U.S.E.S Conference

Nakuru, Kenya.

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Faculty of the Built Environment

Uganda Martyrs University

ELITH

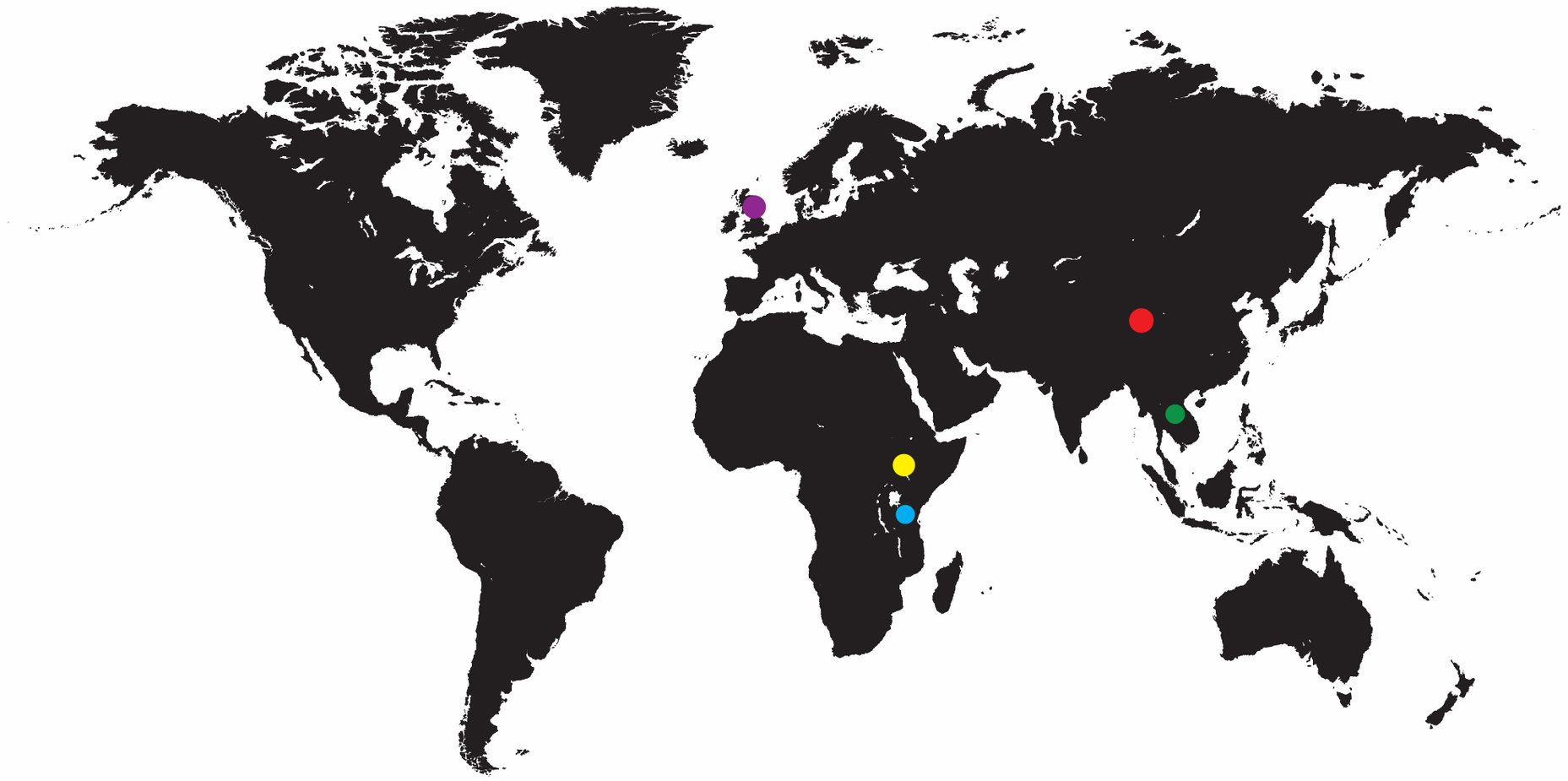
Energy in Low Income Tropical Housing

2013 - 2016

- **Embodied Energy;**
- **Operational Energy;**
- **Urban scale Energy;**
- **Processes and Policy.**

