ecobuilder
Sustainability for development
CONCEPTION, INGÉNIERIE, AMÉNAGEMENT ET EXPERTISE ENVIR

Journée Mondiale de l'Habitat 2024
Du 30 Septembre au 07 Octobre 2024

EBOLOWA JMH2024

GREEN BUILDING COUNCIL CAMEROON
Opening the Green door to the future!

WORLD HABITAT WEEK 2024

AFFORDABLE AND SUSTAINABLE HOUSING SOLUTIONS (WORKSHOP)

<<ENGAGING YOUTH TO CREAT A BETTER URBAN FUTURE>>

October 2, 2024

WORKSHOP OUTLINE

1. INTRODUCTION
2. PART I: Presentation
   1. Sustainability and the built environment - (The Home We Want)
3. PART II : Round table discussion
   1. The Indigene and the Stakes
4. PART III: Presentation
   1. Paradigm shift to the Home we Want
5. CONCLUSION

1.INTRODUCTION

1.PART I: Sustainability and the built environment - (The Home We Want)

2.

- 1. WHERE ARE WE COMING FROM?
- 2. WHERE WE ARE
- 3. THE HOME WE WANT
- 4. BIM AS A TOOL TO ACHIEVING SUSTAINABILITY IN THE BUILT ENVIRONMENT

