

The background is a vibrant, isometric aerial view of a city constructed from various colored blocks and structures. The city features a mix of green spaces, blue water bodies, and colorful buildings. A large, semi-transparent dark rectangle is centered over the image, containing the main title in white text.

Circular + Regenerative Built Environment

Embracing regenerative practice at the University of Pretoria



welcome!

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Topics

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Graduate Built Environment

Graduate Design & Urban Strategy

Urban Strategy & Built Environment Innovation
Built Environment Professional Practice

Fields

Urban Strategy & Environmental Design | Strategic Planning
Lean Design & Construction | Lean Organizational Management



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100 Billion Buildings in the World

of all types and sizes in the world.

This number includes **everything** —
from **huts to high-rises**.

The vast majority of buildings are located in Asia and

Africa

An aerial, wide-angle photograph of a city, likely New York City, showing a dense urban landscape with numerous skyscrapers and buildings. The city is surrounded by water, and the sky is blue with scattered white clouds. A dark, semi-transparent rectangular overlay covers the left side of the image, containing white text.

The global building stock will exceed

183 Billion
Square Meters in 2026

Navigant Research (26 April, 2018)

Let's play a Freakonomics Game

The global number of cars is approximately 1.475 billion (2024).

The global number of people is approximately 8.2 billion (2024).

22.9 billion cars + 8.5 Billion People

Enough to park every car on Earth 15 times over!

Almost 12 buildings per person!



3%

of earth surface

creating buildings +
(mis)management

75%+

of climate and planetary resource problems

2050

70%

of the world population will live
in urban settlements.

UN Convention to Combat Desertification
(27 October, 2020)

Image Credit: Statista (2023)



2050

Yes, new buildings are more energy efficient, sure...but

80%

of buildings that will be standing in 2050 globally

have already been built.



“We must prioritise upgrading the buildings we already have in order to avoid high embodied carbon emissions for decades to come.”

— Emily Parish, The Climate Group (12 August 2022)

70%

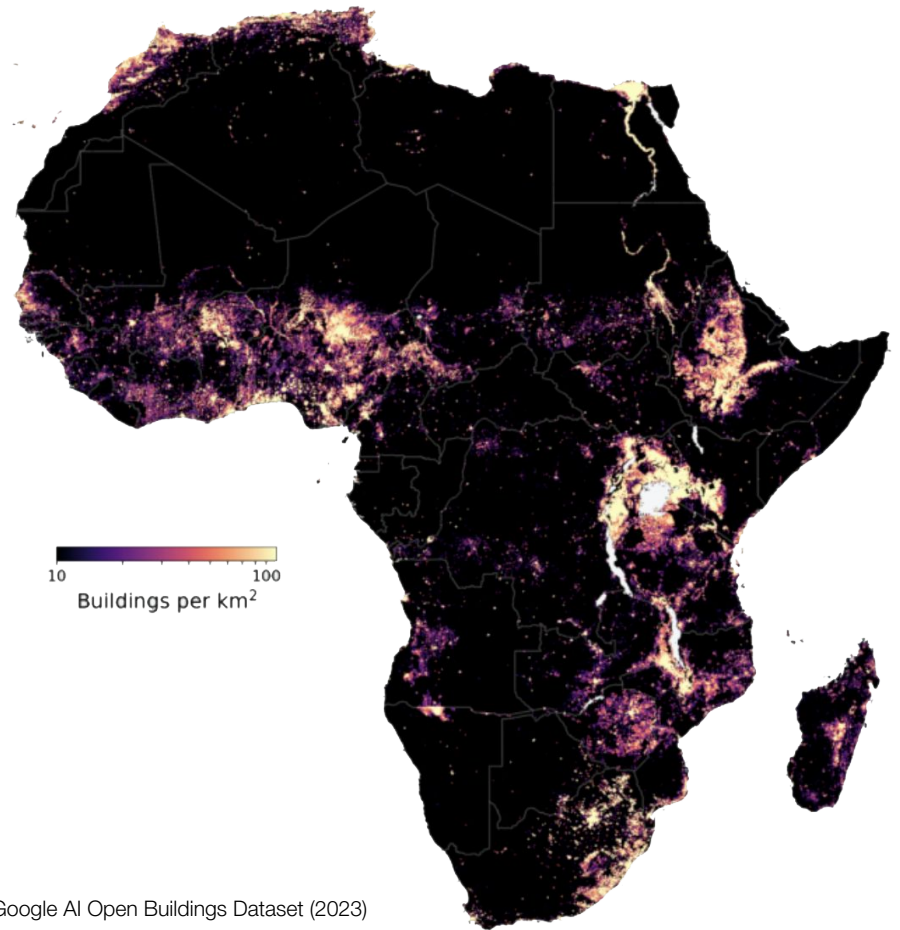
of the African building stock in 2040
still has to be built

majority of this growth will be in *cities*

200%

Additionally, hundreds of smaller African
cities double in size every 20 years

UN Global Status Report for Buildings and Construction (2022);
Vidal (2018)





Designed for Death

Current human-made world is not designed to decompose or regenerate.

Designed for Death

- **30–40% of the total solid waste stream globally in 2022 is construction and demolition waste**
Rodriguez-Morales, J., Burciaga-Diaz, O., Gomez-Zamorano, L.Y., and Escalante-Garcia, J.I. 2024.
- **>75% of all construction waste** (*wood, drywall, asphalt shingles, bricks, clay tiles*) **go to landfills**
U.S. Environmental Protection Agency, 2020.
- **30% of all building materials delivered to a typical construction site end up as waste.**
Osmani, M. 2011.
- **23% of national waste streams are estimated to be C&D waste.**
Bureau of Transportation Statistics. 2016.
- **Concrete + asphalt concrete made up 85% of all U.S. C&D waste in 2018.**
U.S. Environmental Protection Agency (EPA). 2020.
- **C&D waste generation in the U.S. increased by 342% from 1990 to 2018.** U.S.
Environmental Protection Agency (EPA), 2016.
- **From 2005 to 2018, C&D waste levels grew more than 10x faster** than from 1990 to 2005.
Environmental Protection Agency (EPA), 2016.

20%

of waste on landfill sites

40%

of global waste production



40

billion tons / year

Annually, the world uses around 40 to 50 billion tons of sand, primarily for construction materials like concrete and asphalt. This rate is ten times higher than that of cement production, and it far exceeds the natural replenishment rate.

Sand is the second-most exploited planetary resource after water.

<http://www.mineralinfo.org>

39%

of greenhouse gas emissions



Image Credit: Adapted from Dr. JE vd Merwe (2023). Copyright

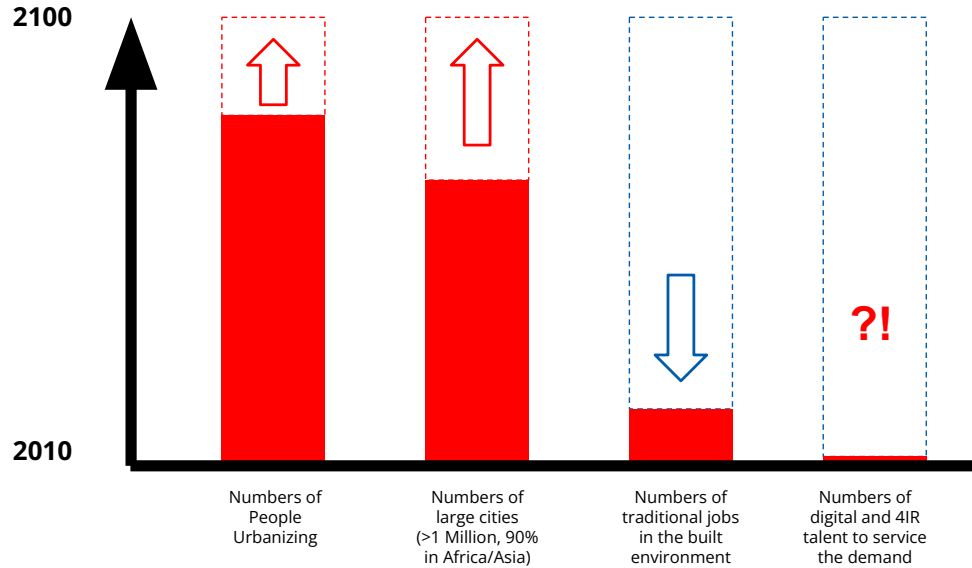


We are running out of sand



We are running out of water

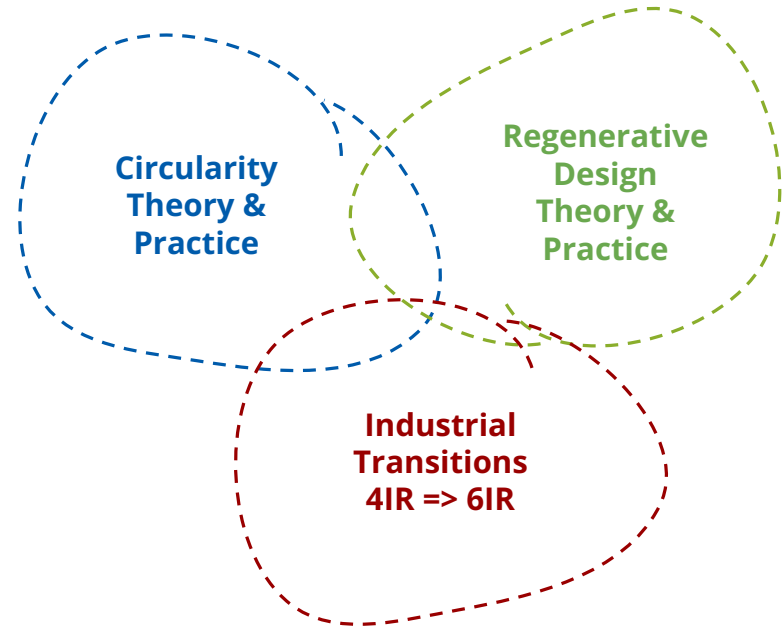
The Context



Many many sources

Capgemini (2017), 'The Digital Talent Gap. Are Companies Doing Enough?';
 Speicher et al., (2019) 'Supporting Worker Success in the Age of Automation.';
 Armstrong, Gilge, and Max, (2021) 'No Turning Back. An Industry Ready to Transcend: 2021 Global Construction Survey.'
 Adepoju, Aigbavboa, (2021) 'Assessing Knowledge and Skills Gap for Construction 4.0 in a Developing Economy'.

The Response



An aerial view of a city, likely a LEGO city, with various buildings, roads, and green spaces. A large, semi-transparent dark gray circle is centered over the image. Inside this circle, there are two white curved arrows forming a continuous loop, one pointing clockwise and the other counter-clockwise. The text "Circular Built Environment" is written in white, bold, sans-serif font across the center of the circle.

Circular Built Environment

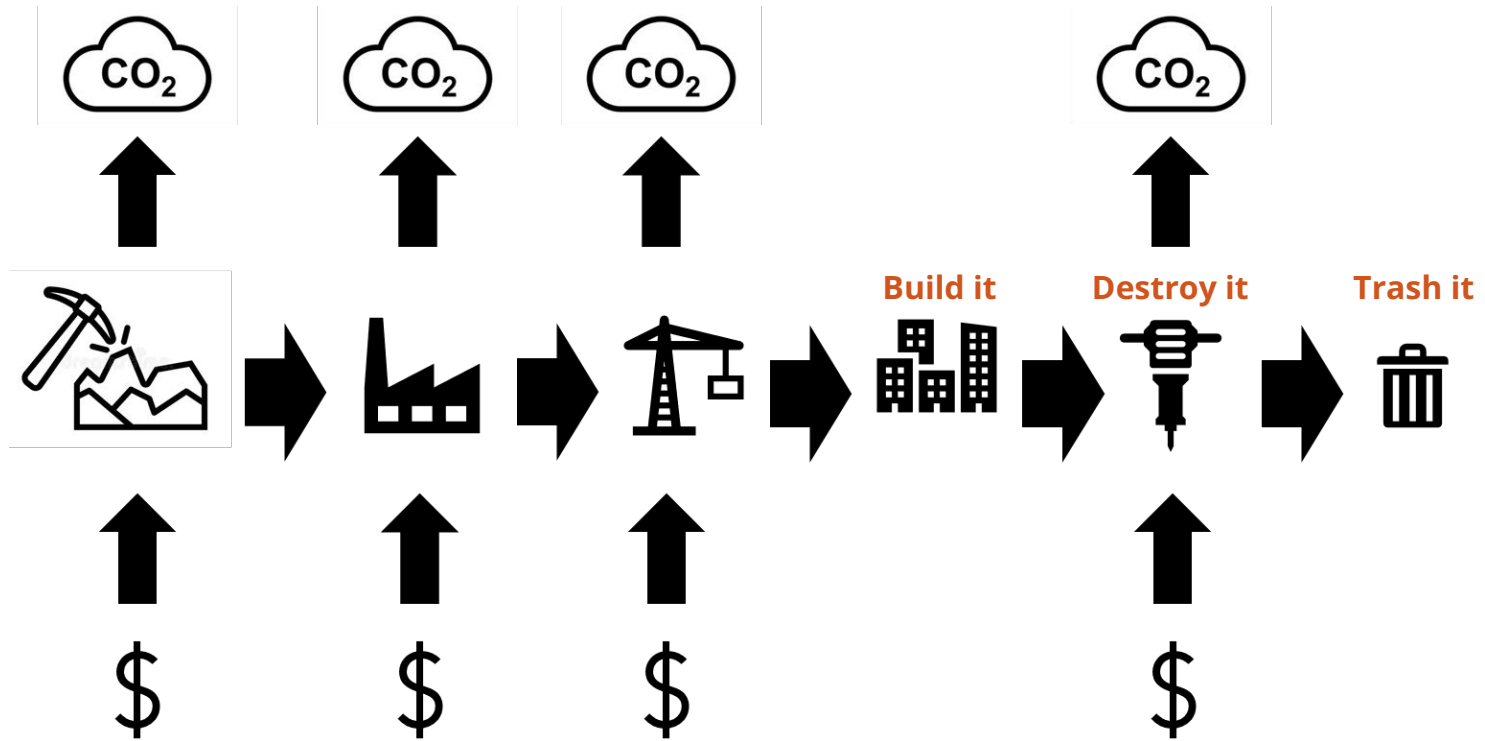


Image Credit: Adapted from Dr. JE vd Merwe (2023). Copyright.

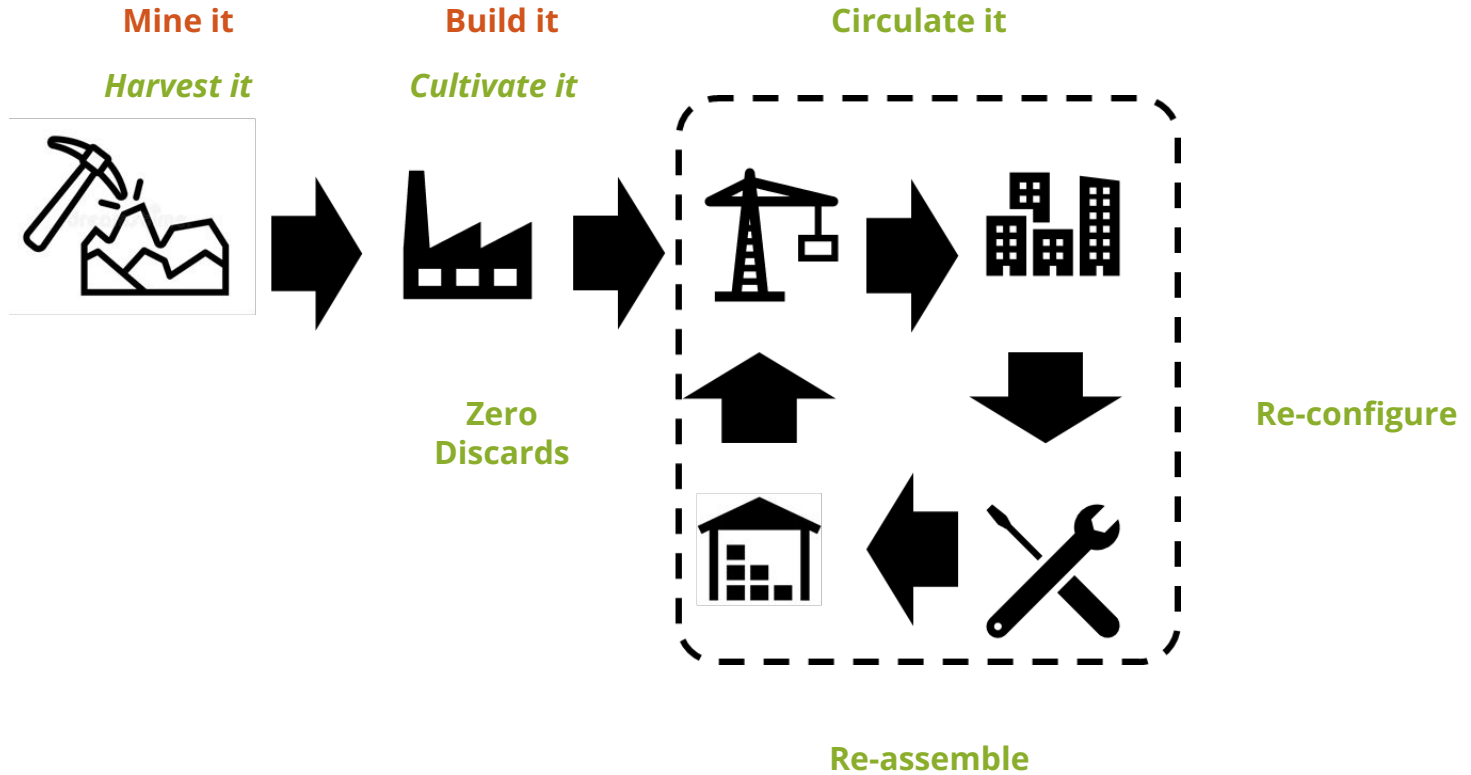
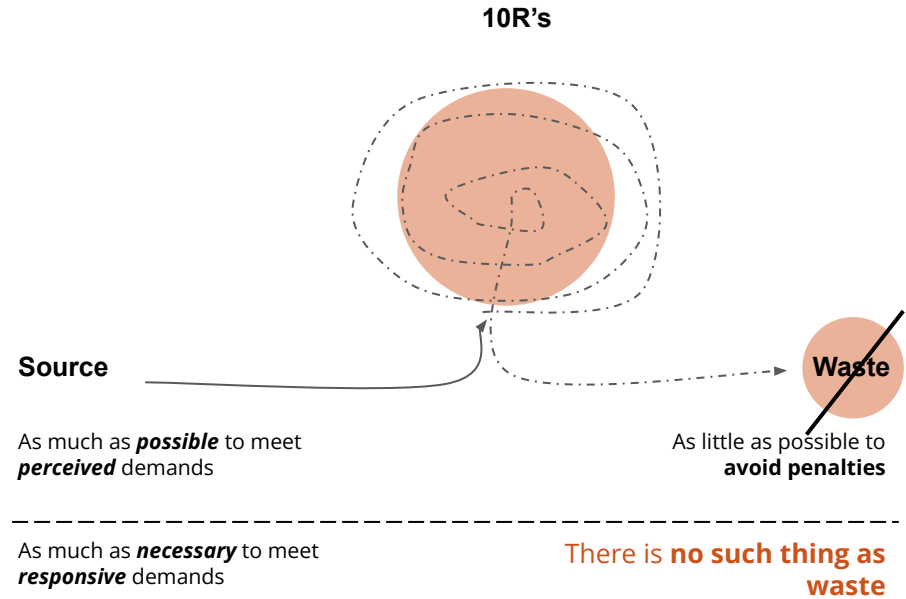


Image Credit: Adapted from Dr. JE vd Merwe (2023). Copyright.