Partner Locations

Energy and Low Income Tropical Housing

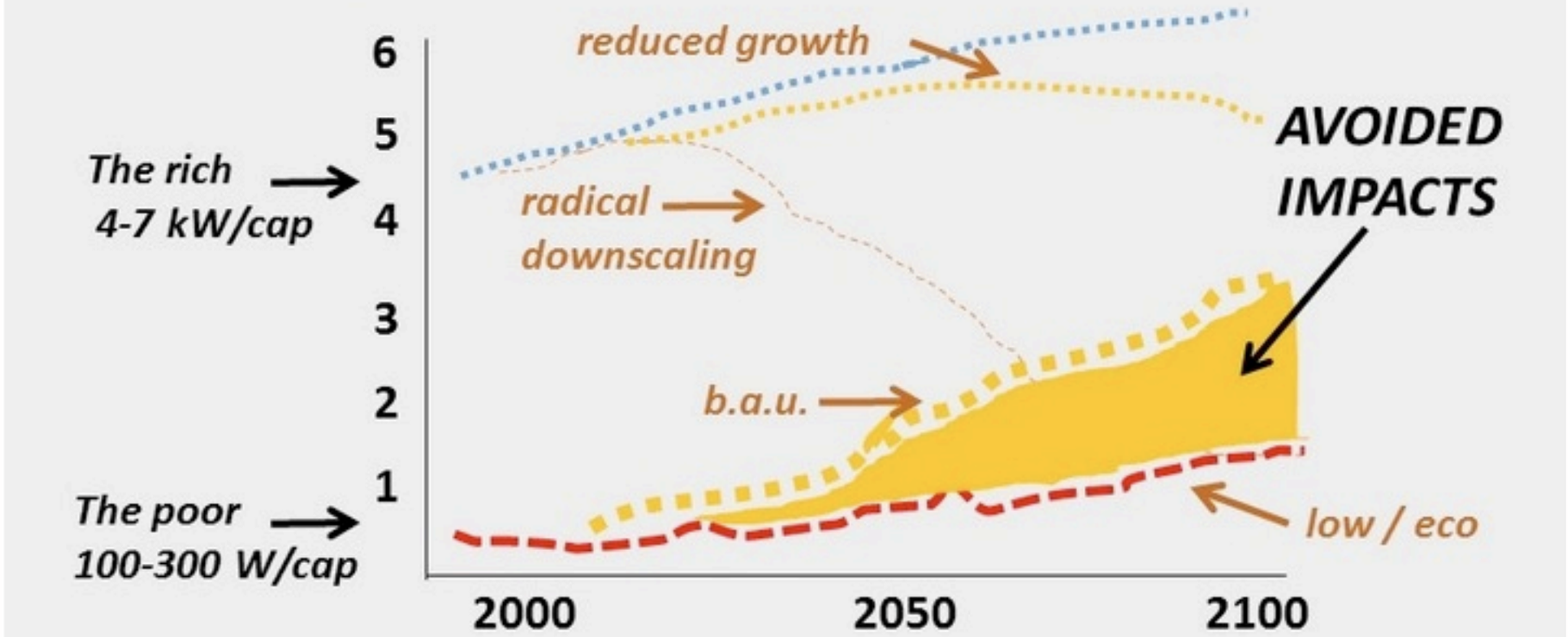


- The University of Cambridge, The University Of Warwick
- The University of Nottingham, Ningbo China
- Uganda Martyrs University, Nkozi
- National Housing and Building Reasearch Agency
- King Mongkuts University of Technology Thornburi

Contexts of Action

ENERGY, RESOURCES AND CLIMATE EMISSIONS:
ABSOLUTE REDUCTIONS VERSUS AVOIDED IMPACTS

In order to improve life quality, the poorest must have access to and consume MORE energy and resources. But by using the best, lowest impact solutions, their development impact could be limited to 1-2 kW/cap (low / eco) instead of growing (b.a.u.) towards present western levels of 4-7 kW/cap.



