a Living Lab for Sustainability?



Download the ISCN's guide to Living Labs <u>here</u>

- Living Labs are user-centred and open innovation eco-systems
- Living Labs are effective in solving complex problems in a multi-stakeholder context
- Especially societal/sustainability problems benefit from involving all stakeholders for cocreation and co-production
- A real life setting is beneficial to simultaneously encounter all relevant foreseen and unforeseen circumstances
- A real life setting improves the impact for replication and upscaling



Contents

What is a Campus as a Living Lab for Sustainability



- Green Buildings are critical
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#### Green Buildings – as Living Labs

- All new buildings must be minimum 4 Star Green Star certified (UCT policy)
- All data from green buildings is made available to students to study and analyse for research purposes
- In some cases, mostly postgrad, can install additional devices for further research



UCT's recently completed HPI d-school building targeting 6 Star Green Star (LEED Platinum equivalent)



#### Campus as a Living Lab – Research Papers Produced

Research Paper published on UCT's solar PV system performance prepared by masters student:

Unlocking Sustainability Potential: UCT's Solar PV Systems as a Living Lab Model Katleho Thabiso Malatse Department of Electrical Engineer University of Cape Town Cape Town, South Africa MLTKAT018@myuct.ac.za Manfred Brame Office of the Vice Chancello ment of Electrical Eng University of Cape Town Cape Town, South Africa University of Cape Town Cape Town, South Africa davorredokum Gineee ora chronom – The paper highlight de vorreg horrow dhe king Lab approximation for CTA the HP vortune, dimensing a practical model for manipulative PV vortune, dimension a real-worth application of the Living Lab framework, discretizing the university's remaining to safe FV vytems and inglifician production. The framework via the vytemes that systems. UCT's current FV informations that and vytems. UCT's current FV informations recording just 24 works of material systems. UCT was an end and the the system of material systems. UCT was an end as the that 24 84% of the available generative. The results have that 24 84% of the available generative for some for universities e. 266 Therefore, the paper focuses on the synergy between the Living Lab approach and UCT's solar PV systems, demonstrating a practical Living Lab model. II. KHUSELA IKAMVA PROJECT In 2020, UCT launched the Khusela Ikamva (secure the future) sustainable campus project as a crucial component of its Vision 2030 Agenda, where sustainability is central. This project's objective is to transform UCT into a sustainable campus by establishing a community of practice. This community is informed by leading research involving all UCT stakeholders, including students, faculty members and erry and reduce 5.05 kilotons of carbon emissions The value of the existing system lies not only in energy generation but also in the data-driven approach, which informs adjustments and further expansion. This symbolic relationship between framework and implementation is a paradigm for institutions sceling holitic mutainability in a read-world administrative staff, emphasizing extensive and inclusive engagement within the university community. It also incorporates exemplary Living Lab interventions on campus, serving as proof-of-concept initiatives. The project focuses on five core themes specific to the UCT campus: energy and carbon management, water usage, waste management, wildlife conservation, and social Keywords-Sasteinebility, Living Lab, Solar PV Systems, Campus Transformation, Green Campu responsiveness. It aims to assess and address the environmental, financial, and social impacts associated with I. INTRODUCTION these themes. Furthermore, it intends to bolster and expand UCT's environmental sustainability strategy by conducting feasibility research on various elements. Certain solutions The University of Cape Town (UCT) has been involved in the University of Cape Form (OCT) are open involved in sostainability efforts for over three decades, establishing itself as an institution committed to sustainable practices. This dedication was initiated over 30 years ago when UCT became a signatory to the Talloires Declaration in France. reasonity research on various elements. Certain solutions such as solar VV installations will be developed into proof-of-concept models and tested in targeted areas on campus through a Living Lab approach. This project is envisioned to play a pivotal role in transforming not only the physical infrastructure of UCT but also the social fabric of the campus emphasizing its commitment to sustainability [1]. By July 2023, this declaration had 526 signatories, indicating the increasing global emphasis on sustainability in higher community, ultimately making UCT a more sustainable education [2] In 2008, UCT adopted the Green Campus Policy Framework, paving the way for the Green Campus Action Plan [3] [4]. This comprehensive strategy emphasared energy conservation, carbon emission reductions, recycling, and III. SUSTAINABLE CAMPUS LIVING LAB FRAMEWORK Considering UCT's sustainability initiatives, this framework for a Living Lab approach is paided by findings from a study that explored the central aspects of Living Labs [9]. The Living Lab approach at UCT is designed to tackle water conservation, reinforcing UCT's holistic sustainable ethos [5] [9] The LYUNG LD approxim at OCT is designed to incide summinibility issues, such as cardon footpaint reduction, particularly in the context of the Khusela Barma project. It builds upon UCT's memberships in sustainability networks and its commitment to a greener campus. According to the hiterature [9], this approach encompasses three key theoretical In 2012, UCT became a member of the International Sustainable Campus Network (ISCN) [6], which collaborates with the Global University Leaders Forum (GULF) to create with the Gobal University Leaders Forum (GULF) to create the Sustainable Campus Charter. This charter, updated in 2018, aligns with significant milestones like the Paris Agreement and the UN Sustainable Development Goals (SDGs), emphasizing the importance of addressing global implication