Design *for* Circularity

- | | | |
|-----|-------------------------------------|--|
| 1. | D4 Circularity (10R's) | Maximal in-use |
| 2. | D4 Disassembly | Maximal post-use |
| 3. | D4 Longevity | Maximal life-cycle |
| 4. | D4 Adaptability | Maximal multi-use |
| 5. | D4 Regenerative Impact | Beyond first-use |
| 6. | D4 Energy Recovery | Maximal capture & recovery |
| 7. | D4 Dematerialization | Optimal material use |
| 8. | D4 Embodied Carbon Reduction | Minimum carbon cost/impact |
| 9. | D4 Cradle-to-Cradle | Continuous reuse in closed-loop system |
| 10. | D4 Decomposition | Materials safely break down to zero |



The image is a composite of three aerial views of a city, likely from a video game, arranged horizontally. The left and right panels show vibrant, colorful cityscapes with various buildings, parks, and landmarks. The central panel is a dark, semi-transparent overlay that contains a large, white, circular arrow pointing clockwise. In the center of this arrow, the text "Urban Strategy Level" is written in a bold, white, sans-serif font.

Urban Strategy Level



Manage videos

[Home](#) [Videos](#) [Playlists](#) [Community](#)

Mapping outcome Y LETTER - EXIME

Broken window theory

Broken windows

Broken windows theory

2023 Urban Strategy Studio: Hatfield Solid Waste Strategy

38 views • 1 year ago

Architecture

Civils

Construction
Economics

Geography

Quantity
Surveying

Industry
Partners

TRANSDISCIPLINARY CLASSROOM



South Africa

Netherlands

Hatfield

Creative
Space

Urban Strategy Studio

Architec-
ture

Civils +
Structural

Quantity
Surveying

Geography

UP
Facilities

Project
Owners

Hatfield
CID

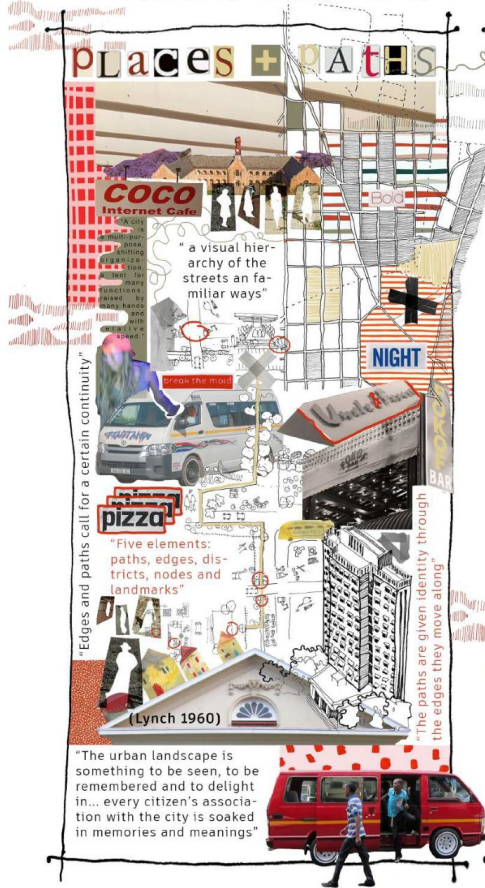
Industry
Partners

The infographic is a circular wheel divided into 12 segments, each representing a dimension of wellbeing. The segments are labeled as follows, starting from the top and moving clockwise:

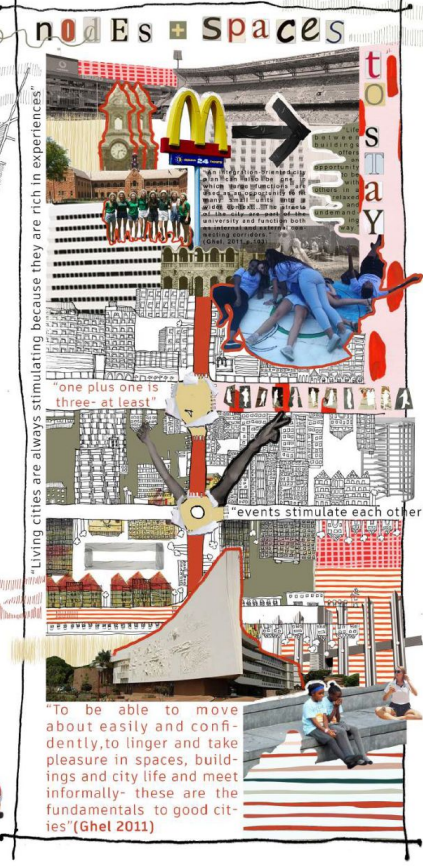
- FOOD:** Illustration of a McDonald's sign and a KFC bucket.
- DIVERSITY & EQUALITY:** Illustration of a group of diverse people's faces.
- COMMUNITY:** Illustration of a group of people in a community setting.
- EDUCATION:** Illustration of a school building and a graduation cap.
- INCOME:** Illustration of various banknotes and a credit card.
- CULTURE:** Illustration of a person in traditional attire.
- POLITICAL VOICE:** Illustration of a person speaking into a megaphone.
- MOBILITY:** Illustration of a bus and a person walking.
- SOCIAL EQUITY:** Illustration of a hand holding a scale of justice.
- PEACE AND JUSTICE:** Illustration of a hand holding a peace sign.
- JOBS:** Illustration of people working in an office.
- HOUSING:** Illustration of a house and a person.
- CONNECTIVITY:** Illustration of a network of lines and nodes.
- HEALTH:** Illustration of a person in a medical setting.
- ENERGY:** Illustration of a power plug and a leaf.
- WATER:** Illustration of a water drop and a glass.

C.2 MEASURABLE GOALS

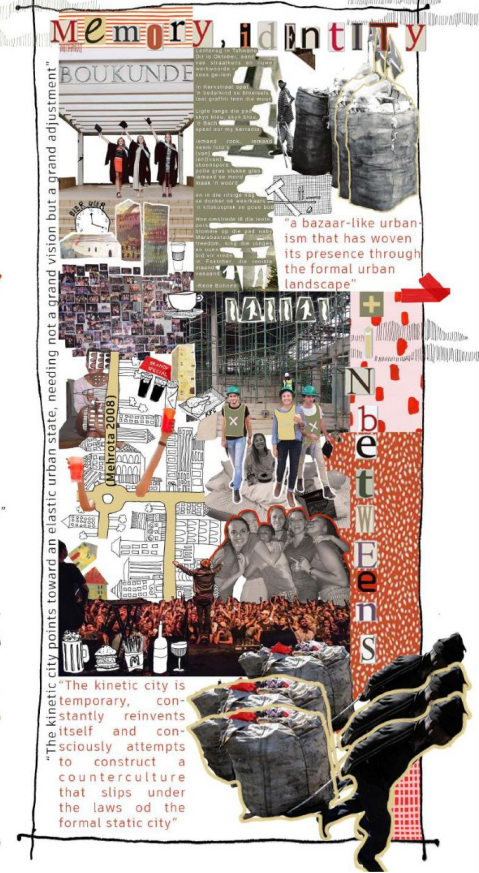
Kevin Lynch (1960) "The image of the City"



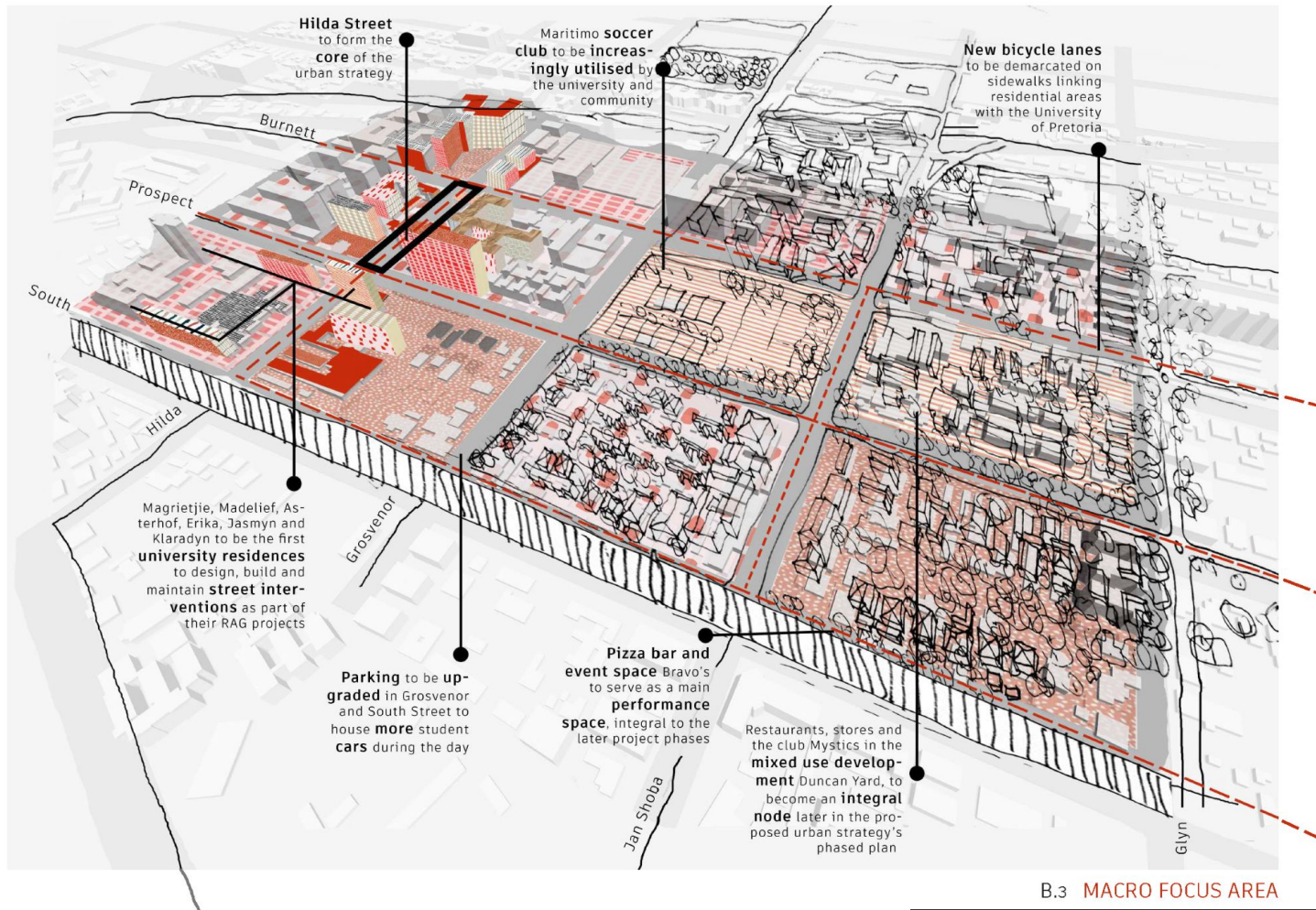
Jan Ghel (2011) "Life between buildings: using public space"



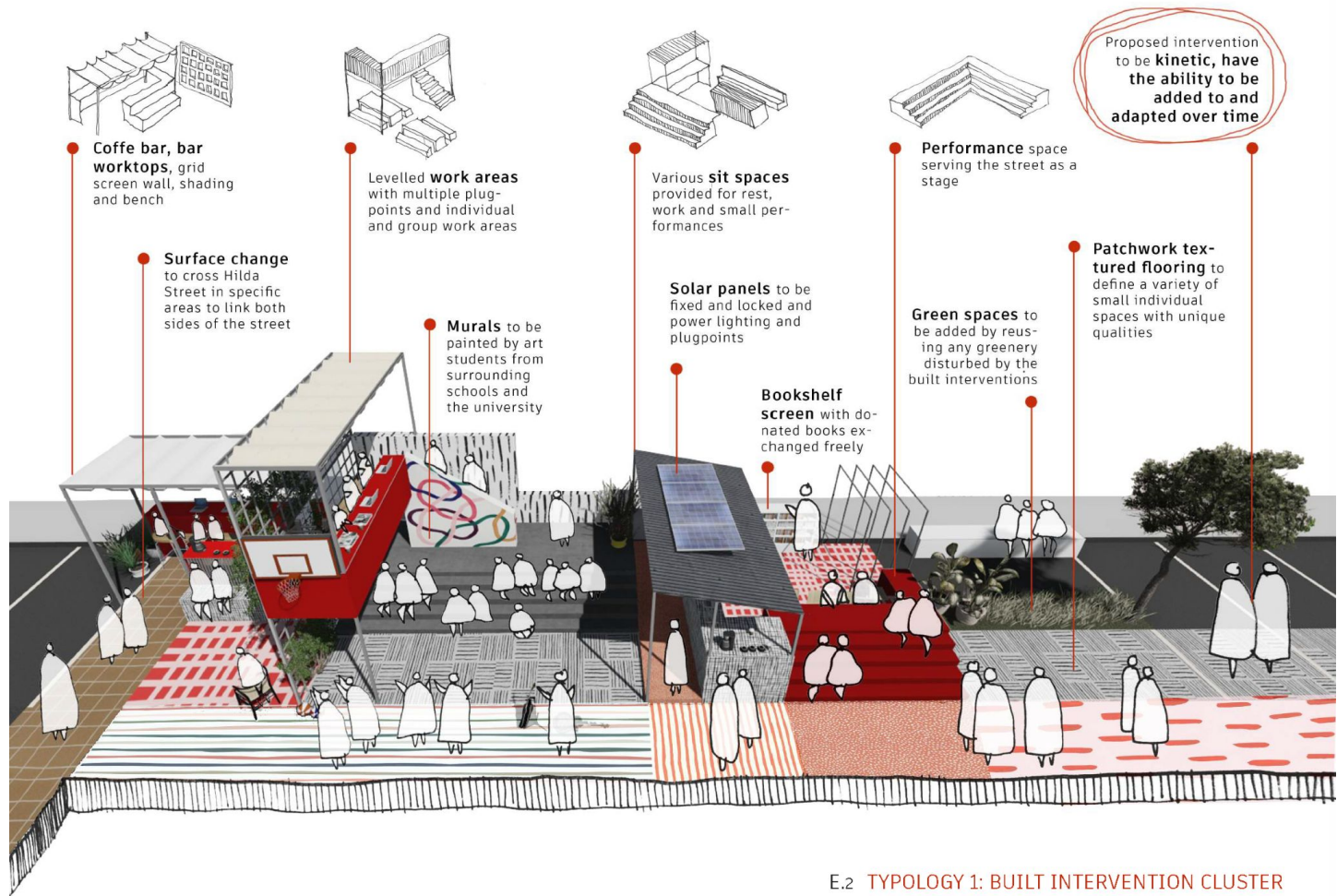
Rahul Mehrota (2008) "Negotiating the static and kinetic city"



C.1 VISUALISING THEORY



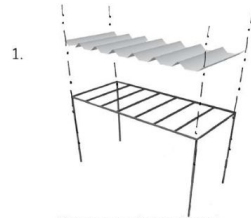
B.3 MACRO FOCUS AREA



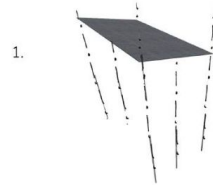
E.2 TYPOLOGY 1: BUILT INTERVENTION CLUSTER



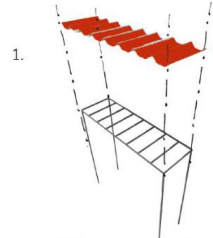
Roofing



1. Slung material and steel frame shading



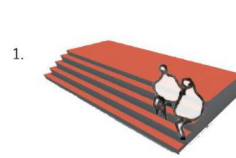
1. Corrugated sheeting to host solar panels



1. Shaped perspex and steel framed roof



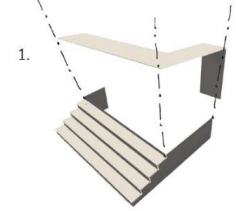
Stairs



1. Brick and mortar seating low staircase



1. Galvanised steel single staircase to first floor



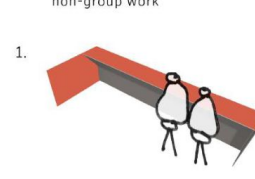
1. Performance and bar seating multi-functional as a work top



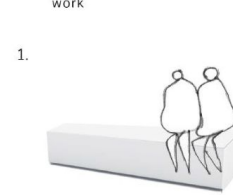
Tables and Seating



1. Bar seating for shorter stays, coffee breaks and non-group work



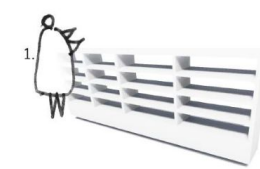
1. Galvanised steel bar top with plugs for non-group work



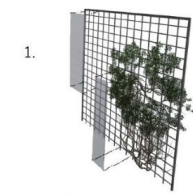
1. Low benches for short term users



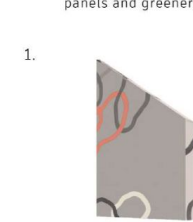
Walls



1. Public library screening device serving both sides



1. Galvanised steel grid screen for privatising panels and greenery



1. Mural wall serving as an intervention's landmark

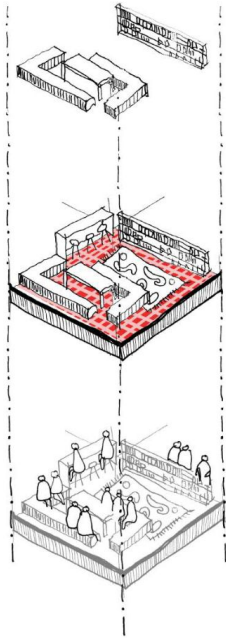


E.3 TYPOLOGY 2: PARTS



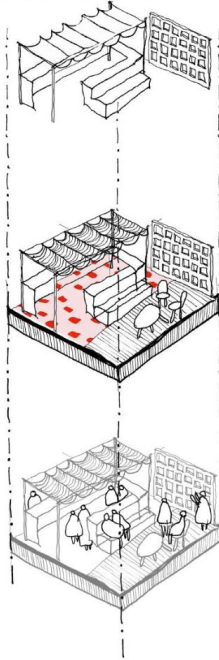
Read

Shelving to serve as an open library or temporary storage space. Low seating and table arrangement for **casual reading, informal meetings and talks**. (solar powered plug-points provided)



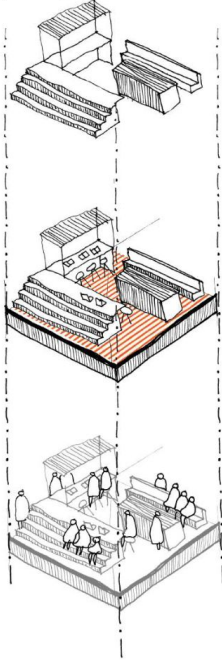
Drink

Bar seating and service area to accompany a **temporary coffee stall**. Grid screening to serve as planter wall, exhibition wall or to simply enhance privacy. (solar powered plug-points provided)



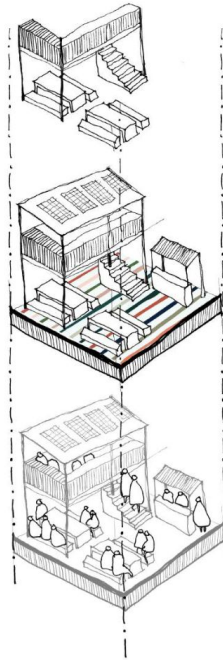
Sit

An amphitheatre toward the street is suited for **street performances** with smaller crowds. A variety of sit spaces provided for casual meetings. (solar powered plug-points provided)