- ://warwrick.ac.uk/fac/sci/eng/elith/

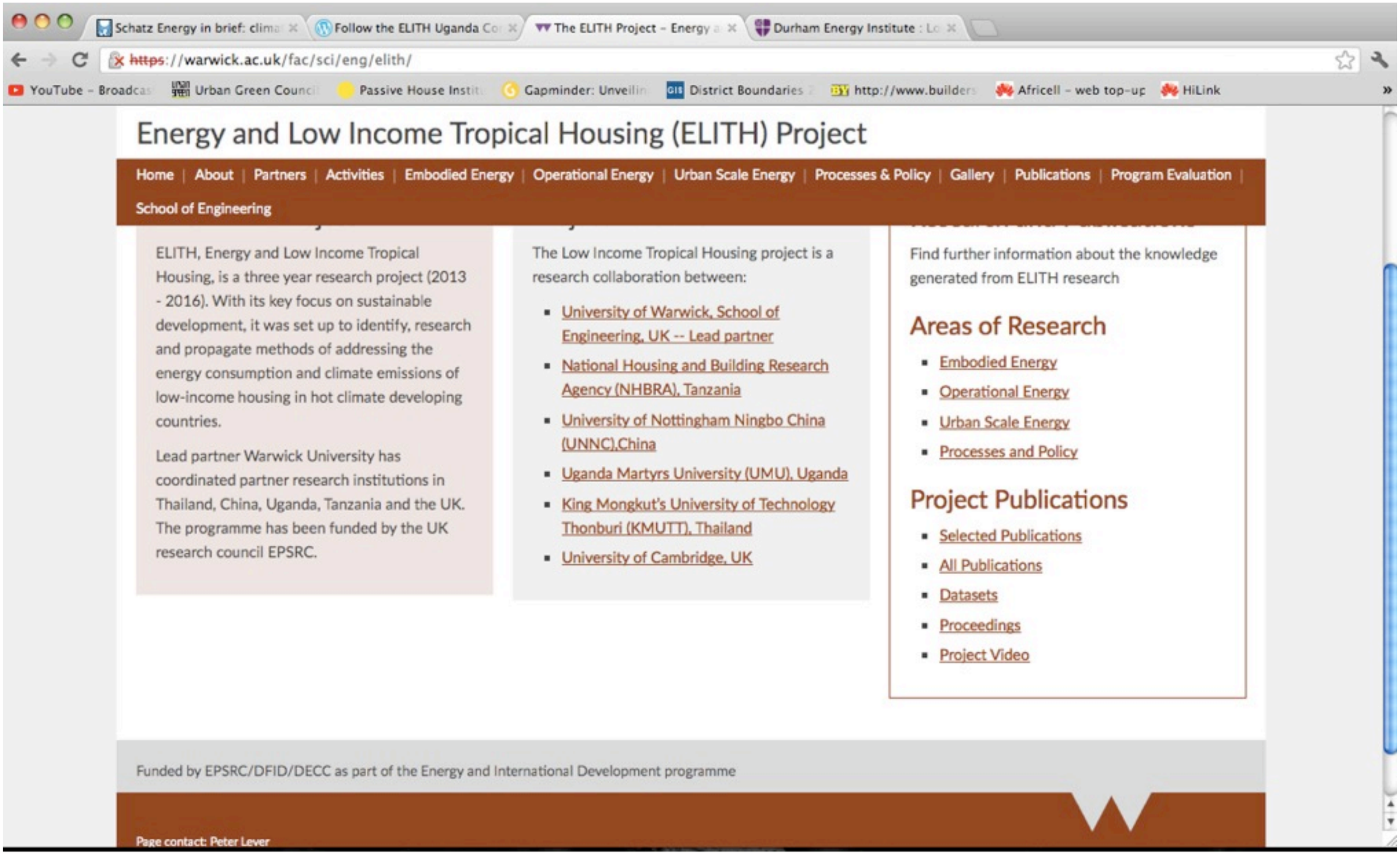
Project Team Composition

- Diverse leanings and output based on discipline, country and specific interests.

- Physicists, Engineers and Architects across Thailand, China, England, Tanzania and Uganda.

- Interests: energy and simulation studies, materials/technology, Life Cycle Assessment (embodied and operational energy), urban design, neighbourhood design and the architecture of dwellings

- **https://warwick.ac.uk/fac/sci/eng/elith/.**



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Sustainable planning: the dynamics of change

To ensure a sustainable project, all four of the actor groups must be included in the planning and project organisation – as well as in the lifetime management.

The dynamics and processes of change: sustainable building almost everywhere has identified and pursued four difficult but essential processes:

1. From segregated spatial zoning of cities to mixed use districts

2. From specialised to integrated design and planning - also a key to lower costs,

3. From uncontrolled construction to *voluntary* energy efficiency guidelines and then on to *mandatory* standards and codes for environmental quality

4. From private-public contradictions to a win-win modus with better cooperation.

Process planning: four critical agents of change

Chris Butters, Warwick University UK ***ELITH Research Program, 2015***

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SPACE COOLING STRATEGIES: GENERIC PRIORITIES

	A. HOT DRY	B. HOT HUMID
BASIC PASSIVE	**Minimise solar incidence** (shape, colour, shadings, veg...) **Maximise air movement** (location, shape, openings, veg) **Plan, section** **Thermal mass**	Minimise solar incidence (shape, colour, shadings, veg...) Maximise air movement (location, shape, openings, veg) Section (mass? ... ...
SPECIAL PASSIVE	**Water** **Wind towers** **Evaporative cooling** **Solar chimneys**	
BASIC ACTIVE	**Ceiling fans** **WInd cowls**	Ceiling fans Wind cowls
HI TECH ACTIVE	**Humidifiers, AC ...** **District cooling**	Desiccants, AC ... District cooling
	whenever supply side: renewables	whenever supply side: renewab

Chris Butters: Design Principles for Cooling. There are fewer options in hot climates

- ://warwrick.ac.uk/fac/sci/eng/elith/

Scope, Team

UMU FoBE staff team:

- Alex Ndibwami, Researcher (Team Leader)
- Dr. Mark Olweny, Researcher
- Thomas Niwamara, Research Assistant
- Herbert C Drazu, Research Assistant
- Achilles Ahimbisibwe, Parttime Research Assistant
- Conrad G Kazoora, Parttime Research Assistant

Housing, Energy, Carbon

Objectives

- Measure operational-energy in current housing;
- Develop ways of reducing housing-use energy and costs on building services and appliances;
- Review and develop passive design strategies in tropical housing
- Measure embodied energy in materials
- Develop ways of reducing embodied energy in materials
- Identify ways of improving rural building materials production in Africa

Schatz Energy in brief: clima | Follow the ELITH Uganda Co | The ELITH Project – Energy a | Durham Energy Institute : Lo

https://elithumu.wordpress.com

YouTube – Broadcas | Urban Green Council | Passive House Institu | Gapminder: Unveilin | District Boundaries | http://www.builders | Africell – web top-up | HiLink

Follow the ELITH Uganda Conversations here…

The site is a continuous update of the activities undertaken by the ELITH project at The Faculty of the Built Environment, Uganda Martyrs University Nkozi.

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VERNACULAR ARCHITECTURE: Advocating Volcanic Stone Construction as a Viable Alternative to Fired Brick in Mountainous Areas of Southwestern Uganda.