Firstly, it draws from open and user innoval challenges like environmental degradation [7]. As of 2023, UCT's targets include achieving Net Zero emissions (Scope 1 and 2) by 2050 and reducing emissions by 2-5% annually since 2020. Comparing results from 2012 to 2021, UCT has already achieved a 9% reduction in Scope 1 and 2 emissions, demonstrating its commitment to

This Research is Funded by the Khusela Ikamya Initiativ-

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sustainability [8]

Clater: Maate, Kateto Thateo, David Oyectikur, and Marthel Brazer. "University Subanatility Potential UCT's Sour PV Systems as a Living Lab Week. In 2006 20rd Southern Atrican Universities Power Engineering Contenence (SAUPEC) pp. 14. IEEE, 2028.

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acknowledging their relevance to Living Labs. It also highlights that Living Labs transcend conventional open innovation structures by involving diverse stakeholders and emphasizing real-life environments [10]. Secondly, it considers the multifaceted characteristics of Living Labs, ecognizing that each may have unique objectives, operations and actors [11] This diversity of characteristics is narticular? relevant to a learning institution like UCT, as it allows for alioning Living Lab initiatives to the specific needs of an academic community. Among the eight common key

Katleho Malatse



Fig. 4. UCT's Carport Solar PV System

can result in losses of up to 62.8% [16 Bitatesi Chentry



Fig. 5. Carport Solar PV system Generation - 30 October 2023

1) UCT's Solar PV Efficiency Solar PV system efficiency is a measure of how effectively the solar PV system converts unlight into usable electricity. It considers the efficiency of solar panels, inverters, and other components, as well as contextual factors such as shading and environmental conditions that can influence overall electricity production

(1) For this section, only the d-school and the ChemEng systems will be considered as these systems are equipped Where Eams is the annual energy yield of the solar PV solar irradiance sensors. ver of the Solar PV panel

The d-school solar PV system consists of two investers

solar inverter 1 (INV\_1) hosting 50 north-east 40° facing solar PV panels and solar inverter 2 (INV\_2) hosting 60 north-west 5° facing solar PV panels with respect to true north.

verter 2 installation looks like the one in Fig. 6.



From the results seen in Fig. 3, the Carport system is the least performing of the three because of shading of the sun

Fig. 6 provides the d-school solar inverter 1 installatio



#### Full paper available here



given in Fig. 2.

all three systems.

Fig. 2. UCT's One-Year Solar PV Yield

nternal consumption, and wheeling [15].

carbon emissions for the period.

 $E_{wp} = \frac{E_{annum}}{P_{max}}$ 

stem and P .... is the

transmission and distribution losses, theft-related losses,

Therefore, the solar PV installation averted 99.55 tons of

Fig. 3 provides the specific annual energy yield (Eup) for

(kWh/kWp)

ons which can be obtained via (1

Fig. 6. d-school Solar Inverter 1 Installation Fig. 7 provides the ChemEng solar PV installation.