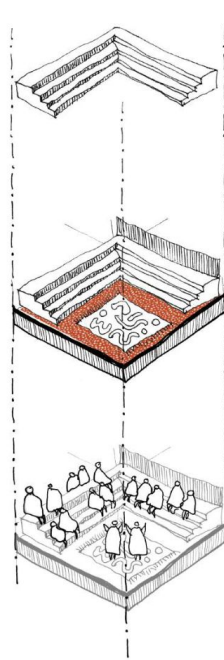
Work

Enhanced **private work** space is suggested at a first level whilst **group work areas** are located on ground floor (all work areas to have multiple plug-points powered by solar)

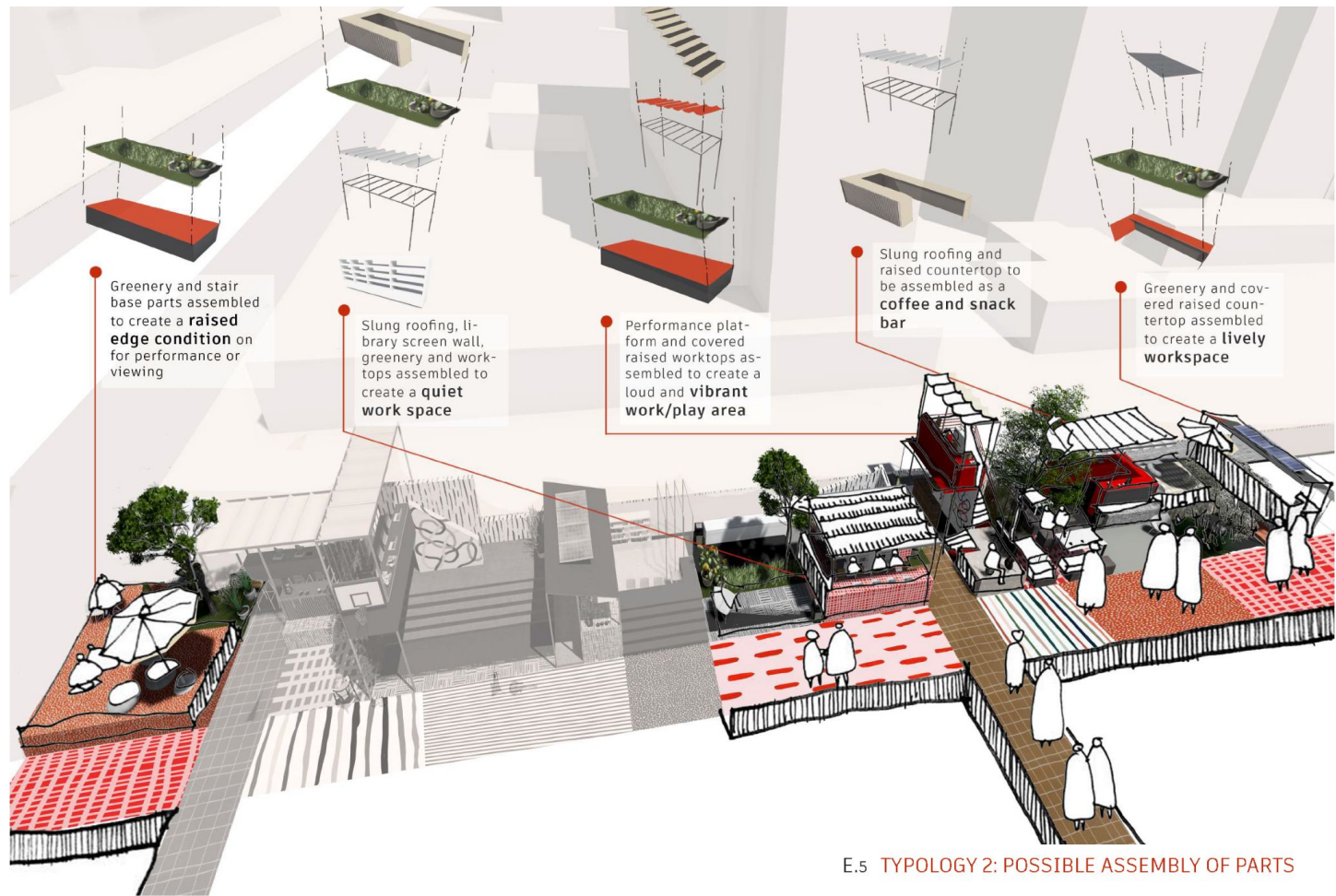


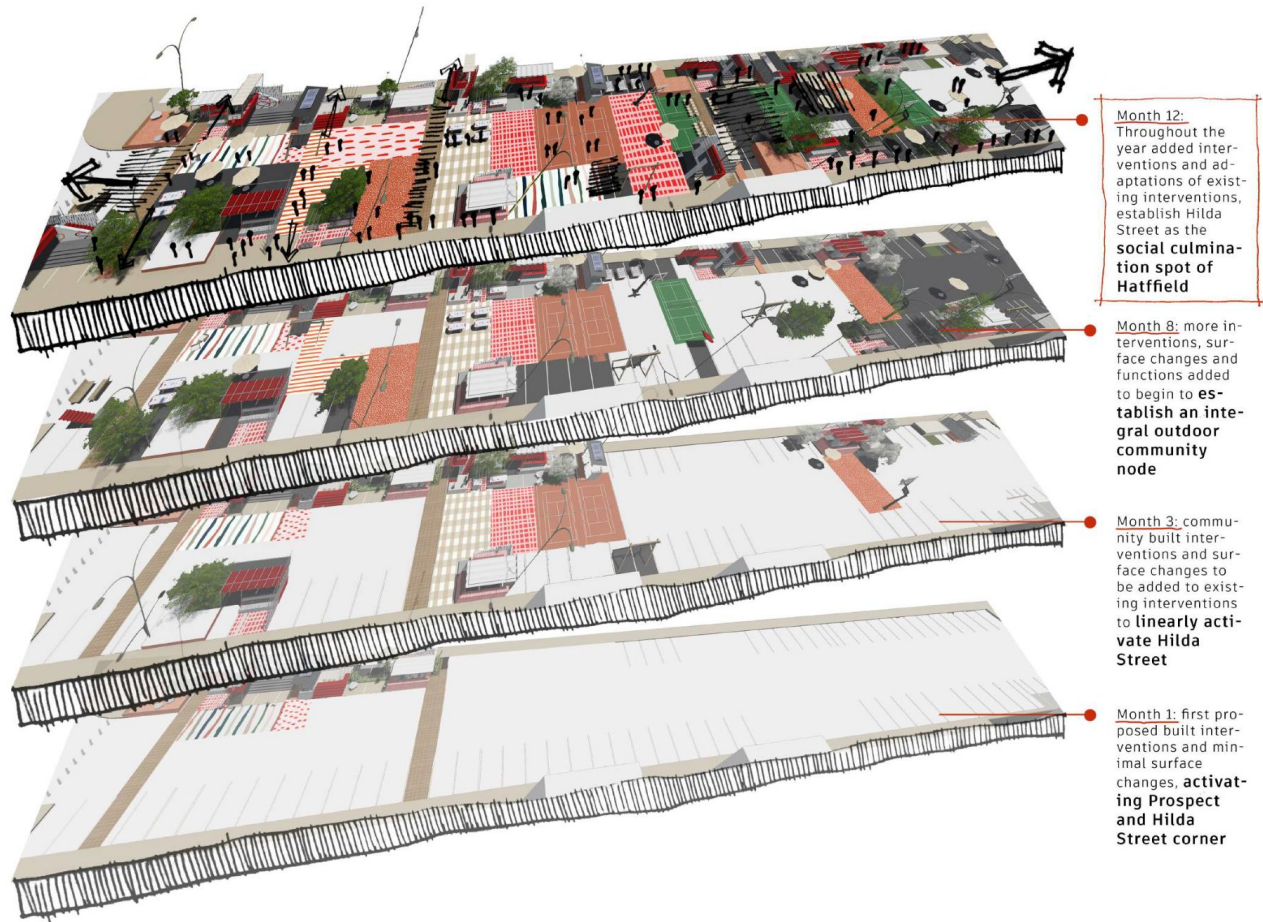
Perform

An L-shaped amphitheatre provides seating for **medium sized performances** as well as a stage area that could bleed out onto the street (solar powered plug-points provided)



E.4 TYPOLOGY 2: ASSEMBLY AND FUNCTIONS





F.1 TYPOLOGICAL TIME-LAPSE

1.1 Measurable Outcomes

INFRASTRUCTURAL UPGRADE

Such as street lights and robots, proposed Bagarezi pathway and facilities are crucial to the overall success of the project

COMMUNITY INVOLVEMENT

Through upcycling initiative, pick-up points, workshops that creates a collaborative trash economy (Schenck & Blaauw, 2011:3)

HOME & WORK SECURITY

Reducing the number of Bagarezi's that 'sleep elsewhere' by 96% (Schenck & Blaauw, 2011:11)

ENVIRONMENTAL SUSTAINABILITY

Diverting waste from landfill sites and creating upcycling initiative that can provide additional skills development and showcasing of products (Dickinson, 2017: 6)

Collaboration
Security
Wellbeing
Sustainability

INCLUSION OF INFORMAL TRASH ECONOMY

- Organizing Bagarezi's so as to allow them greater representation,
- Including their needs in policies
- Recognizing them as part of the waste management system
- Acknowledging their contribution to the environment (Schenck & Blaauw, 2011:17)

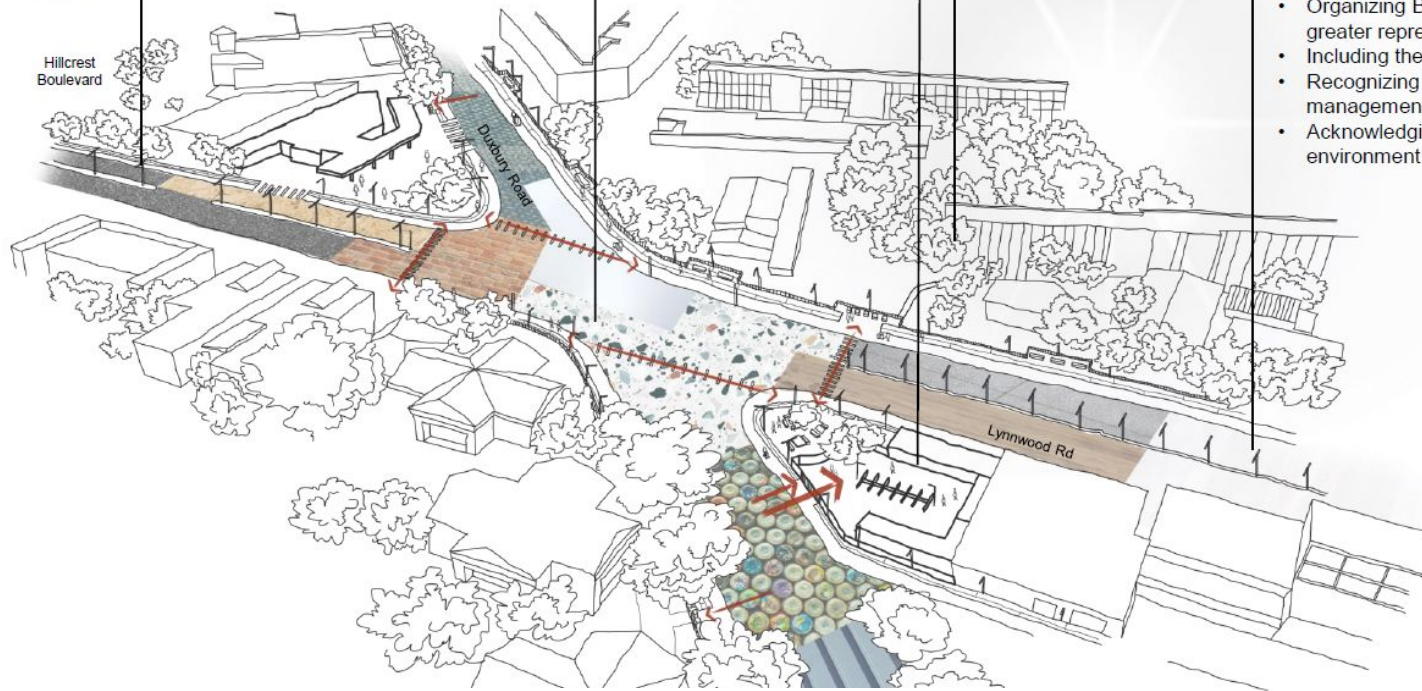


Image Source

Department of Architecture (2022). Q1 Urban Strategy Studio

Involve,
Pedestrianise,
Activate,
Influence,
Integrate

With a large amount of
**usable outdoor
public space**, Hatfield
community hosted and
locally located **events**
can take place more fre-
quently

Interstitial spaces
bordering on Hilda
Street can be **adapt-**
ed and enhanced
over time

Infrastructurl ele-
ments like street light-
ing, power supply and
the proposed bicycle
lanes are **crucial** to the
overall **success of the**
project

Through the creation of an
extensive **variety of small
outdoor spaces**, an **in-**
crease in the **amount of**
social interaction **overlaps**
can take place

The **variety of outdoor public,
semi-public and semi-private
spaces** provided will attract a
larger portion of the micro and
macro-community, increasing the
overall **quality of life** for many
Pretorian residents (from 94th to
91st out of 231 (Nkosi 2018))

In addressing **city green
spaces, solar energy and
quality outdoor areas**, Hat-
field can increase its **prosper-
ity index** rating from 0,479 to
5,902 (Cape Town's current
figure) (Business Tech 2019)

Through **increasing the quality
of outdoor public areas** wanting
to be used by the community, Hat-
field's general **livability** could in-
crease from 7th to 5th locally
(Business Tech 2019)

F.2 MEASURABLE OUTCOMES

Urban Strategy Studio

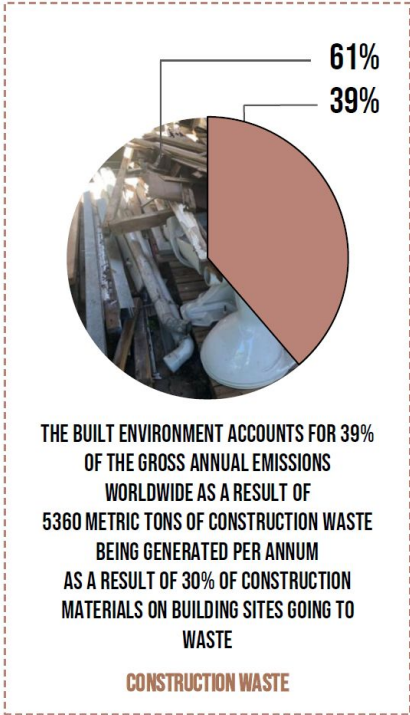
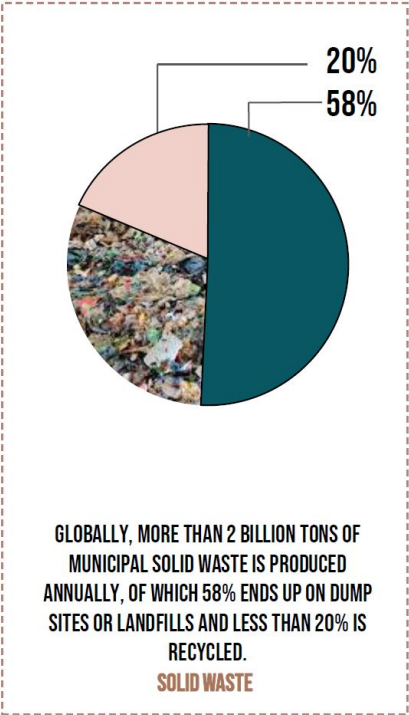
Process

- Real-world Problems
- Real-world Stakeholders
- Co-create the solutions
- Local, International + Transdisciplinary Collaborations
- Digital Twin mindset

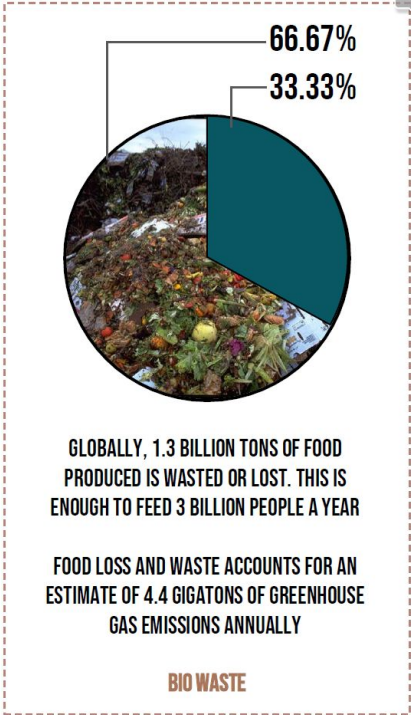
Example

Urban Strategy Studio 2023 +
University of Twente, Netherlands

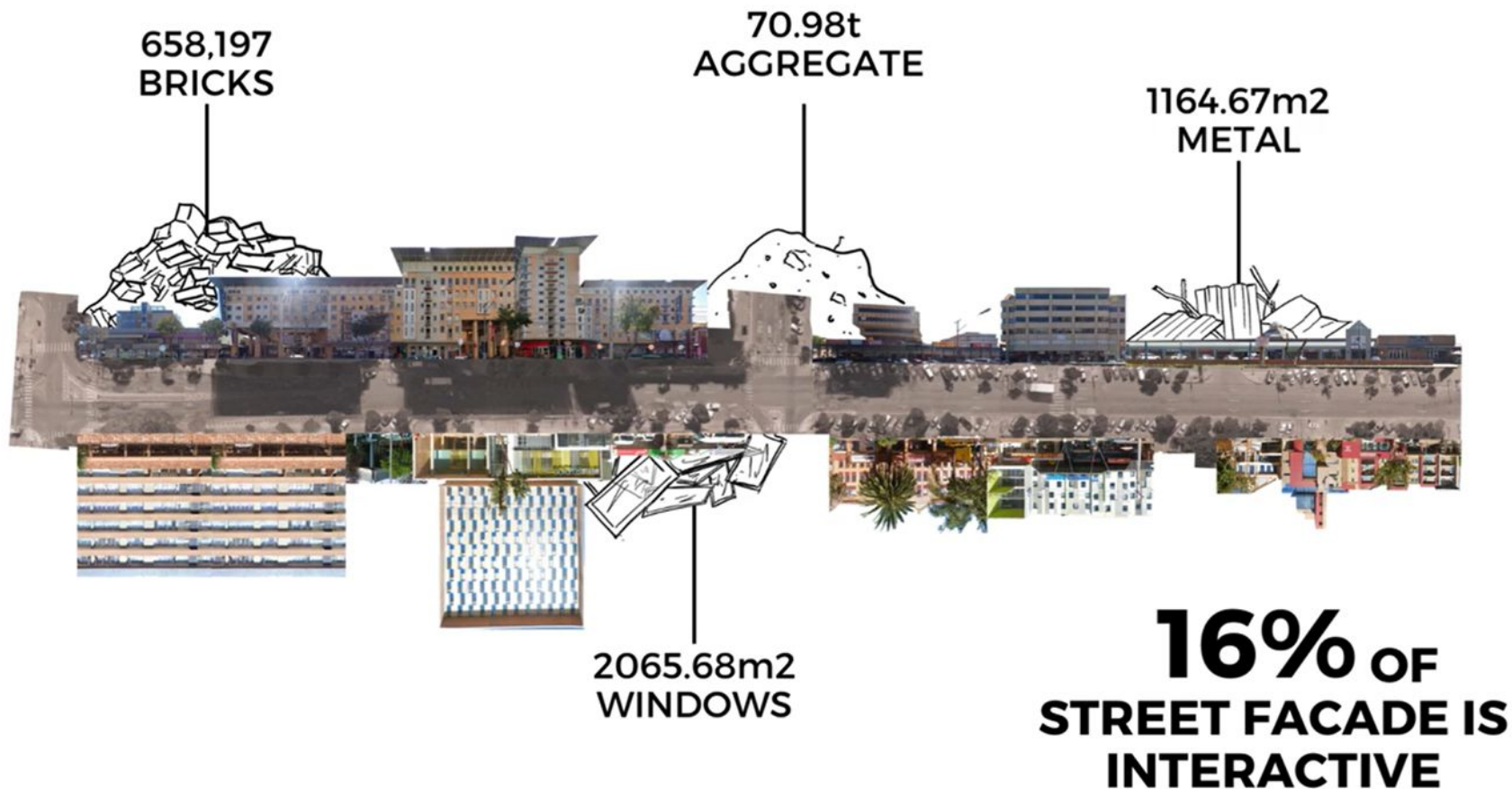
Hatfield Waste Twin
with Mr Ivan Cardenas, masters