Posted on May 30, 2017

Keywords: Vernacular, Stone Construction, Sustainable development

The following discussion presents volcanic stone as a viable walling material in areas where it is abundant. Kisoro, Fort Portal and Bushenyi located in Southwestern Uganda are areas endowed with abundant volcanic stone. However, area residents still opt for brick walling despite the poor soils in those areas. The poor soils produce lower quality bricks compared to the fired clay brick from other areas especially around the Victoria basin. Natural stone possesses physical properties suited for structural walling yet in Uganda it is habitually specified for its aesthetic finish *(floor surfacing and wall cladding)*. In comparison to Compressed Earth Block (CEB) and Compressed Soil Blocks (CSB), stone has not been explored enough as a potential front-runner among sustainable walling alternatives. Further, little is being done to empower local communities to meet their own aspirations as industry, economics and urban development conspire to interrupt the transition to sustainable development particularly with regards to how environmentally unfriendly materials like fired brick are propagated.

The use of stone in construction is not completely alien to our context. According to Nnamdi (1997), stone construction in Africa dates ba
10,000 years ago. In fact, Shadmon (1996) writes that Stone was used for construction way before man ever started using metallic tools.

Follow

- https://elithumu.wordpress.com

Key Statistics on Housing in Uganda

- Population growth @ 3.2% | Urbanisation @ 5.2%
- 7.3 million Households | 6.2 million housing units | 4.7 persons per household
- Backlog: 710,000 units overall | 900,000 units as result of substandard housing
- Annual need: 200,000 units = 135,000 Rural and 65,000 Urban

Main causes of the housing deficit in Uganda

- The cost of providing utilities/infrastructure
- Borrowing rates
- Cost of building materials
- The cost of land
- Prohibitive government investment models among others financing and policy issues
- The distortion in FOREX

Major Findings, Key Impacts And Communication Strategies

- ‘Informality’ for majority; professional services lacking
- Joint efforts made target small sample, multiply at slow rate. Led by NGO and CBOs with links to Local Government and Communities. Links created fail in having a **multiplier effect** or visible **uptake rate** - restrained capacity or poorly conceived models that do not encourage self driven uptake at community level. At commercial scale, pricing is generally out of touch with what people can actually manage. Price of property is escalated by Government’s failure in its overall strategy and key infrastructure like roads, water supply and access to electricity. Security of tenure can only be overemphasized - results in either tenements or self built, often inadequate and assembled of out of what is available, accessible and simply what works(?).

Housing, Resultant Consequences

A lot of housing is poorly **lit** or poorly **ventilated**; insufficient or inefficient **spaces**; lack of or inadequate **sanitary facilities**; and often built through **questionable processes** - **material wastage** and little thought on the implication of the **production processes** on the **environment**.

Situation today has not been informed by the studies and policy discourse that date as far back as the 1970s and 1980s by John Turner among others and even more recent studies.

Implementation Streams: Skilling

- *Expanded research collaborations and consultancy to include:*

- Belgian Technical Corporation - student housing design
- Building Tomorrow - student housing design
- Haileybury Youth Trust - dissemination/diffusion studies
- Ministry of Energy and Mineral Development - Reviewing the 2002 *National Energy Policy*
- Ministry of Works and Transport - *Developing a Building Code for Uganda.*
- A database of interested professionals

- Reinforced/Improved the existing and introduced support courses to the FBE curriculum
- Design Build student projects

Implementation Streams: Skilling

- Housing deficit: Registered the state of affairs through community surveys
- The Building Control Act: Developed and constantly improving tools for peer/self evaluation
- The Machakos East African Schools of Architecture Resolution on Environmentally Conscious Design in Curricula: Presented the benefits of good practice
- The Uganda National Housing policy: Unpacking familiar concepts - wood fuel use, bases for selection of wall materials and aspirations
- Regional Centre of Expertise - Greater Masaka (UMU), A number of technical institutions in the country: Engaging in key policy and regulatory stakeholders.

Siting	
The stream is concerned with issues of locating and laying out a building in its environment.	Site use/ Site planning Building configuration Lanscaping

Fenestrations	
The purpose of this unit is to present design considerations in the disposition of windows and exterior openings.	

Efficient square metres	
Appropriate space planning aims to provide maximum housing benefit from limited resources while dealing with aspirational concerns within fair limits.	Form Space

Transition spaces	
This stream identifies opportunities presented by adjacencies of spatial functions.	Outdoor transitions Indoor transitions

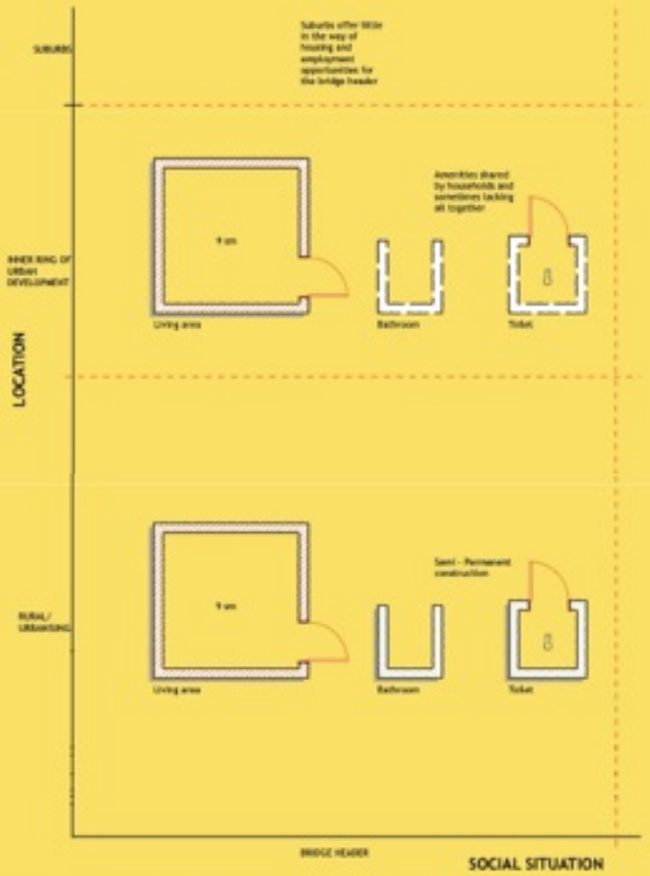
Materials	
Building materials constitute more than half of the cost of low income housing. This stream prsents various issues for considerationin material deployment.	