## Focus: Energy/Carbon Emissions, Water, Waste, Human Health

- In terms of green campus, we need to focus on key items where we can have the biggest impact
- Energy/carbon emissions, water, waste and human health are the key focus areas in UCT's sustainability strategy
- Project example on the right plan to recycling sewage water in a facility next to Kopano – will be used for flushing toilers and irrigation. Living lab research opportunities:
  - Off-take points for further alternative filtration
  - Off-take points for water quality sampling
  - Access to ongoing data readings and measurement
  - Alternative pond plant selection and research
  - Learning centre



## Campus as a Living Lab – Reviewed all cleaning products used at UCT

- UCT did a full review of all its cleaning products using a masters student in the faculty of health sciences
- We did not just take it at face value requested chemical ingredients of every product
- Ultimately had to lean on trustworthy eco labels due to limited info sharing from suppliers on chemicals used





Full Eco-choice standard available here



#### Khusela Ikamva meaning "secure the future"



A 5-year research project to further catalyse the transformation of UCT into a sustainable campus by establishing a community of practice informed by:

- leading research focused on energy, water, waste, wildlife, community of practice on campus
- > extensive, inclusive engagement
- exemplar Living Lab interventions on campus



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#### Campus as a Living Lab map:

- Includes links to  $\geq$ research papers and research institutes
- QR codes proposed  $\succ$ per initiative – can be used for future signage

https://uctsustainablecampus.net

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# **UCT Urban Heat Island Project**



#### Description

UCT is investigating the urban heat island effect on campus, camparing various green and built up spaces to measure the different air temperatures that are experienced in these outdoor spaces. UCT has many green spaces with trees and low vegetation reducing the average surface temperature but also has many hard surfaces that absorb more heat than vegetated surfaces. The Future Water Institute is leading this work.

3 GOUD HEALTH AND WELL-BEING	11 SUS AND	COMMUNITIES	13 CLIMATE		
<u>https://futurev</u>	vater.u	<u>ict.ac.za/</u>			
ICT Dept/Research roup:		Future	Future Water		
ustainability ategory:		• Greer • Wate	<ul><li>Green Buildings</li><li>Water</li></ul>		
'ype:		Multi i	Multi interventior		
ite location:		Upper	Upper campus		





## Electric Bus Feasibility Study

- VC's Strategic Fund allocated budget for a detailed feasibility study
- Purpose of the study was to look at three key elements of feasibility for the UCT Shuttle service on a like for like service:
  - > Is it technically and practically feasible?
  - ➢ Is it financially feasible?
  - ➢ Is it environmentally feasible?
- It was found not to be feasible for any of these aspects (technical, financial and environmental)
- UCT plans to experiment with EV buses in the meantime with 1-2 EV buses proposed to be put in operation (currently no funding for this)



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# Buildings are incredibly resource hungry & have many environmental impacts



#### **Extraction & Manufacture**

- Land, biodiversity
- Raw Materials
- > Water
- Energy / emissions



#### Construction

- Land, biodiversity (site)
- > Water
- Energy / emissions

 $\geq$ Air

# + End of Life

#### In Use

- Water
- Energy / emissions
- > Air

 $\geq$ 

Materials used by building occupants

> Air

#### **Raw Materials Extraction**

Resource depletion



#### Lithium Extraction





# Buildings are the greatest polluters (energy use – embodied & operational)





#### globally generate 1 in 3 tons of CO<sub>2</sub>

Graphic compliments of Green Building Council South Africa & photo credit to www.thisis.capetown



#### What is a green building / green infrastructure?



# How do you define green buildings/green infrastructure? How do you compare one project to another? Who says it's green?

Image compliments of Green Building Council South Africa



#### Standards for green buildings and green infrastructure

#### **Government Regulations / Standards:**

Minimum standard for energy efficiency in buildings only in place by 2011, updated in 2022



#### **Voluntary Standards:**

Green standards for buildings launched in 2008 by
GBCSA all the way to Net Zero Carbon in 2018



Image credit: www.writingcooperative.com and www.legaro.co.za .



# Is there an additional cost to go green? Green Premium.



www.gbcsa.org.za/wp-content/uploads/2023/06/Cost-of-Green-2021\_Digital.pdf For

#### Green Premium definition: (according to the GBCSA):

"The green cost premium is defined as the additional cost of green building over and above the cost of conventional construction, expressed as a % of the total cost of the project.