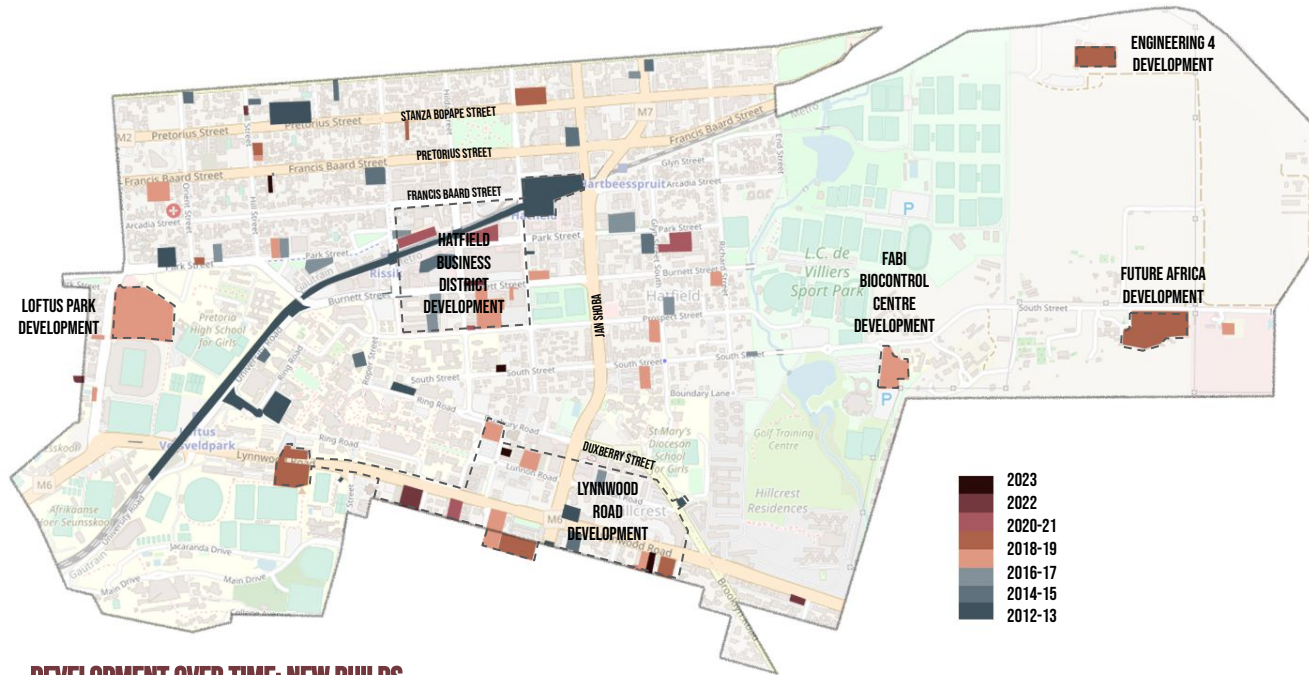


THE CURRENT SITUATION GLOBALLY

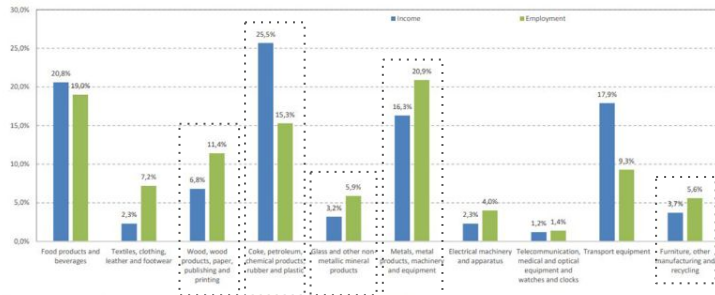


BURNETTE CURRENT ELEVATION

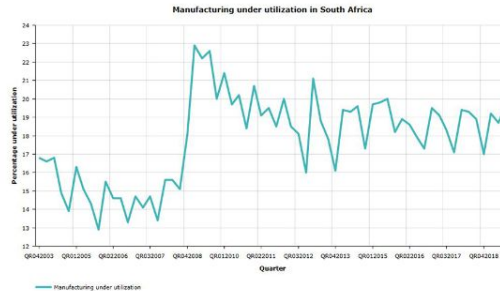




DEVELOPMENT OVER TIME: NEW BUILDS



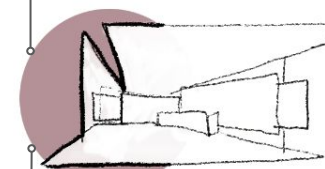
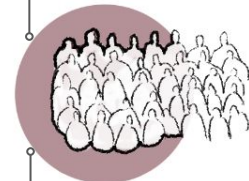
LOW INCOME FOR HIGH AMOUNTS OF EMPLOYMENT



HIGH INFRASTRUCTURE UNDERUTILIZED



CONSTRUCTION GROWING AT A HIGH RATE



HIGH AMOUNT OF UNDERUTILIZED BUILDINGS



LOW INCOME FOR BUILDING USE AND BUILDER

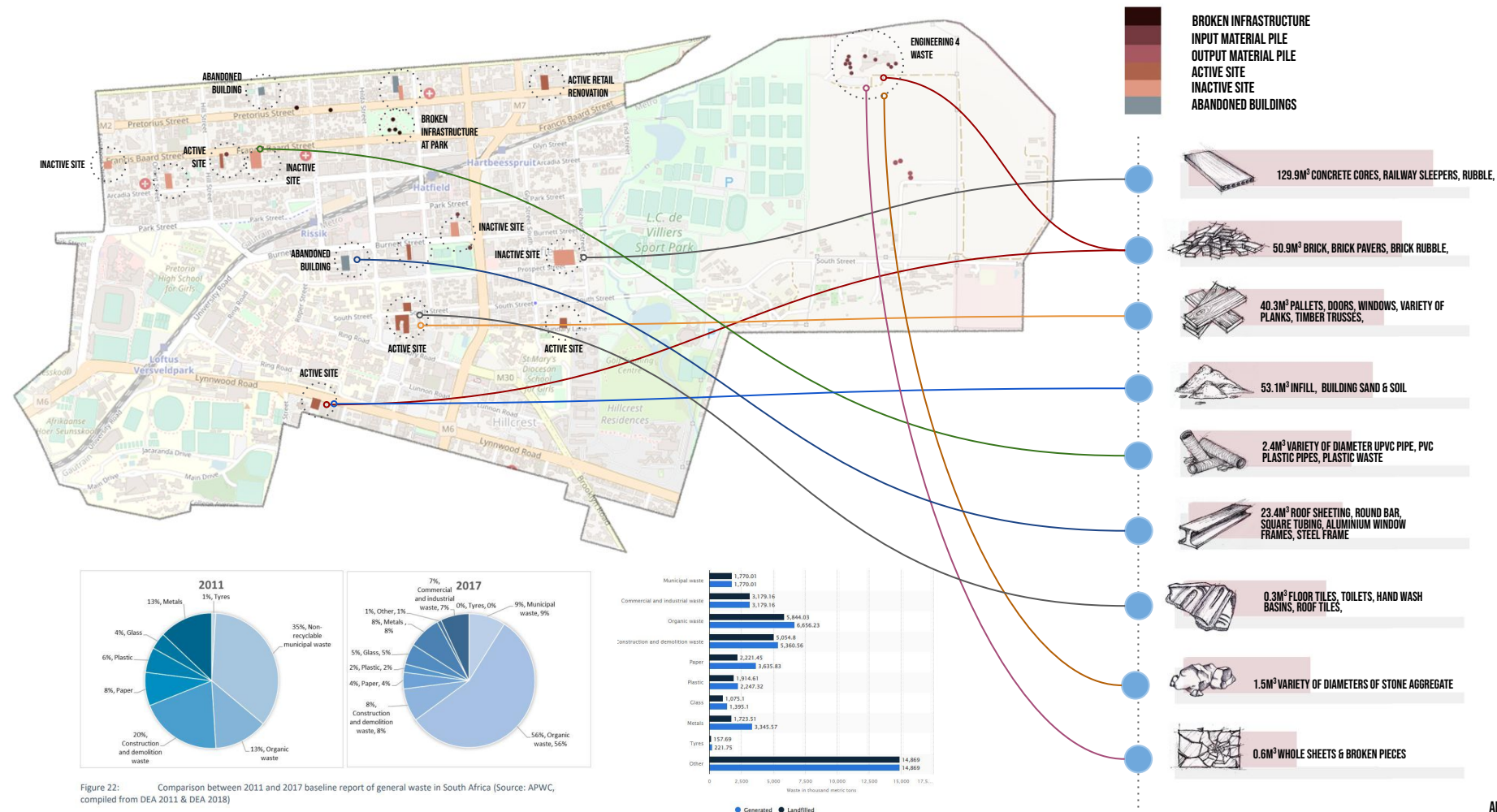
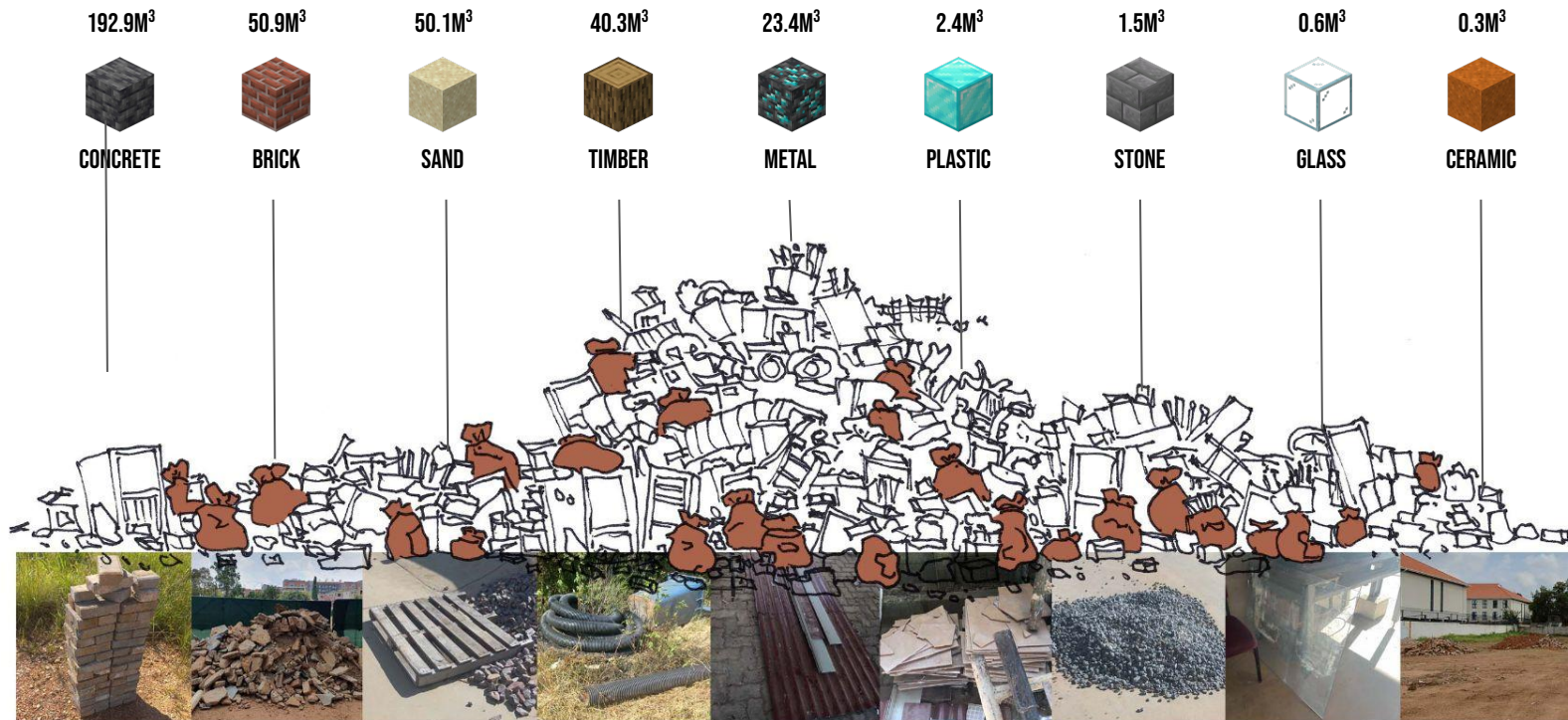
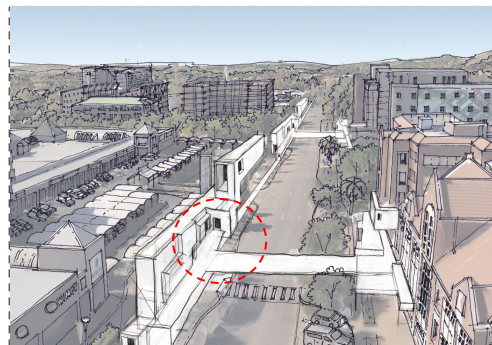
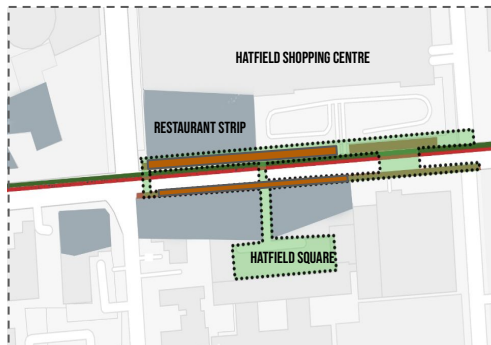


Figure 22: Comparison between 2011 and 2017 baseline report of general waste in South Africa (Source: APWC, compiled from DEA 2011 & DEA 2018)

SURVEY DATA

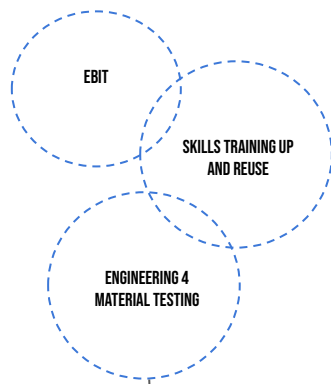


**“WASTE, EXCLUDING HAZARDOUS WASTE, PRODUCED DURING THE CONSTRUCTION, ALTERATION, REPAIR OR DEMOLITION OF ANY STRUCTURE, AND INCLUDES RUBBLE, EARTH, ROCK AND WOOD DISPLACED DURING THAT CONSTRUCTION, ALTERATION, REPAIR OR DEMOLITION.”
(DEPARTMENT OF ENVIRONMENTAL AFFAIRS, 2012)**



FOCUS AREA : BURNETT STREET FOR MINECRAFT PRODUCTION

- CONNECTION OF RESTAURANT STRIP AND HATFIELD SQUARE TO FACILITATE PRODUCTION LINE OF MATERIAL CRAFT
- BIKING LANE
- "RAIL" FOR MATERIALS
- INTERVENTION



192.9M³



CONCRETE STRUCTURE

50.9M³



BRICK STRUCTURE

50.1M³



SAND FOR INFILL IN GROUND

40.3M³

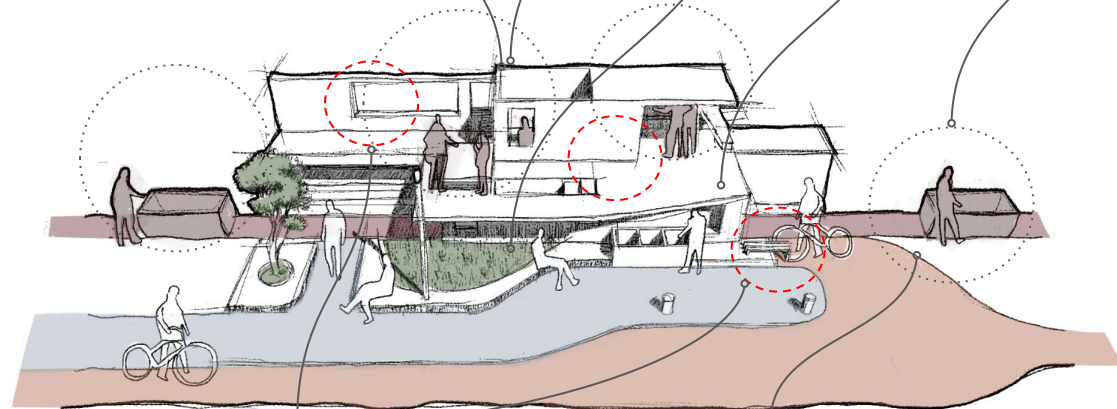


TIMBER PANELS AND DECKING

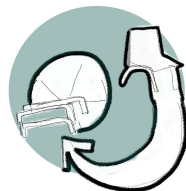
23.4M³



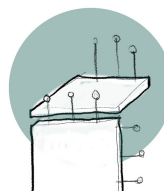
METAL CARTS OR COMPOSITE



REUSE



MATERIAL INNOVATION



The image is a composite graphic. It features a background of two cityscapes: a modern, colorful one on the left and a more traditional, green one on the right. A large, dark, semi-transparent rectangle is centered over the image. Inside this rectangle, at the top, is a white circular arrow pointing clockwise. Below the arrow, the text "Regenerative Purpose-Driven Projects" is written in a white, sans-serif font. In the center of the rectangle, the words "Hatfield Digital" and "Twin City" are stacked in a large, bold, white, sans-serif font. At the bottom of the rectangle is another white circular arrow, pointing counter-clockwise, completing a circular flow around the central text.