Housing is an aspirational construct across social statuses. Key to the provision of diverse solutions is acknowledging that while construction/building can be improved in terms of cost and embodied energy, it needs to deal with its site and socio-cultural issues: and this can happen in the context of design procurement options and construction approach.

Procurement/Propagation

Scope and Objective

The objective of this stream is to share knowledge about and skills necessary for social or socio-economic engagement in as far as they influence attitudes toward procurement and propagation of materials/ technology. The stream captures best practice examples moving in the direction of participatory and socially-driven planning, informed by key stakeholder engagement, local context and culturally aware processes that empower end users all the while improving the building construction process.



Dwelling environments provide three basic functions: location, tenure and amenity. The level of importance of these in relation to each other is dependant on the level of social economic security achieved. Three social situations (Turner, 1968) are identified which roughly parallel income: the lowest income is the 'bridge header' seeking a toehold in the urban system. The second is the 'consolidator' who has obtained a relatively firm hold but is in danger of losing it unless he can consolidate his newly achieved socio-economic status. The third level is the higher income 'status seeker'. These three can be compared according to their priorities in terms of location, ownership, and amenity, rated according to the level of need.

Increased competition for scarce resources in urban areas leads to a higher level of improvision and restriction in built space.

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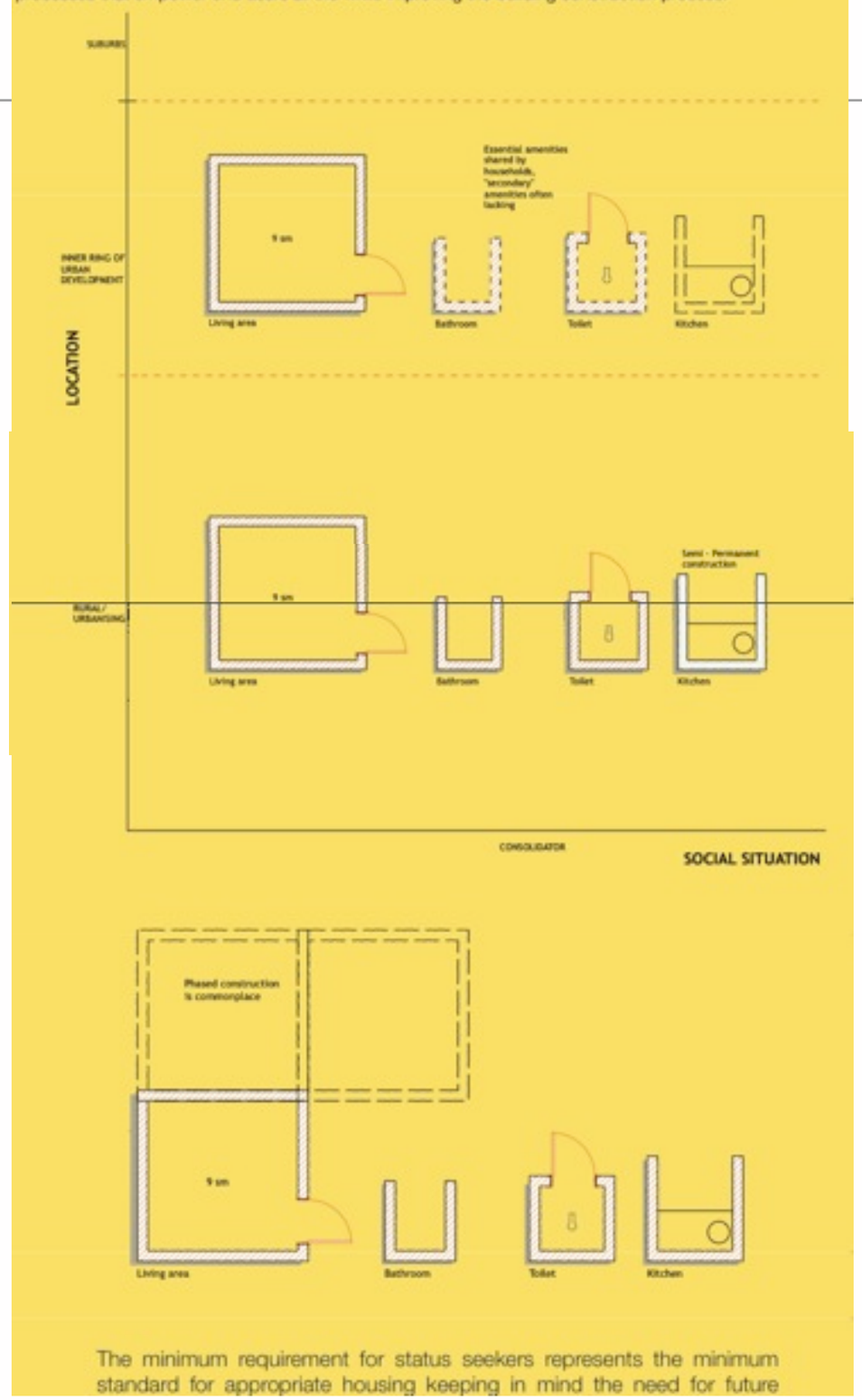
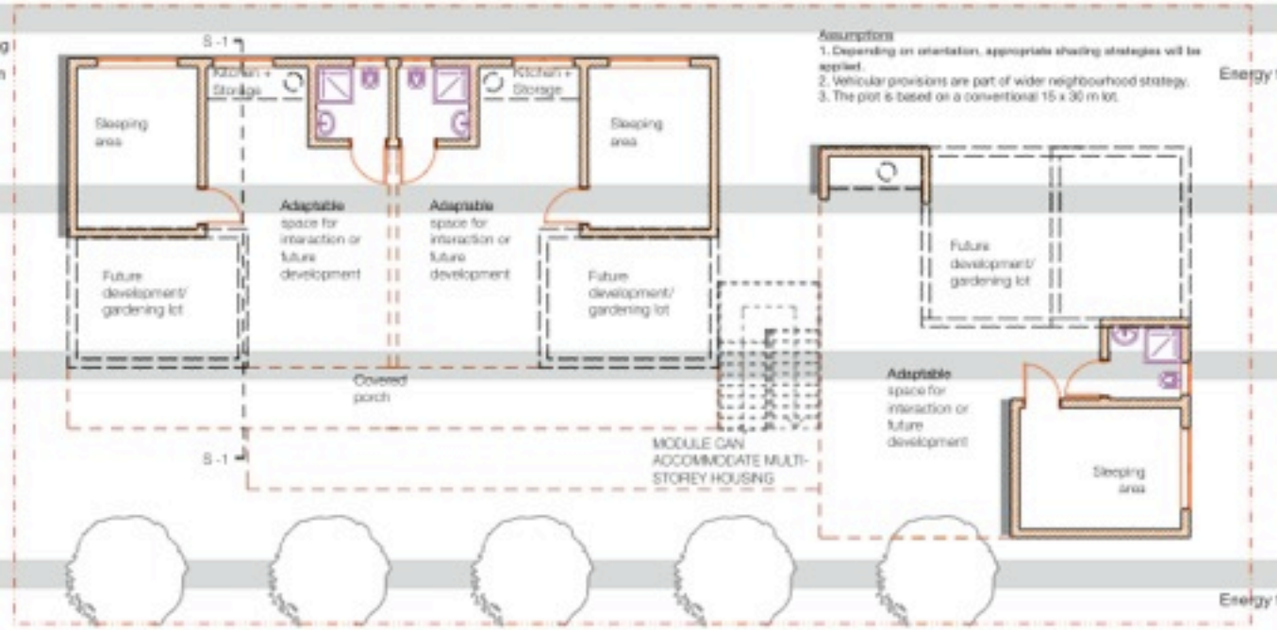


The minimum requirement for status seekers represents the minimum standard for appropriate housing keeping in mind the need for future