1. WHERE ARE WE COMING FROM? – The history

Pre-historic times

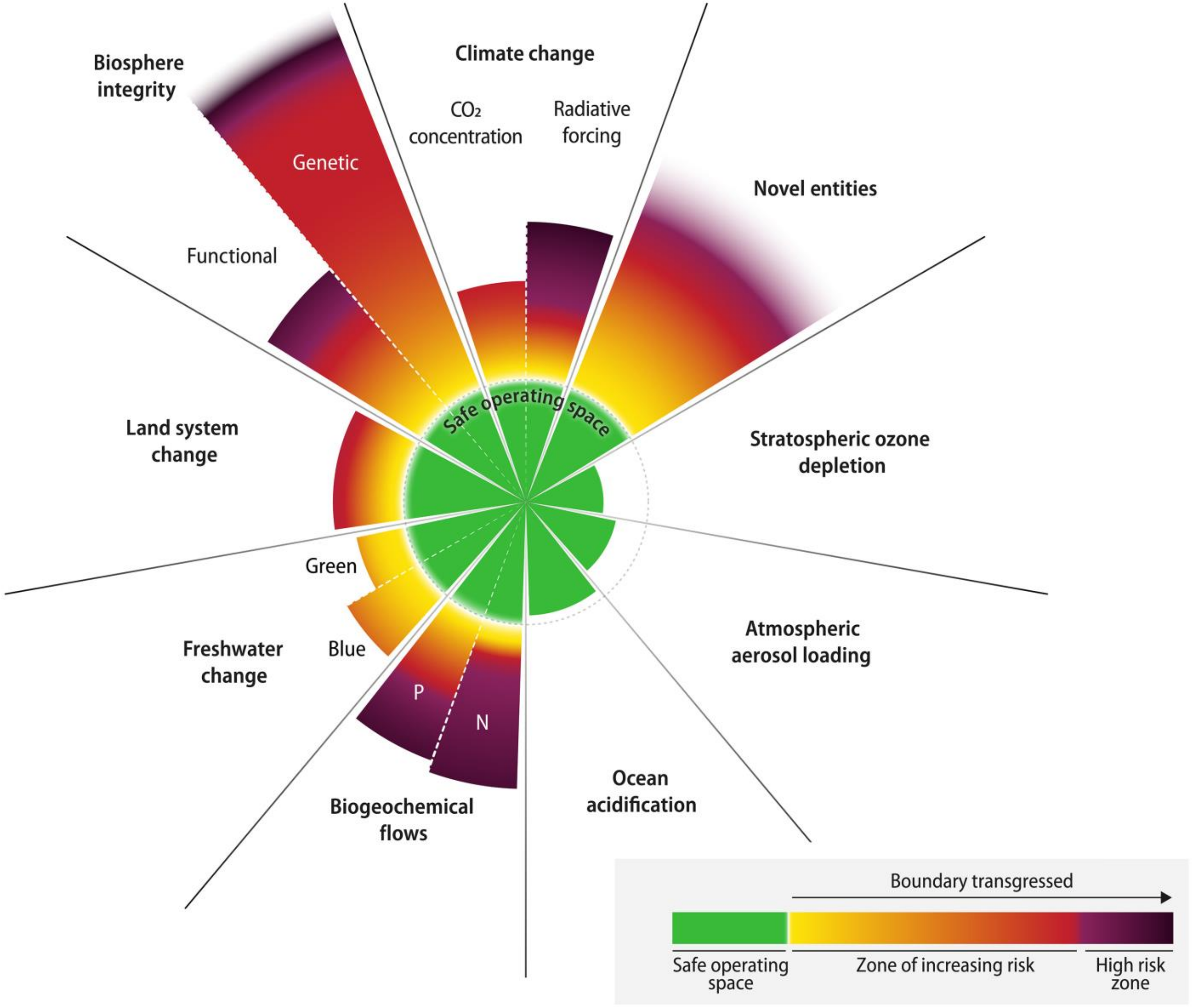
Industrial revolution

Socio -economic crisis

International collaboration

- MDG
- SDGS

1. WHERE ARE WE COMING FROM? – Planetary Boundaries



Source: Earth beyond six of nine planetary boundaries

BREACHED

Climate change	• Rising temperatures • High sun radiation
Biosphere integrity:	• Plant and species extinction
Land use change	• Insufficient forest cover negatively affect biogeophysical processes
Global water use	• Insufficient portable water
Biogeo-chemical flows	• Excess ocean dead zones
Novel entities	• Plastics pollution