Regenerative Purpose-Driven Projects

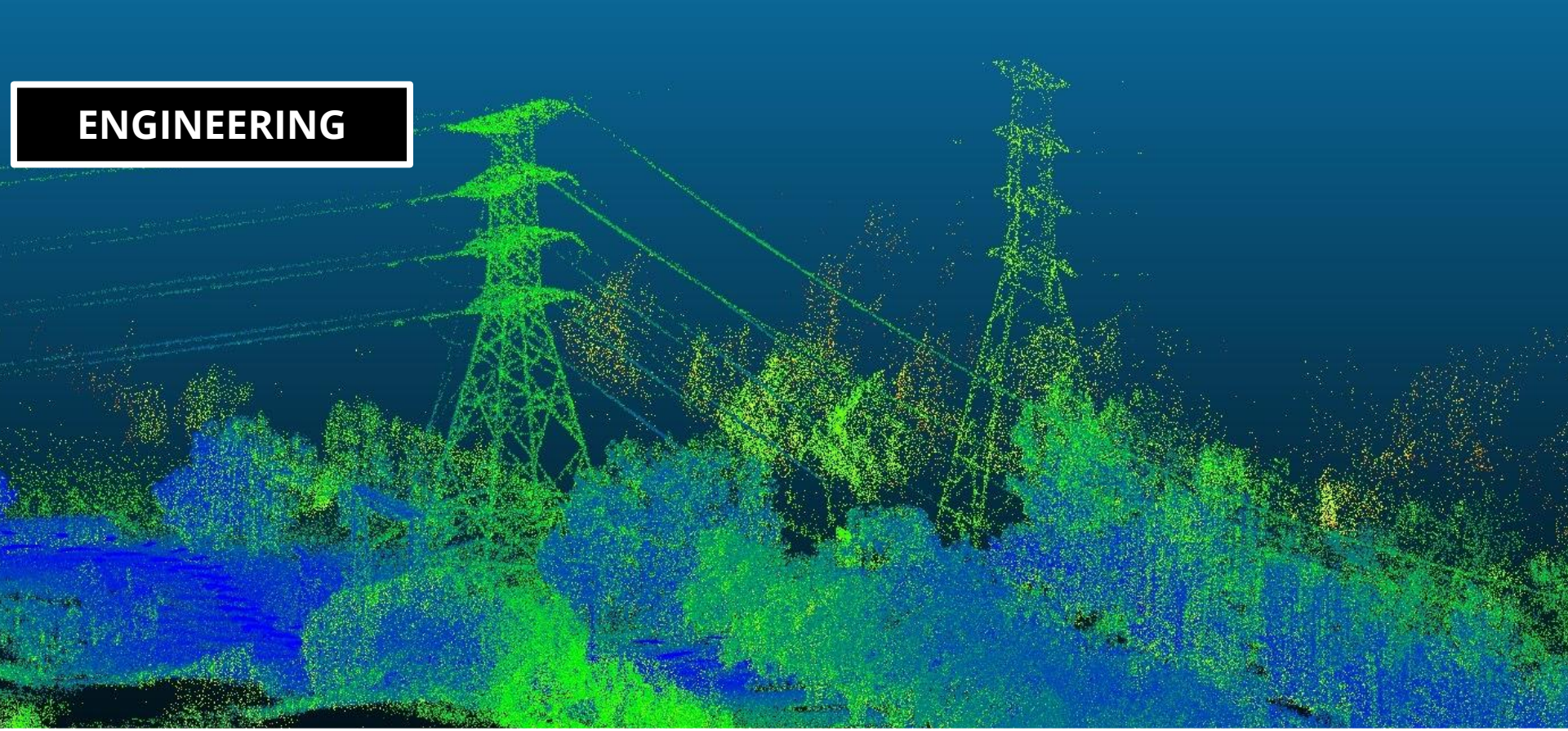
Hatfield Digital Twin City



TRANSDISCIPLINARY TRAINING



TRANSDISCIPLINARY TRAINING



ENGINEERING

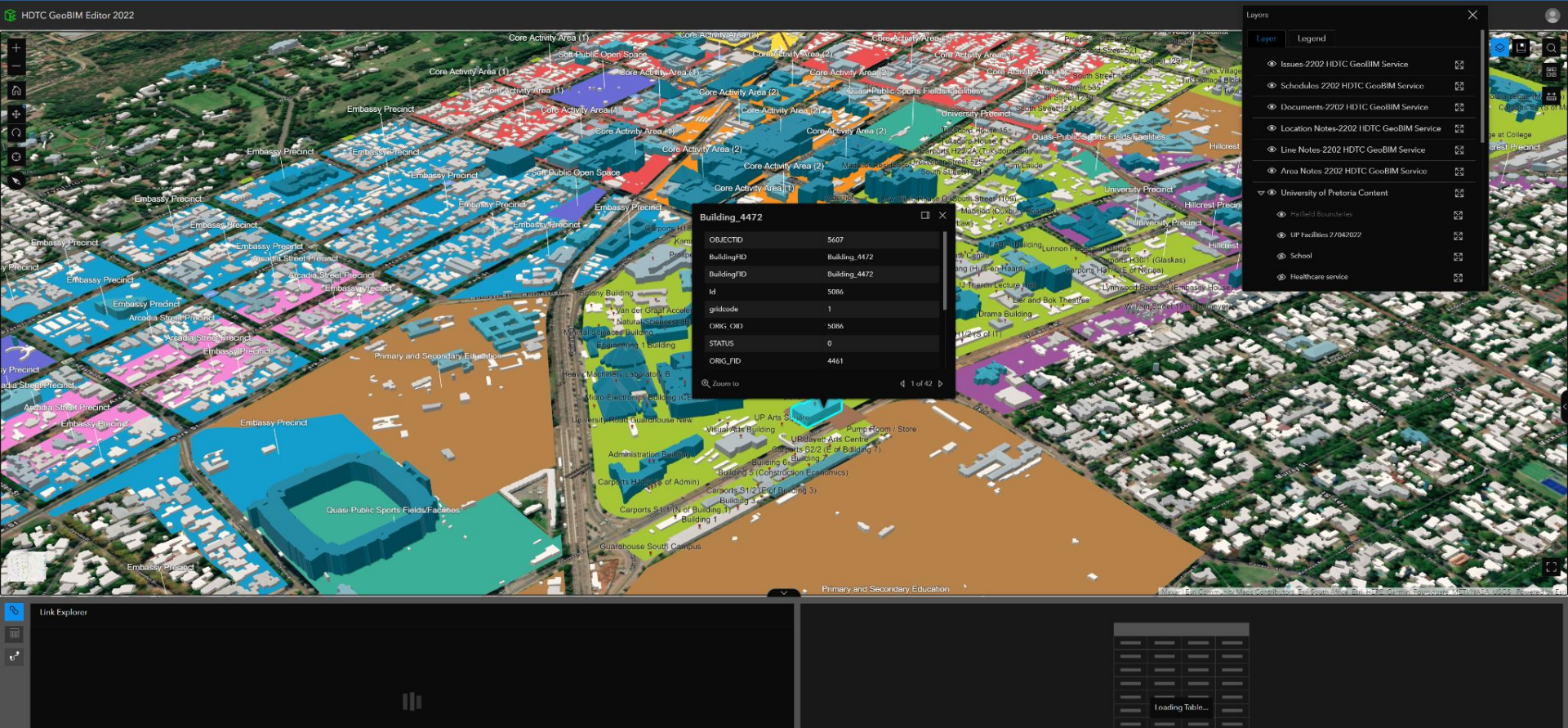
HATFIELD DIGITAL TWIN CITY - POINT CLOUD SCANNING (LiDAR)

Led by Dr. Davey & Prof. Steyn — Students in Architecture + Geoinformatics + Civil Engineering



HATFIELD DIGITAL TWIN CITY - 3D POINT CLOUD SCANNING (LiDAR)

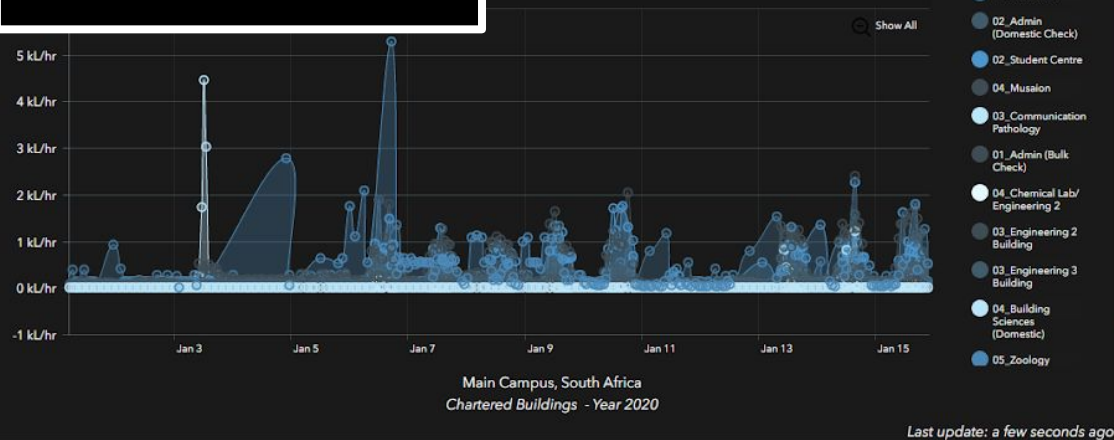
Led by Dr. Davey & Prof. Grabe — Students in Architecture + Geoinformatics + Civil Engineering



UP DIGITAL TWIN GEOBIM DEVELOPMENT

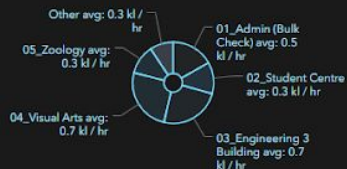
Be patient! Work in progress...

PERFORMANCE



Top Consumers

Annual Ave kL / hr per instrument

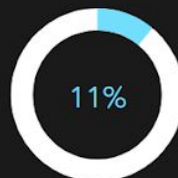


Campus Water Consumption

0.4 kL / hr
Average

Last update: 11 minutes ago

Water Instruments Mapped



HDT_20201031_C

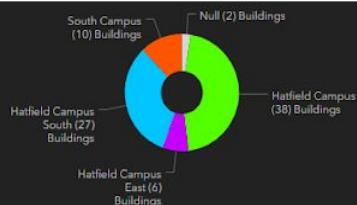


UP WATER TWIN PILOT 2021 (CARBON & ENERGY TO FOLLOW)

Be patient! Work in progress...

Building Portfolio

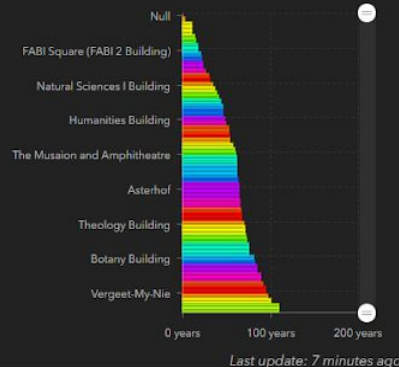
HERITAGE



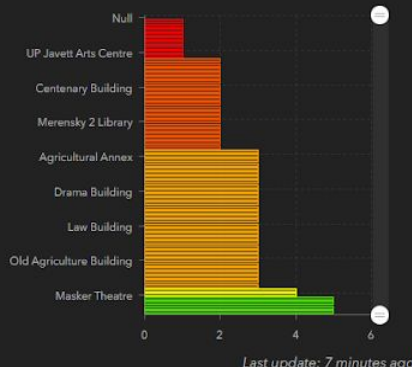
- |4017| Hatfield Campus | Zoology Building
- |4047| Hatfield Campus | Visual Arts Building
- |4102| Hatfield Campus East | Vergeet-My-Nie
- |4022| South Campus | UP Javett Arts Centre
- |4232| Hatfield Campus South | Tukkieverf
- |4258| Hatfield Campus | Thuto Building
- |4045| Hatfield Campus | Theology Building
- |4086| Hatfield Campus | The Musaion and Amphitheatre
- |4083| Hatfield Campus | Technical Services Building
- |4053| Hatfield Campus | Study Centre Building
- |4038| Hatfield Campus South | Student Service

Last update: 7 minutes ago

Building Age (years)

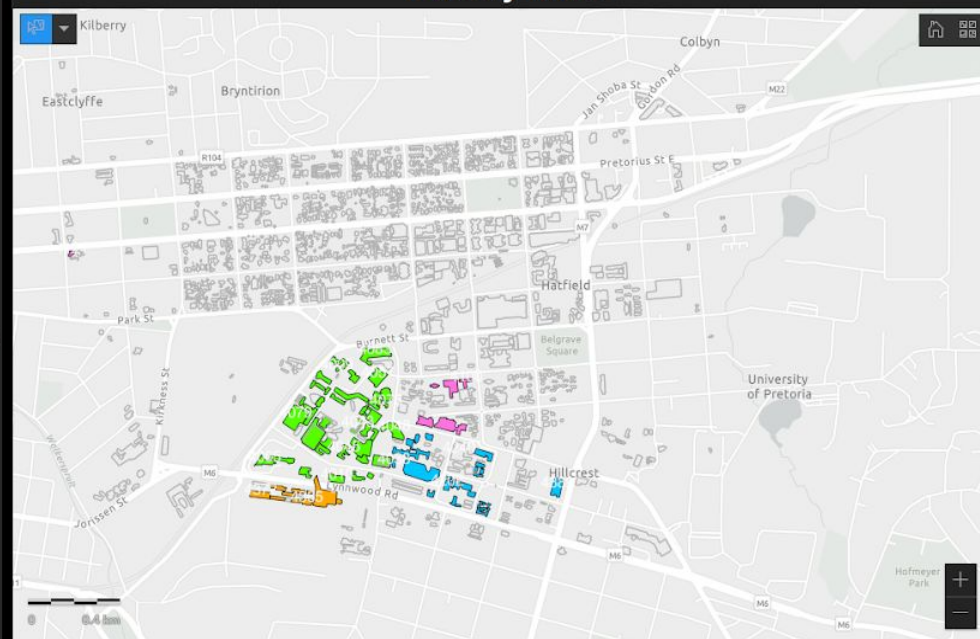


Building Conditions



Hatfield Digital Twin City

Quality Twin



Eri Community Maps Contributors, Eri South Africa, Eri, HERE, Garmin, METI/NASA, USGS

Powered by Eri

Select building(s) by using **filters** (above) - or - map **mouse selection** (little blue box on left of map) - or - mouse selection on any of the graphs/maps. You can do **single** selections - or - click-drag for **multiple** selections.

To **reset** to full precinct, "**unselect**" whatever you clicked on - or - click outside anywhere on a "**dark grey area**"

HATFIELD DIGITAL TWIN CITY - HERITAGE ASSET DATASET

Led by Dr. Davey & Ms Helene Potgieter — Students in Architecture + Geoinformatics

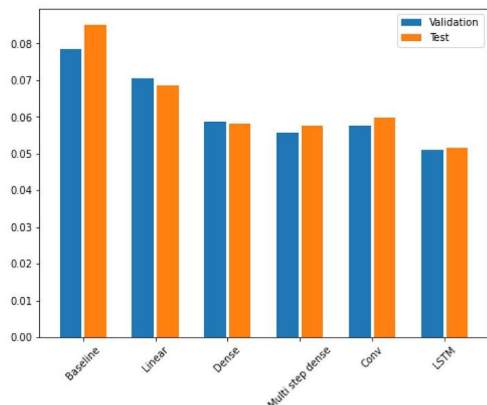
AI & ML

HATFIELD PREDICTIVE UTILITY CONSUMPTION APPLICATION using AI, Machine Learning Models

Next Steps

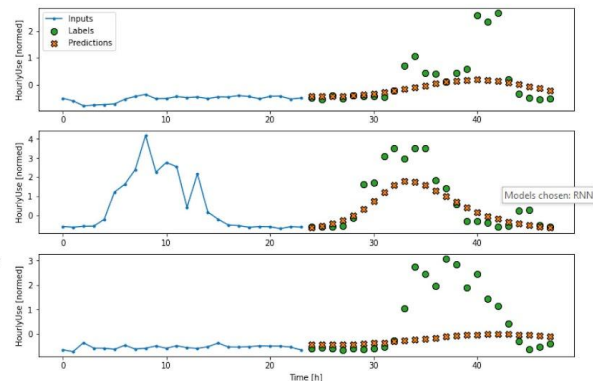
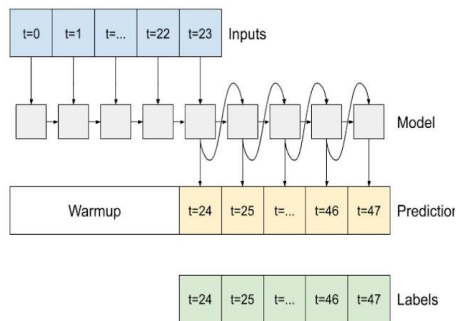
- It works!!!!
- More data and application please!
- Maturity development

PERFORMANCE: TESTING VARIOUS MODELS SELECT ONE



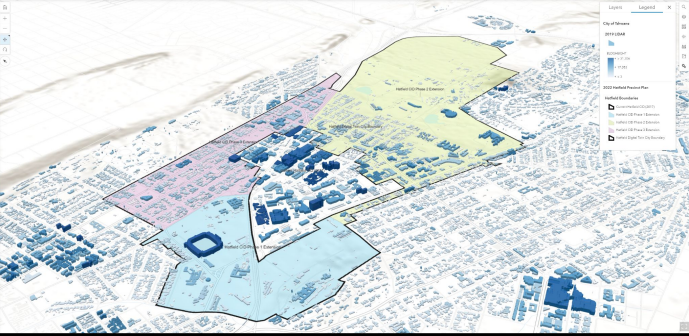
MODELS CHOSEN: RNN

Autoregressive model



UP CHEMICAL ENGINEERING STUDENTS 2021

What systemic long-term urban improvements could we achieve with Digital Twin City Tech & Data?



2 days, 15 students, 25 square km
We now know our urban waste landscape.



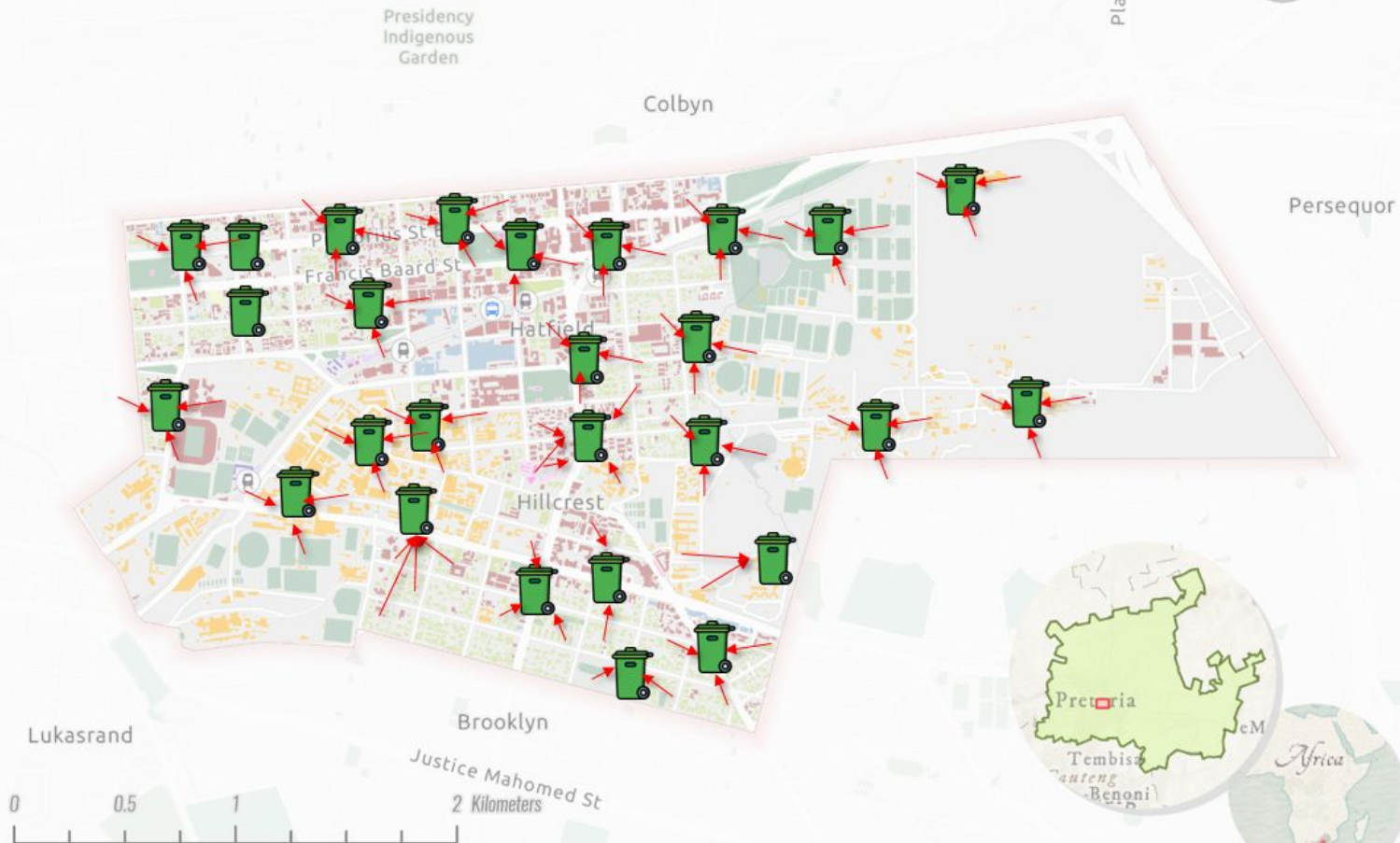
LESS INTENSE

MORE INTENSE

FIGURE 2: EPICOLLECT HATFIELD SOLID WASTE DATA COLLECTION (CARDENAS, 2023)