#### For example:

- Green building project costs R100 million in total
- Includes green building costs of R3 million over and above the cost of conventional construction,
- It is considered to have a green cost premium of R3m/R100m expressed as % i.e. 3 %"



# Is there an additional cost to go green? Green Premium.



www.gbcsa.org.za/wp-content/uploads/2023/06/Cost-of-Green-2021\_Digital.pdf

Rating achieved- Green cost premium (%)	MIN	AVERAGE	МАХ
TOTAL	0,47%	3,63%	14,24%
4 Star	0,47%	3,55%	14,24%
5 Star	1,33%	3,49%	11,73%
6 Star	8,60%	10,50%	11,70%

#### Green Premium on UCT projects where measured:

Avenue Res (4 Star):	1,25%
School of Education (4 Star):	1,41%
d-school (6 Star):	2.25%
(South African average	3,63%



# Major benefits in obtaining independent review of green credentials

- Getting your building Green Star certified requires your project documentation to be independently reviewed by the GBCSA's auditors
- It's like getting your financials independently audited
- Because of this, the documentation of the projects is of a very high quality
- The green credentials are verified
- > No green washing
- > The cost savings are verifiable



# Green Buildings and Green Building Policy

- d-school 6 Star Green Star certified (UCT's greenest building), plus 4 x 4 Star buildings (New Lecture Theatre, School of Education, Avenue Res, GSB conference centre)
- > A few other new buildings on the horizon:
  - Arise Building (Faculty of Health Sciences)
  - Nelson Mandela School of Public Governance (site is on P18 at the top of Upper Campus)
  - > Jagger Library
  - Digital & Polar Lab (Next to NEB)
  - HW Pearson 5<sup>th</sup> floor rebuild (Green Star Interiors) – on hold
- In 2023 Council approved UCT's more detailed green building policy





#### Stellenbosch University: Got 18 of their existing buildings Green Star certified



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#### Stellenbosch University: Biomedical Research Centre 4 Star Green Star certified





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#### Nelson Mandela University: Business School - 4 Star Green Star certified



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# Using multiple ways of creating awareness of sustainability initiatives

#### d-school example:

- Signage with various green building features + QR code with more info on this feature online for self guided tours (also do guided tours)
- Cross section with green building features illustrated
- Model built of building to gain perspective
- Screen with solar PV, water, energy and fresh air data for the building
- All data available for students to access and undertake research on



UCT's recently completed HPI d-school building achieved 6 Star Green Star (LEED Platinum equivalent)



#### Using art on campus as a powerful form of communication on sustainability

- Art students are invited to do art projects focused on sustainable campus themes that are then displayed on campus
- In one example, art students analysed waste generated on campus
- Then they made an intenstine filled with all the recyclable waste that does not end up in the recycling bin



<u>https://www.news.uct.ac.za/article/-2022-05-13-giant-fabric-intestine-promotes-culture-of-recycling-on-campus</u>



### Greenovate & Falling Walls comps – UCT Students from EBE are regular winners:



# Examples of other projects / initiatives:

#### **GSB Sustainable Campus Plan:**

Working with GSB to develop their own specific environmental sustainability plan, including green key certification for the hotel on campus.

#### Faculty of Health Sciences:

Working with FHS to develop their own specific environmental sustainability plan, including green lab certification for the IDM Institute (including 56 labs), its carbon footprint and a solar PV installation.

#### Active support of GCI:

Student Green Campus Initiative is a wonderful way for students to help create environmental awareness on campus.





#### Campus as a Living Lab map:

- Includes links to research papers and research institutes
- QR codes proposed per initiative – can be used for future signage

https://uctsustainablecampus.net



#### **UCT Sustainability Map**



Map About



Contents

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Image credit to Rigsby Search Group



## Some questions to ask of your institution

- Who is responsible for setting the policy and tracking campus environmental sustainability?
- Where and what is the environmental sustainability strategy or policy publicly shared?
- Are you measuring and publicly reporting on your carbon footprint?
- How are you verifying your green building credentials?
- How are you using your campus as a Living Lab for sustainability?



#### South Africa's context: Doing much more...with much less



Image Credit: https://www.inc.com/



# In summary – how will UCT grow its impact towards achieving the SDGs?

- Understand & appreciate your context
- Be strategic and do much more with much less
- Find champions and find ways to support them – their good work will be infectious
- Create awareness creatively and immersively
- Continue with this patiently and persistently





"It is in your hands to create a better world for all who live in it."

- Nelson Mandela

Let's do this – it's in our hands.