2. WHERE WE ARE – SDG 11

SDG 11 – SUSTAINABLE CITIES AND COMMUNITIES

Make cities and human settlements inclusive, safe, resilient and sustainable


Safe and affordable housing


Affordable and sustainable transport systems


Inclusive and sustainable urbanization


Protect the world's cultural and natural heritage


Reduce the adverse effects of natural disasters


Reduce the environmental impacts of cities


Provide access to safe and inclusive green and public spaces

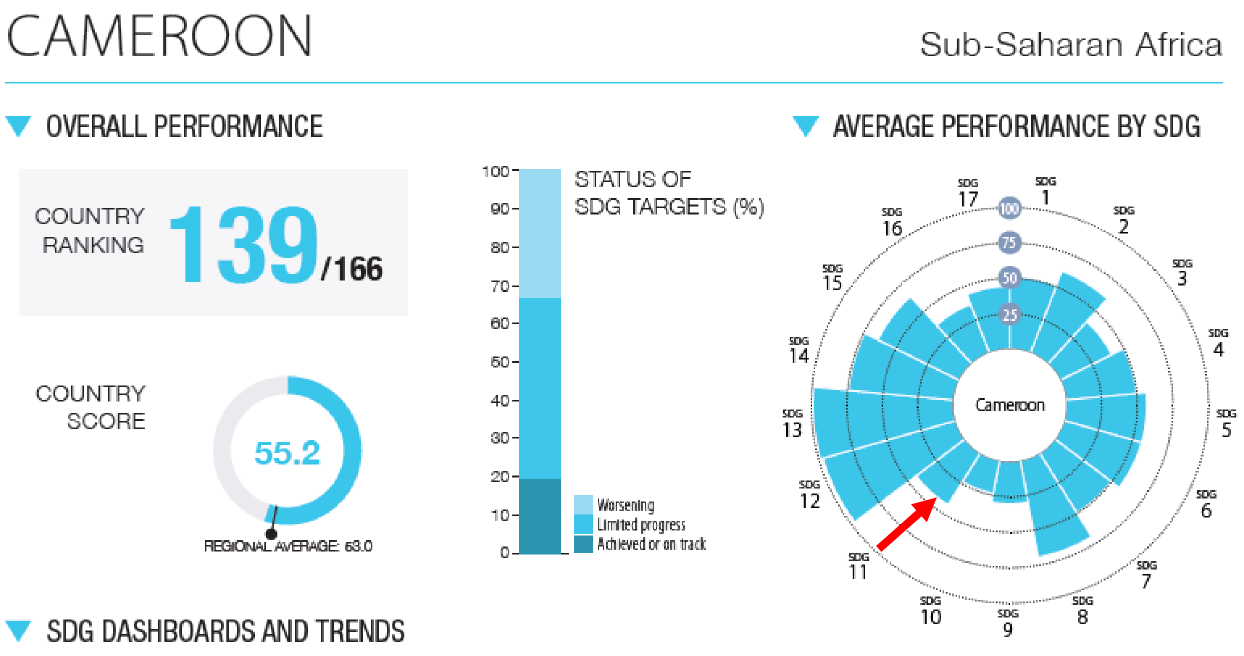

Strong national and regional development planning


Implement policies for inclusion, resource efficiency and disaster risk reduction


Support least developed countries in sustainable and resilient building

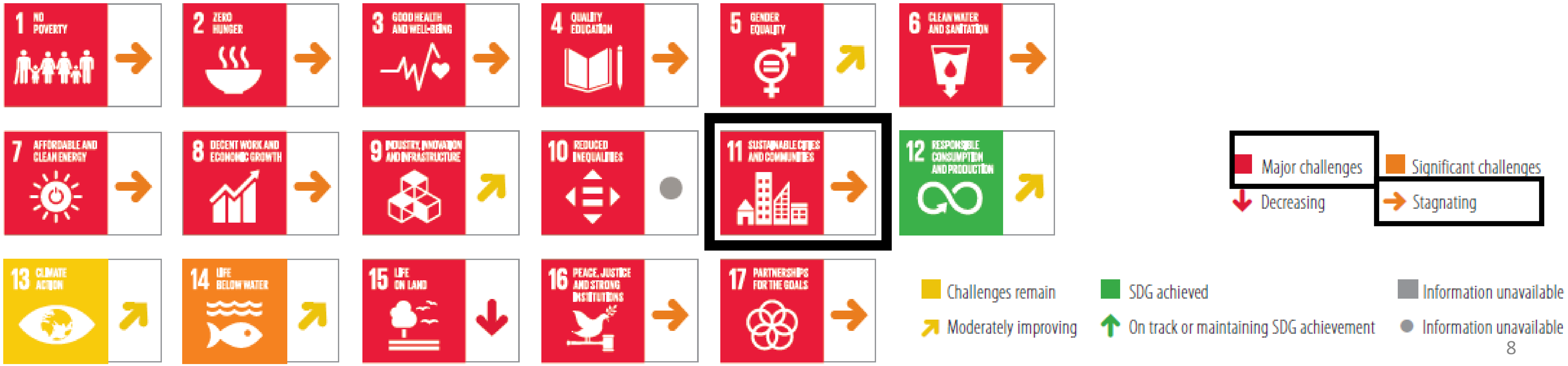
3 GOOD HEALTH AND WELL-BEING | 6 CLEAN WATER AND SANITATION | 7 AFFORDABLE AND CLEAN ENERGY | 8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY, INNOVATION AND INFRASTRUCTURE | 10 REDUCED INEQUALITIES | 12 RESPONSIBLE CONSUMPTION AND PRODUCTION | 13 CLIMATE ACTION | 15 LIFE ON LAND | 17 PARTNERSHIPS FOR THE GOALS