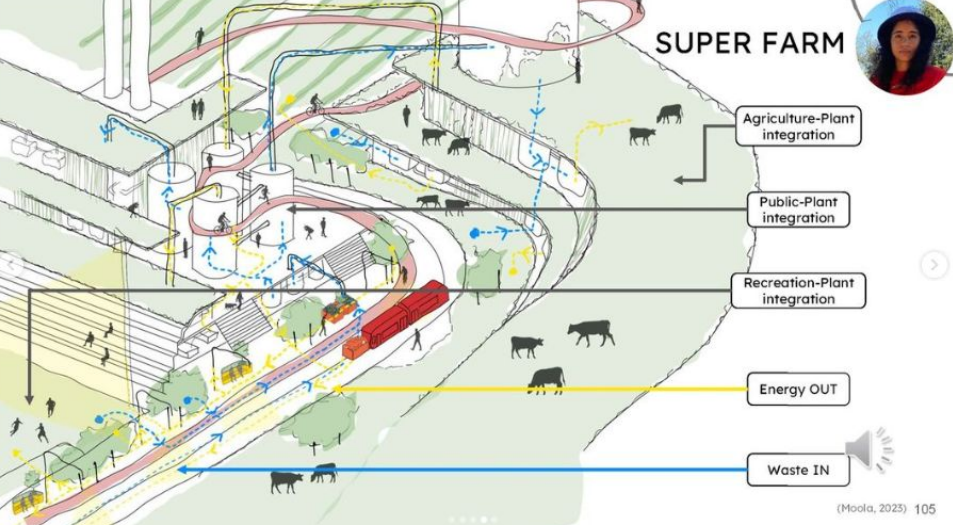


CONTAINER ASSIGNATION



**4.105
BUILDINGS
TO 1.127
CONTAINERS**





IMPACT OF STRATEGY - SUPER FARM - BIOGAS PLANT



5 743 320 kWh PER YEAR

HATFIELD FOOD WASTE TO ELECTRICITY

48 PASSENGER TRAM AND 100 STREET LIGHTS
12 HOURS A DAY FOR A YEAR

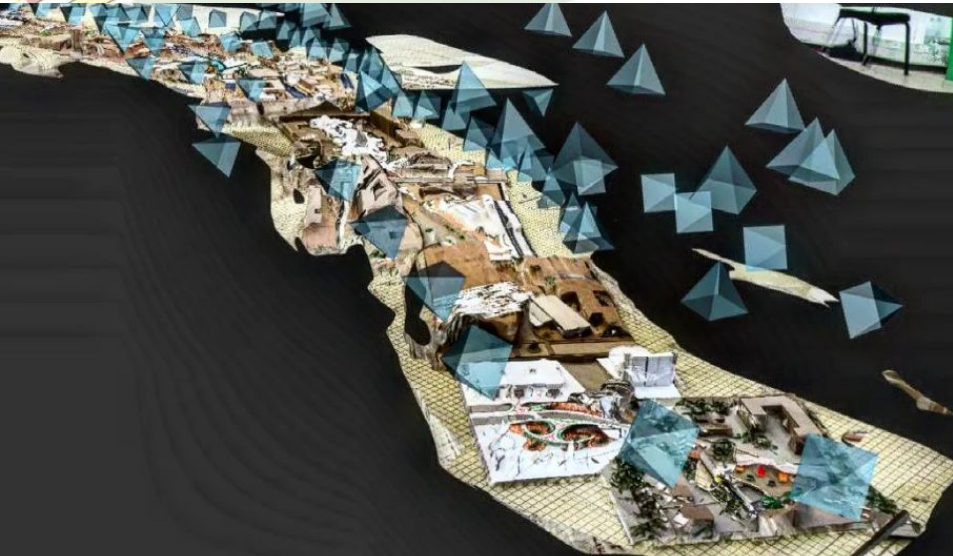
11 093 000 kWh PER YEAR

½ MENLO PARK GREEN WASTE TO ELECTRICITY

21%
UP ELECTRICITY PER YEAR



109



URBAN SQUARE FUTURE STATE



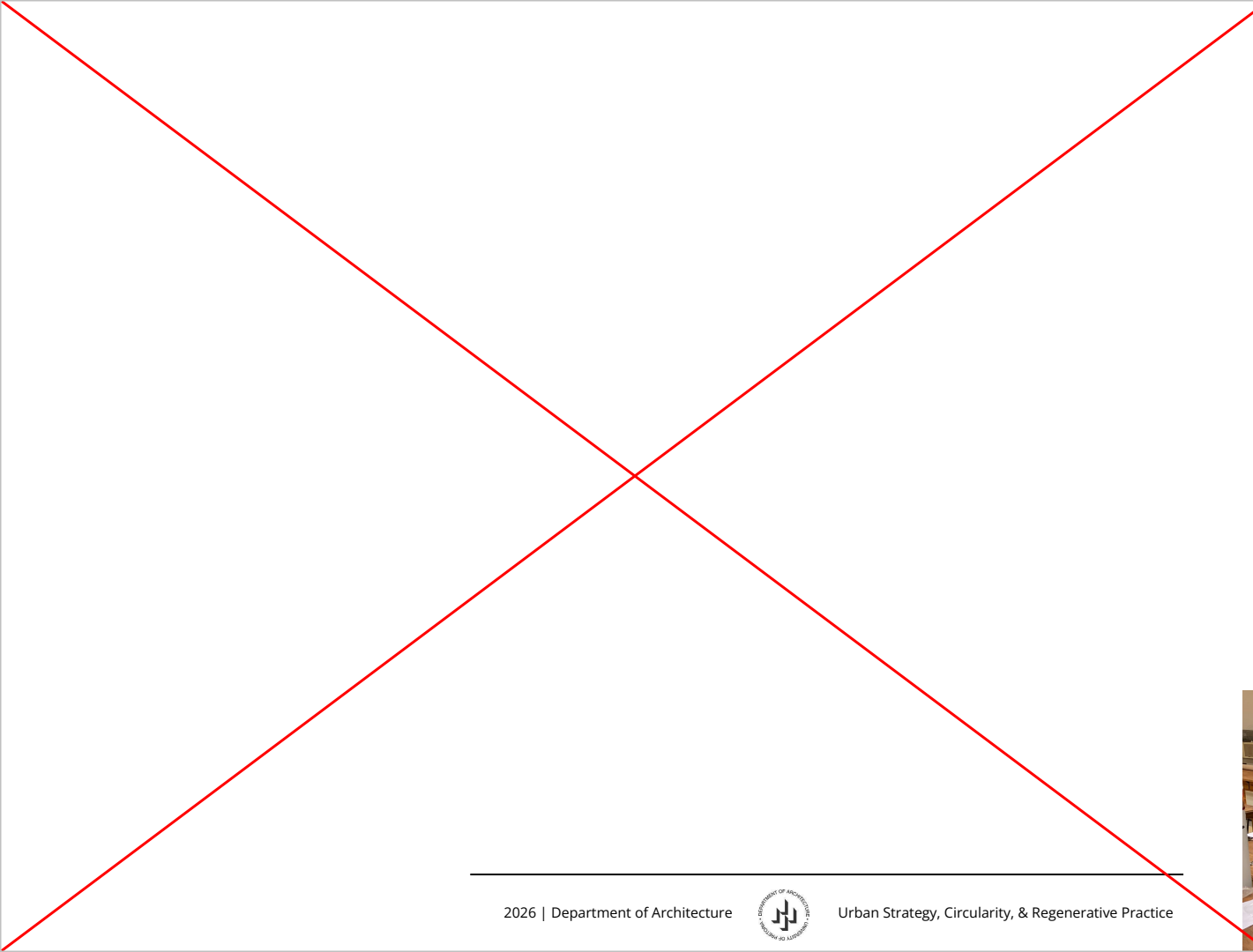
Ivan Cardenas: Masters Thesis

Hatfield: Solid Waste Digital Twin, South Africa

University of Twente, Netherlands with University of Pretoria.

- Awarded 2nd place, 2023 Best Master Thesis on Geo-information Sciences of The Netherlands, *Symposium 20 Years of Geo-Informatie Nederland*.





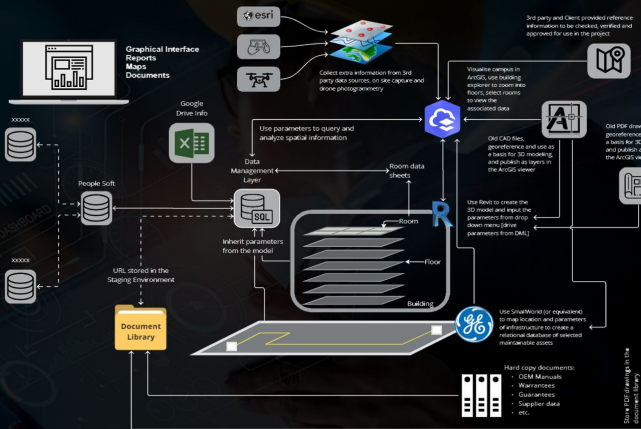
2024



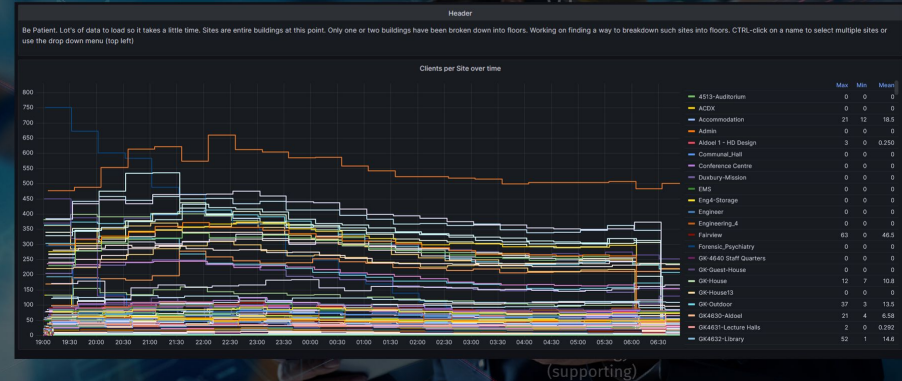
HATFIELD URBAN DIGITAL TWIN CITY

Be patient - work in progress! :-)

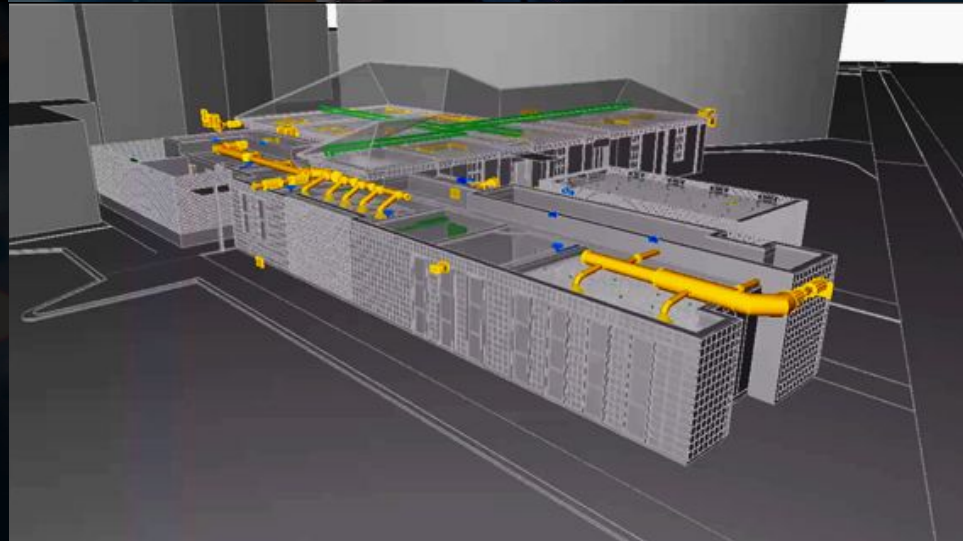
UP FM PROPOSED INFORMATION LANDSCAPE



03 - Live Occupancy Tracking (Wifi)



(supporting)



CASE I: BLIND BILLING IN A "BLACK BOX"

Visual Intelligence Engine

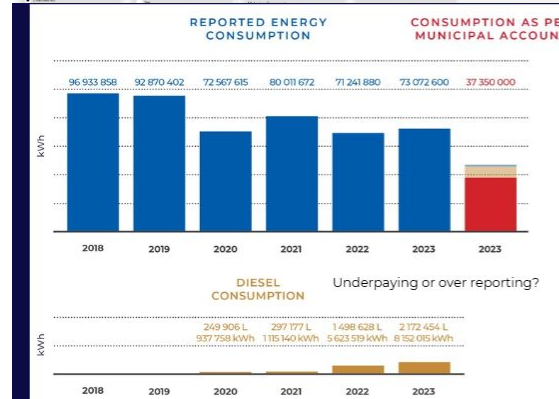
Transforming spatial data into a strategic management layer:

- **Digital Hygiene:** Intensive cleaning and normalization of legacy records.
- **Information Ecosystem:** Moving facilities knowledge from personal laptops to enterprise servers.
- **Unification:** Standardizing 724+ Building (and asset) IDs across all departments and campuses.
- **Title Deed Digitization:** Mapped to 724 footprints to resolve billing leaks.
- **Metering Digitization:** Field workers capture real-time asset data on smartphones.
- **Spatial Relational Overlays:** Linking financial invoices to specific physical coordinates.

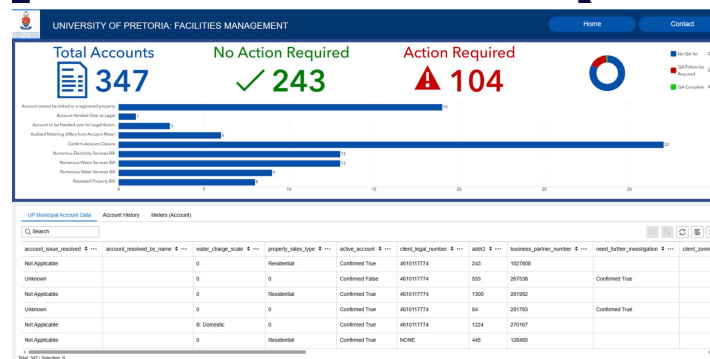
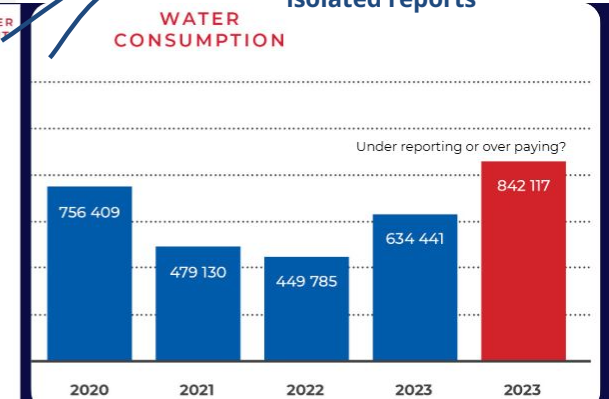


Location-based (GIS) field verification

Desktop studies on isolated reports



WATER CONSUMPTION



Strategic Success

Justified the entire DT project cost in 1 month

[Pretoria](#) [Home](#) [Documents](#) [Pages](#) [Site contents](#)

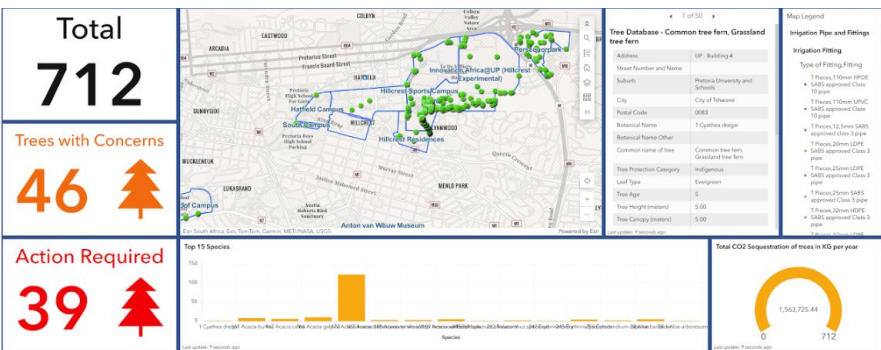
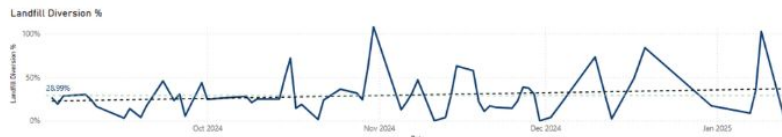
Landfill Airspace m3

Litres Of Oil

Co2

Number of Trees

Litres Water



Managing Dynamic Biological Assets

After Digital Twin, managing natural assets as strategic infrastructure to minimize future liabilities:

- **665 Trees Mapped:** Digital inventory of botanical value (Evergreen vs Deciduous)
- **Physical Metrics:** Canopy width (m) + Trunk girth (mm).
- **Sequestration:** Auto-generated carbon offset coefficients (CO2 KG/year/ species)
- **Seasonal Risk Mitigation:** Targeted pruning + invasive species removal, identifying invasive species + damaged limbs before failure.
- **Maintenance:** Aligning irrigation + care schedules with real biological water requirements.
- **Sustainability:** Evidence-based carbon neutrality planning.
- **Carbon Tax:** Hard + dynamic evidence for Carbon Tax Deductions



UP Green Infrastructure = Forested Estate

SQL DT = Automatic Kg/CO2/year
Sequestration Math



UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Make today matter

www.up.ac.za



SCALING PARTICIPATION IN REGENERATIVE & INNOVATION PRACTICES

2024

The image is a composite of three aerial views of a city, likely from a video game, arranged horizontally. The central portion is a dark, semi-transparent rectangle. Overlaid on this rectangle is a large, white, circular arrow that curves clockwise. In the center of this arrow, the words "Building Strategy Level" are written in a bold, white, sans-serif font. The city views on either side show various buildings, including skyscrapers and colorful structures, with green spaces and water visible. The overall style is that of a modern, stylized city simulation game.

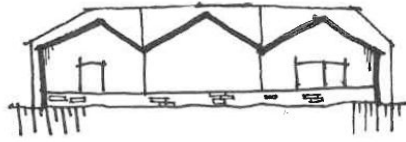
Building Strategy Level



Future Value of Buildings?
What are we going to do with them?