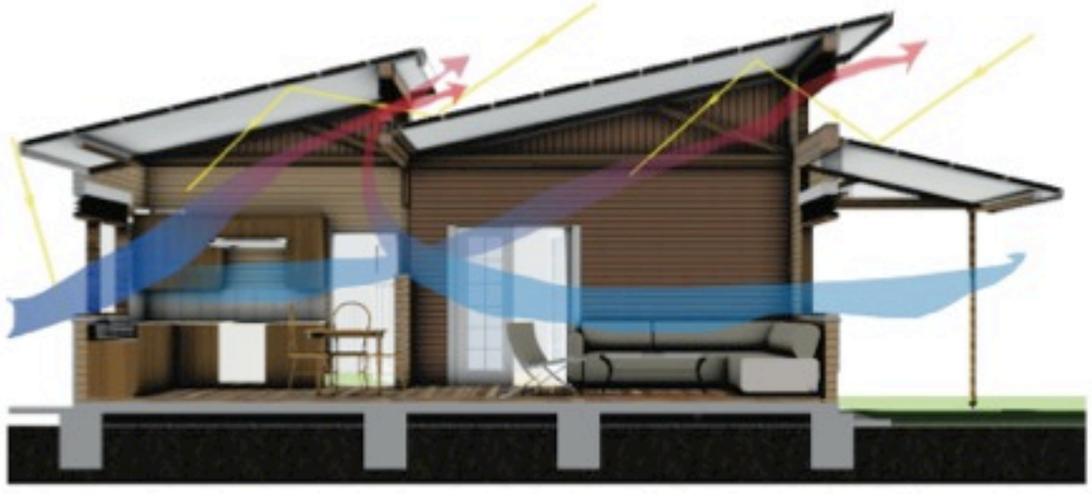
DESIGN AND CONSTRUCTION STRATEGIES

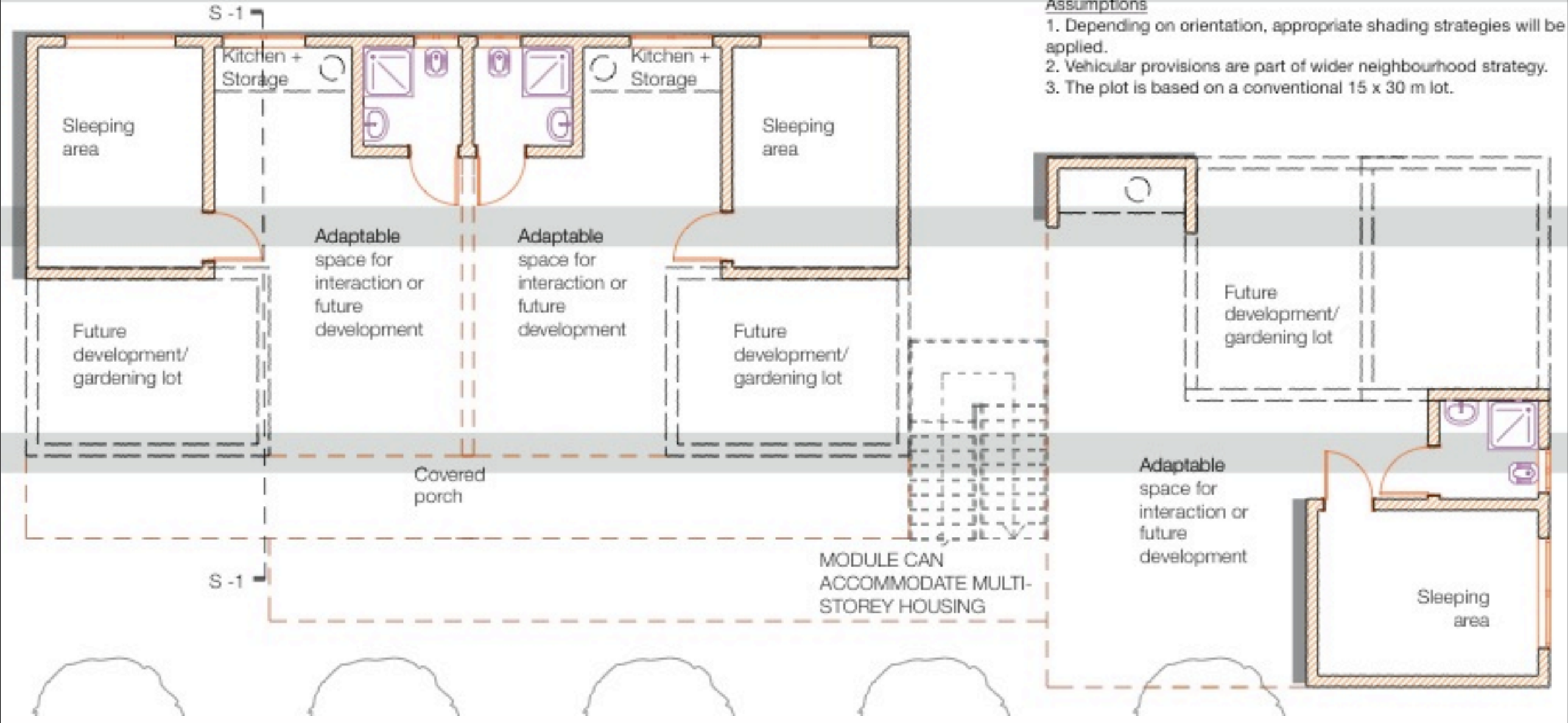
Housing is an aspirational construct across social statuses. Key to the provison of diverse solutions is acknowledging that while construction/ building can be improved in terms of cost and embodied energy, it needs to deal with its site and socio-cultural issues; and this can happen in the context of design, procurement options and construction approach.

CONSIDERATIONS		PRE-CONSTRUCTION	DESIGN/CONSTRUCTION OPTIONS	POST-CONSTRUCTION			
		EMBODIED ENERGY	COSTS	OPERATIONAL ENERGY	SAVINGS	GAINS	RISKS/ GAPS
Siting							
The stream is concerned with issues of locating and laying out a building in its environment.	Site use/ Site planning			Energy for cooling		Green space/ Outdoor living	
	Building configuration				Materials		
	Lanscaping					Quality of life	
Fenestrations							
The purpose of this unit is to present design considerations in the disposition of windows and exterior openings.					Energy for cooling	Day lighting	
Efficient square metres							
Appropriate space planning aims to provide maximum housing benefit from limited resources while dealing with aspirational concerns within fair limits.	Form				Materials		
	Space					Volume of space and associated enviornment benefits.	
Transition spaces							
This stream identifies opportunities presented by adjacencies of spatial functions.	Outdoor transitions			Energy for cooling		Outdoor living	
						Privacy	
	Indoor transitions					Privacy	