We have built it



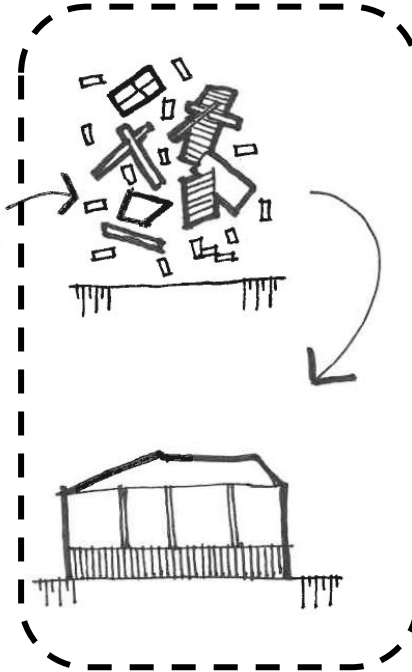
Greenhouse One

Destroy it?!



Greenhouse None

Circulate it!



Disassembly it?

Deconstruct it?

Reuse it?



Architecture

Structural
Engineering

Construction
Economics

Others



Civil
Engineering

Quantity
Surveying

Industry
Partners

UP
Facilities



POSTGRAD RESEARCH 2023

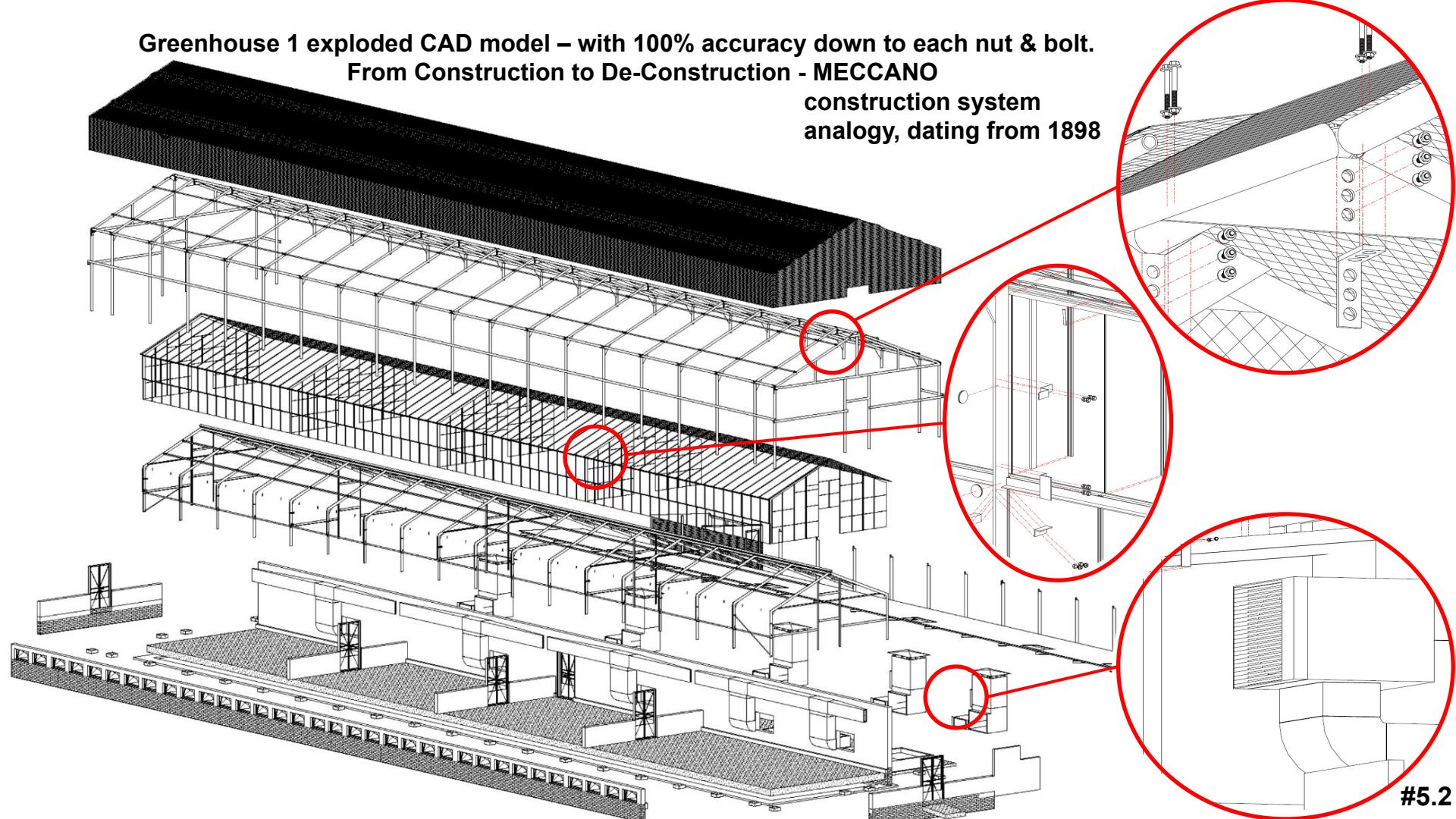
BIM FOR CIRCULARITY & DE/RE-CONSTRUCTION

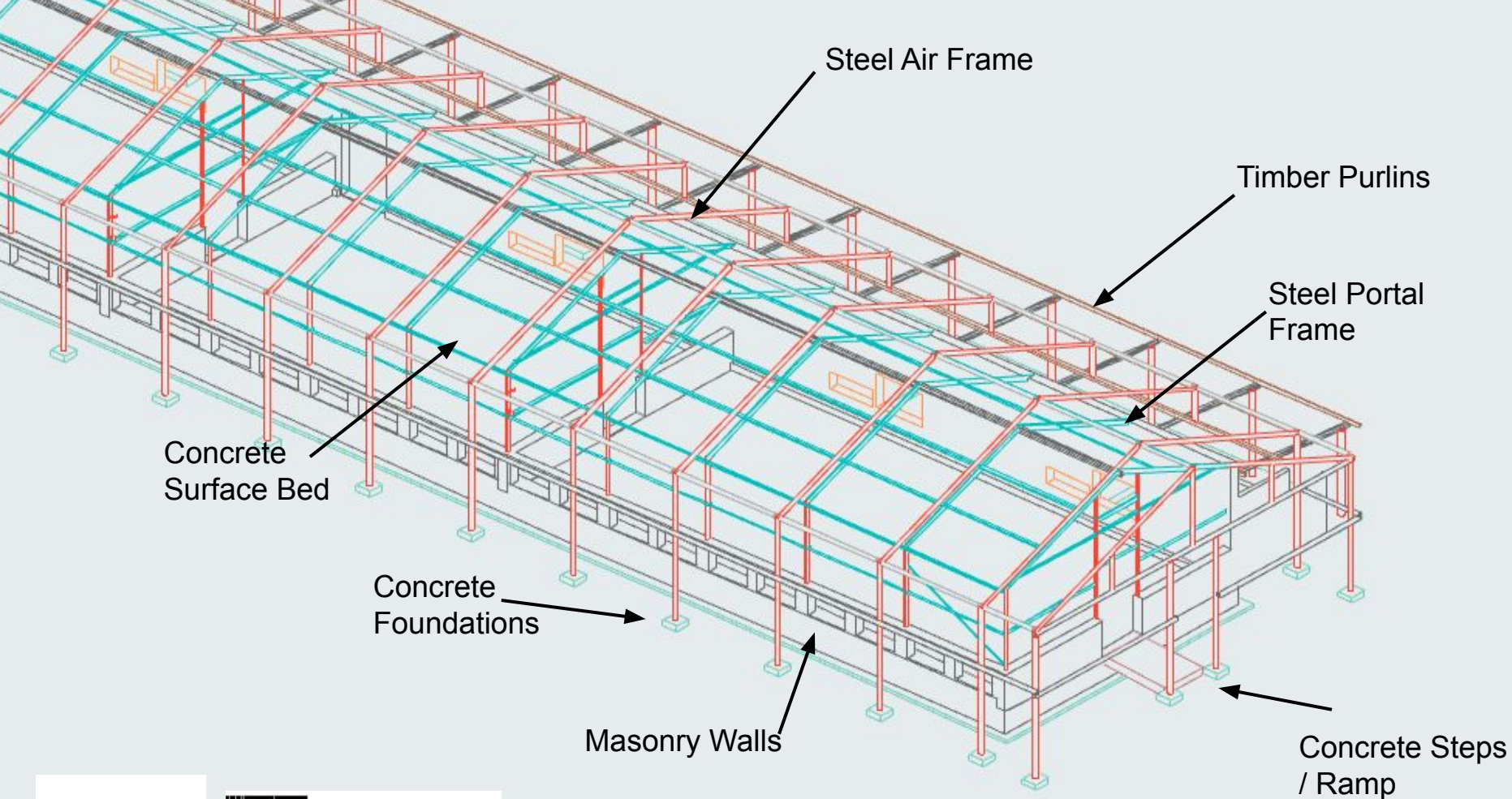
Structural Condition Assessment



**Greenhouse 1 exploded CAD model – with 100% accuracy down to each nut & bolt.
From Construction to De-Construction - MECCANO**

**construction system
analogy, dating from 1898**





Condition Assessment



Using new tools



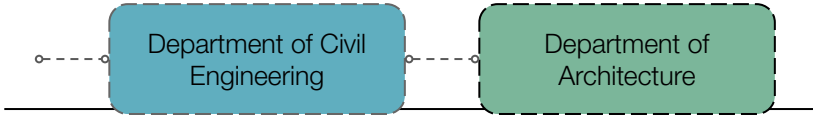
Determining structure



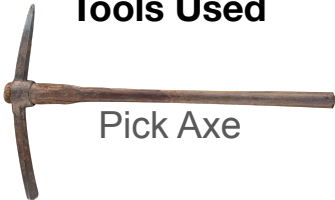
Analysing elements

Site Visit- 05/05/2023

DATA COLLECTION



Tools Used



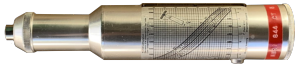
Pick Axe



Shovel



Steel Rod



Schmidt Hammer



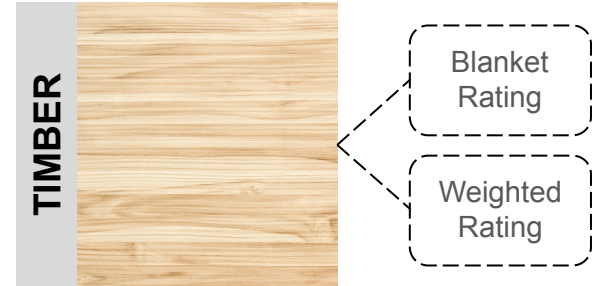
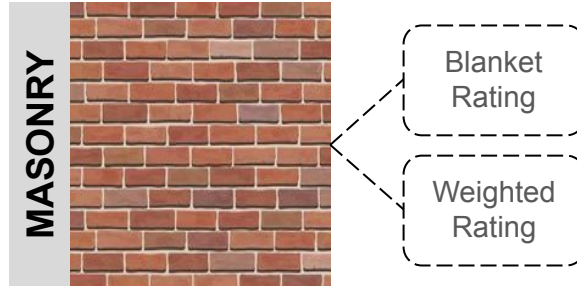
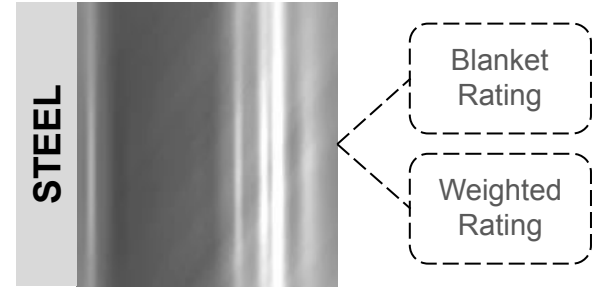
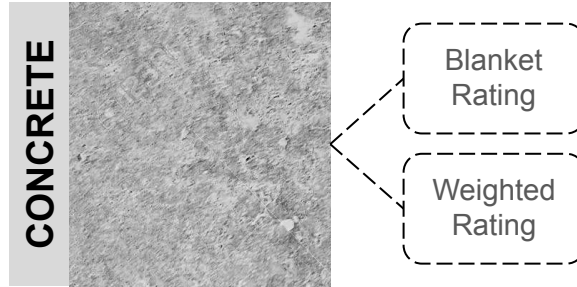
Measuring Tape



Our Eyes

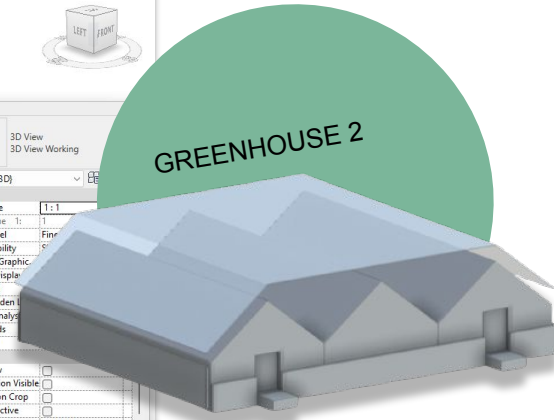
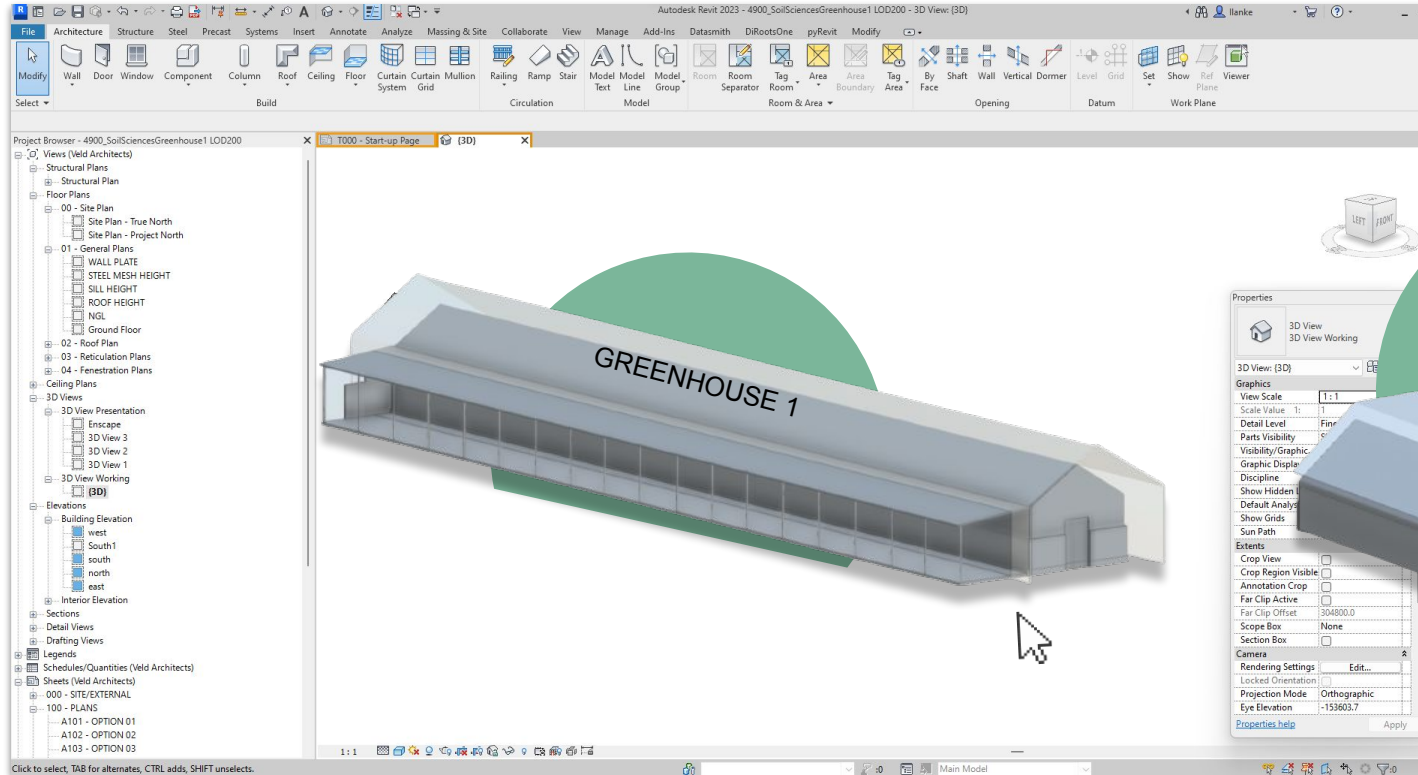
CONDITION RATING	CONDITION	ACTION REQ'D
5	Very Good	Planned Preventative Maintenance
4	Good	Condition-based Maintenance
3	Fair	Repairs
2	Bad	Rehabilitation
1	Very Bad	Replacement

(Abbott et al., 2007, pp. 352)



Preliminary structural & material assessment

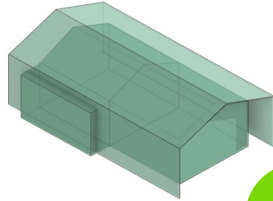
Project, Tools, and Models **change**. So too, do our **roles**.