Materials					
Building materials constitute more than half of the cost of low income housing. This stream presents various issues for consideration in material deployment.	Raw material sourcing			Cost reduction	Environmental protection
					Job creation for local people
					Reduction of money/ foreighn exchange outflow
	Transportation	CEB - 0 Kj			CEB requires weather cover and periodic maintenance.
		SCEB - 25.3 Kj/ km/ s.m			SCEB requires high level of quality assurance at the production phase for benefits to be meaningful. Block making equipment is costly but the costs can be brought down depending on procurement options as part of mass housing or community partnerships.
		Brick - 268 Kj/ km/ s.m (stretcher bond)			Country brick is readily available in many locations and yet is associated with consumption of considerable ammounts of bio mass at the production phase.
	Unit (s.m)	CEB - 28 units/ s.m (stretcher bond)			
		ISSB - 34 units/ s.m			
		Brick - 52 units/ s.m (stretcher bond)			




S -1
Kitchen + Storage
Kitchen + Storage
Sleeping area
Sleeping area
Adaptable space for interaction or future development
Adaptable space for interaction or future development
Future development/ gardening lot
Future development/ gardening lot
Covered porch
MODULE CAN ACCOMMODATE MULTI-STOREY HOUSING
S -1
Assumptions
1. Depending on orientation, appropriate shading strategies will be applied.
2. Vehicular provisions are part of wider neighbourhood strategy.
3. The plot is based on a conventional 15 x 30 m lot.
Future development/ gardening lot
Adaptable space for interaction or future development
Sleeping area

Key Findings, Dissemination Streams

Improving Rural Building Materials Production In Africa And Reducing Housing Embodied Energy And Costs

Ndibwami, A and Ahimbisibwe, A. 2017. Education with(in) practice: Reducing the gap between architectural practice and education

Ahimbisibwe, A. and Ndibwami, A. 2017. The triple helix model as driver for innovation with local building technology in urbanising societies.

Ahimbisibwe, A. and Ndibwami. A. 2017. Changing attitudes in educating the developing world: Incorporating earth construction in an East African curriculum.

Wasswa, P., Ahimbisibwe, A., and Ndibwami, A. 2017. Vernacular architecture: Advocating for volcanic stone construction as a viable alternative to burnt brick in mountainous areas of South-western Uganda.

Niwamara, T. & Ndibwami, A. 2016. Adoption of appropriate technology in construction: A pilot study of compressed earth blocks uptake in Kamuli District - Uganda.

Olweny, M., Ndibwami, A., Thomas., P., Ahimbisibwe, A., Lubingo, M., Katta, J. 2015. To Build or Not to Build: Going Live is [Not] Just Being Practical!

Ahimbisibwe,. A., Ndibwami, A. and Niwamara, T. 2015. Rural (low income) housing: inspiring communities to shape their future.

Operational-energy In Current Housing And Ways Of Reducing Costs On Building Services And Appliances

Drazu, C., Olweny, M.R.O., & Kazoora G. 2015. Household energy use in Uganda: Existing sources, consumption, and future challenges

Kazoora, G., Olweny, M., Aste, N. & Adhikari, R.S. 2015. Energy consumption trends of residential buildings in Uganda: Case study and evaluation of energy savings potential

Embodied Energy In Materials And Ways Of Reducing Housing Embodied Energy And Costs

Olweny, M., Ndibwami, A. and Ahimbisibwe, A. (2017). Embodied energy of the common wood red brick.

Passive Design Strategies In Tropical Housing

Olweny, M., Mugagga, L. L., & Nedala, T. 2016. A study of thermal comfort and thermal preferences in the upland tropical climate of Uganda.

Follow Up Work: Feasible Projects - **PRED**

- *Prototypes for Resource Efficient Dwellings (PRED)*
- In an attempt to build on a previous partnership with UNHabitat there is an idea to work with communities in municipalities in delivering better housing. The first step has been to work with students to develop prototypes for 3 typologies typical in most urbanising communities that address key issues. Following from previous findings on the ELITH project, community walk through surveys by students and with reference to national household surveys the observation is that, people live in either: poorly lit or poorly ventilated housing; insufficient or inefficient spaces; lack of or inadequate sanitary facilities; among other social, economic and environmental issues students will articulate in more detail. We are focussing on re-imagining three typologies: tenements or ***mizigo***, the shop house or ***duuka*** and the family home or ***amaka.*** The fact that these are prevalent suggests a starting point to ground any interventions towards promoting adequate housing.

Follow Up Work: Feasible Projects - **SPREAD**

- *Sustainable Partnerships for Rural Energy Access and Development*
- With the growth of private not-for-profit universities across Africa, many located in secondary cities and rural centres, there is an opportunity to build synergies between these institutions and their communities for mutual benefit, based on the diffusion of innovation theory, playing on the role of universities and similar institutions as catalysts for development, not only in human capacity, but also as innovators through the uptake of new technologies as a demonstration of commitment to mitigating climate change, and using this capacity to benefit the surrounding community by acting as a hub for technology, in this case as a generator of renewable energy, that in turn can be distributed to the surrounding community, more so community facilities such as schools and hospitals. This Hub-and-Spoke developmental model could showcase the role of higher education institutions as centres of excellence in the true sense, and are not ivory towers, erasing the us-and-them view that befalls many universities that are in the community. These could then be scaled up and replicated in different places further spreading access to modern energy across the country.

Thank You