Creating **Intelligence** requires... **Intelligence**

Where are we in
**BIM INFO
GATHERING**

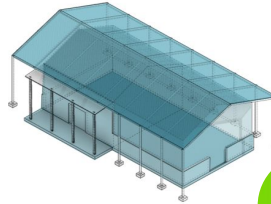
LOD100



BIM

Info&Schedules : Material types
and qualities

LOD200



Info&Schedules : Material types
And elevation component
classification

LOD300



Info&Schedules :
Material types
And elevation material
classification on exterior and
interior

MODEL

Model :Basic Block model



Model :Model elevations to be
detailed on exterior



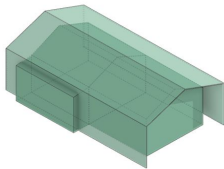
Model :Model elevations to be
detailed on exterior and interior
and LiDAR



Intelligence is a **collective effort**

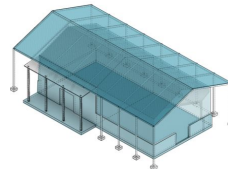
LOD100

	Material	Blanket	Weighted
GH1	Steel	3.0	3.1
	Concrete	3.0	3.5
	Masonry	3.0	2.5
	Timber	2.0	2.0
GH2	Steel	3.0	3.8
	Concrete	3.0	2.8
	Masonry	3.0	3.0
	Timber	2.0	2.5



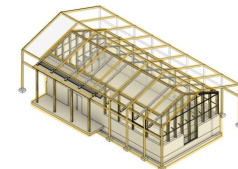
LOD200

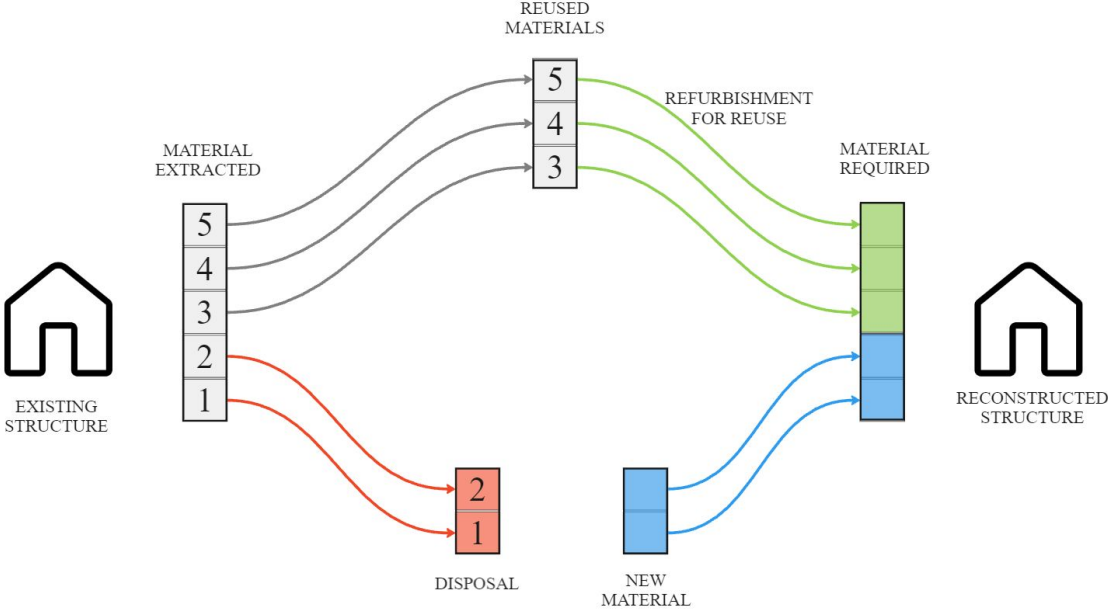
	Material	Blanket	Weighted
GH1	Steel	3.2	3.1
	Concrete	3.0	3.1
	Masonry	2.5	2.7
	Timber	2.0	2.0
GH2	Steel	4.2	3.9
	Concrete	2.8	2.7
	Masonry	3.2	3.0
	Timber	2.0	2.0



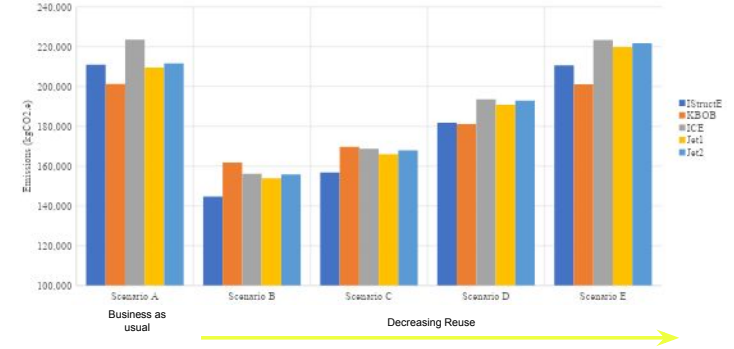
LOD300

	Material	Blanket	Weighted
GH1	Steel	3.1	3.0
	Concrete	2.9	3.1
	Masonry	2.8	2.8
	Timber	2.0	1.5
GH2	Steel	3.0	3.0
	Concrete	2.7	2.4
	Masonry	3.6	3.6
	Timber	2.3	2.5

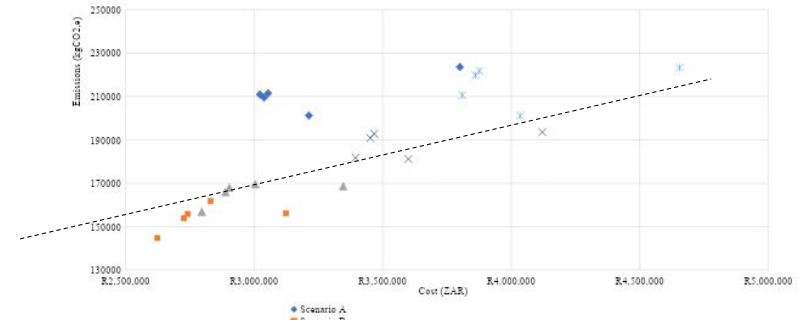




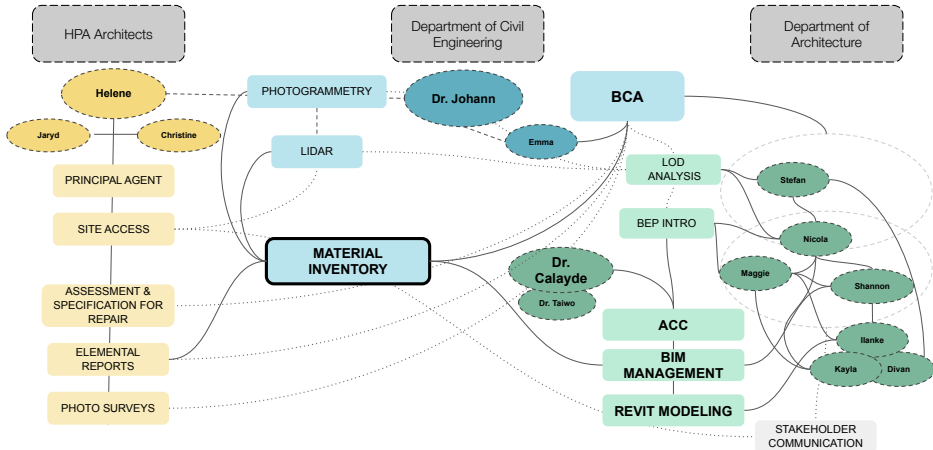
Case Study Comparisons: kgCO₂e



Case Study Comparisons: Cost



On average, it can be seen that increased reuse resulted in **lower costs** despite increased costs associated with deconstruction's additional fuel and labor.





Circularity is one of the drivers of
Regenerative Purpose-Driven Cities

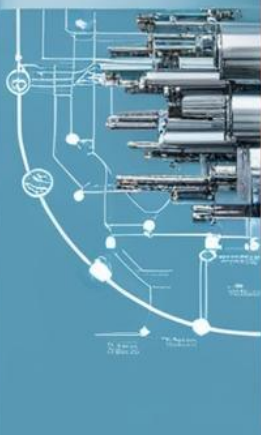
Laboratory for the 6IR



**FOURTH
INDUSTRIAL
REVOLUTION**



4IR



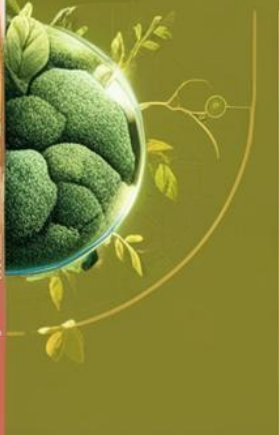
4IR+ 5IR



5IR+



6IR

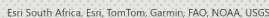


**SIXTH
INDUSTRIAL
REVOLUTION**



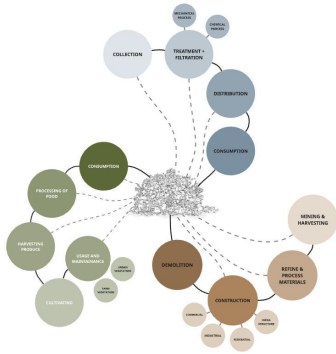
- Dep. Forests and Fisheries
- (Forests, commercial farming, wetlands, plantation forests, etc)

- contiguous (indigenous) forest
- contiguous low forest & thicket
- dense forest & woodland
- open woodland
- contiguous & dense plantation forest
- open & sparse plantation forest
- temporary unplanted (clear-felled) plantation forest
- low shrubland (other)
- low shrubland (fynbos)
- low shrubland (succulent karoo)
- low shrubland (nama karoo)
- sparsely wooded grassland
- natural grassland
- natural rivers
- natural estuaries & lagoons
- natural ocean & coastal
- natural lakes
- natural pans (flooded @ observation times)
- artificial dams (including canals)
- artificial sewage ponds
- artificial flooded mine pits
- herbaceous wetlands (currently mapped)
- herbaceous wetlands (previously mapped)
- mangrove wetlands
- natural rock surfaces
- dry pans
- eroded lands
- coastal sand & dunes
- bare riverbed material

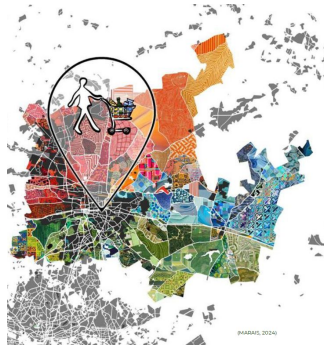


Dataset 2

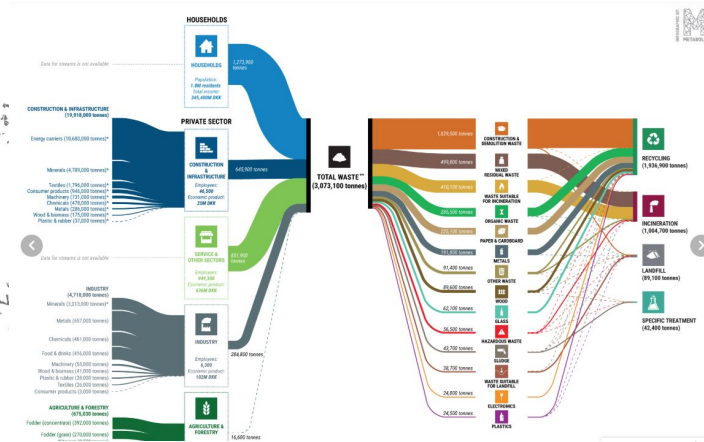
Potential of the Provincial Agricultural Systems



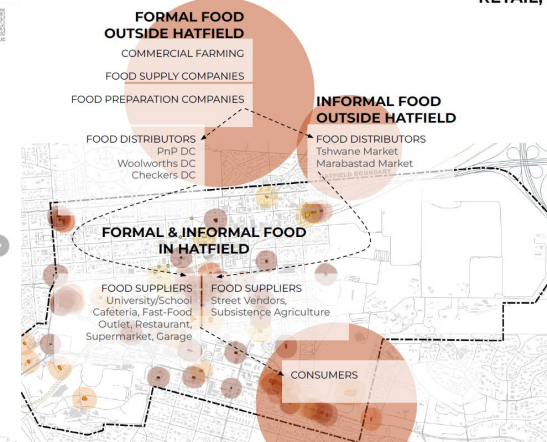
Circular Systems



GIS data

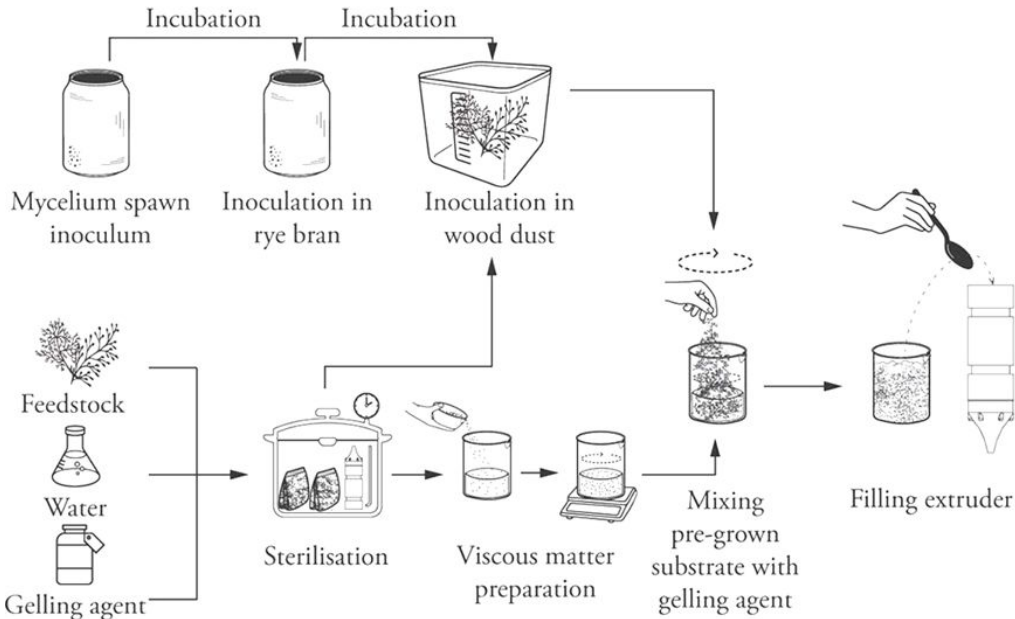


Agricultural Resource Translation Potential

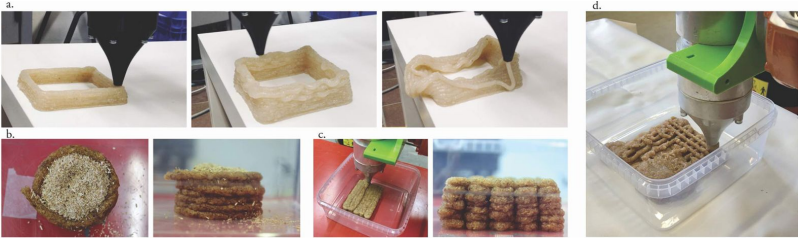


Contextual Built Environment Applications

Additive Manufacturing with MBCs



An MBC extrusion material preparation (Elsacker, Peeters & De Laet 2022)



Various extrusion support methods (Elsacker, Peeters & De Laet 2022)



The growth process of various extrusion patterns (Elsacker, Peeters & De Laet 2022)

Inoculation Stage

Most commonly used:
Rye bran



Growth Stage

Most commonly used substrates:

- **Sawdust.** Excellent structure and nutrient source
- **Straw (Wheat, Barley, Oat, Rice).** Lightweight and abundant
- **Corn Stalks & Husks.** High cellulose content; good binding properties
- **Hemp Hurds.** Naturally mold-resistant and strong
- **Cotton Waste.** Good for fine-textured composites

Research has shown that various substrates have influence on the material properties of the MBC, such as acoustic or thermal performance. **Sawdust** has the best mechanical performance

Extrusion Stage

Most commonly used gelling agents:

- **Agar.** Most common; strong gel structure, biocompatible
- **Gelatin.** Readily available but sensitive to temperature
- **Alginate.** Biodegradable and highly adaptable
- **Pectin.** Plant-based alternative with good binding properties
- **Xanthan Gum.** High viscosity, improves printability composites

New research is promising on:

- **Psyllium Husk**
- **Corn Starch**

A 50/50 mixture of these has been demonstrated as the best for AM extrusion.



Polylactic Acid Printing - current installations



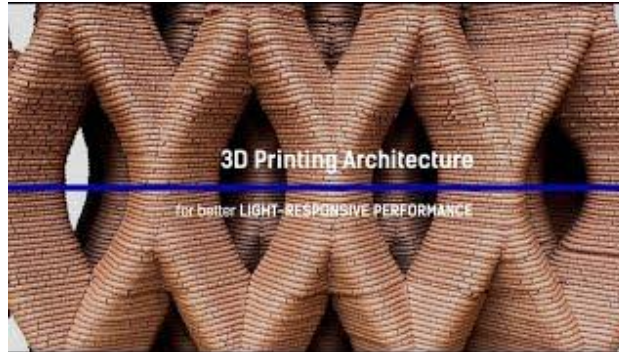
CONIFERA: A 3D-PRINTED FOREST IN THE HEART OF MILAN



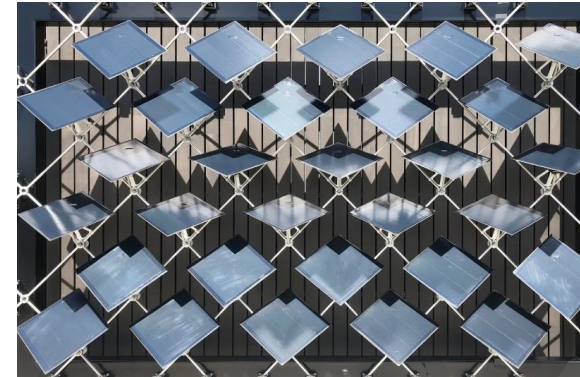
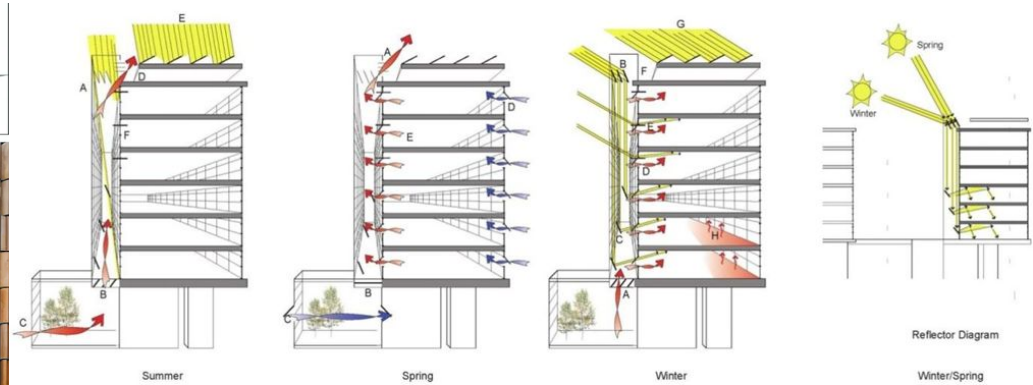
MELLIFERA: THE DANCING BEE HIVES OF INNOVATION



THE ROOF GARDENS LIFT: ELEVATING URBAN ELEGANCE



Polylactic Acid Printing - Facade design



WATER HYACINTH CRAFT

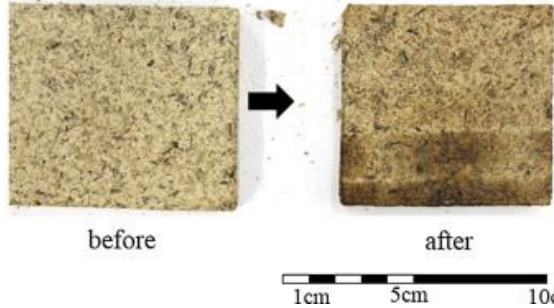


WATER HYACINTH CONSTRUCTION

S-panels



P-panels



(a)



(b)



(c)



(d)

ADDITIVE MANUFACTURING OPPORTUNITY: WATER HYACINTH-CEMENT COMPOSITE for panels + bricks

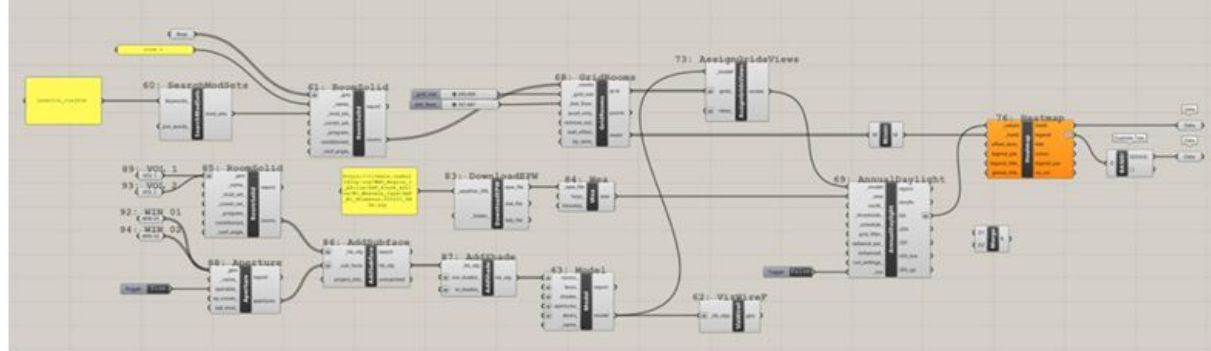
WATER HYACINTH FIBRE BOARDS
WATER HYACINTH INSULATION

DIT 2026 (masters research)

200k tonnes/year
= absolute waste from
the Cape wine industry

Translation for built
environment application

-> transform “waste” for
additive manufacturing
(3d printing) for
**high-performance,
context-based,
bio-based facades**



An aerial, isometric view of a vibrant, futuristic city. The city is composed of numerous colorful, blocky buildings and structures, suggesting a digital or game-like environment. A prominent rainbow-colored building is visible in the upper left. The city is interspersed with green spaces and blue water bodies. A large, semi-transparent black rectangle is centered over the image, containing white text.

**If Africa is going to
build the most cities of
the future...**

**lets build them
circular + regenerative**



Thank you!

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Graduate Built Environment

Graduate Design & Urban Strategy
Urban Strategy & Built Environment Innovation
Built Environment Professional Practice

Fields

Urban Strategy & Environmental Design | Strategic Planning
Lean Design & Construction | Lean Organizational Management