2. WHERE ARE WE?- Cameroon's 2023 SDG Dashboard

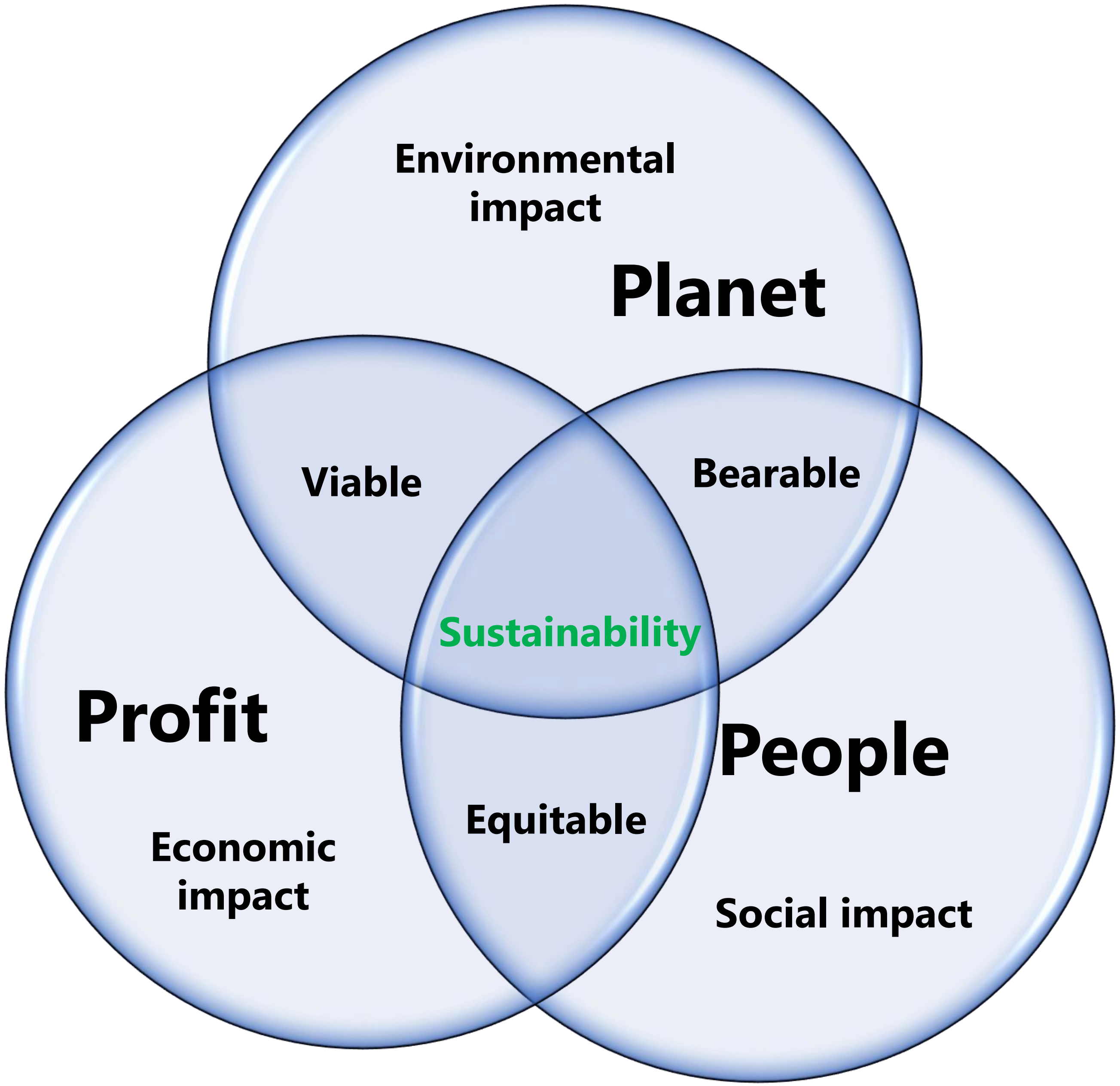


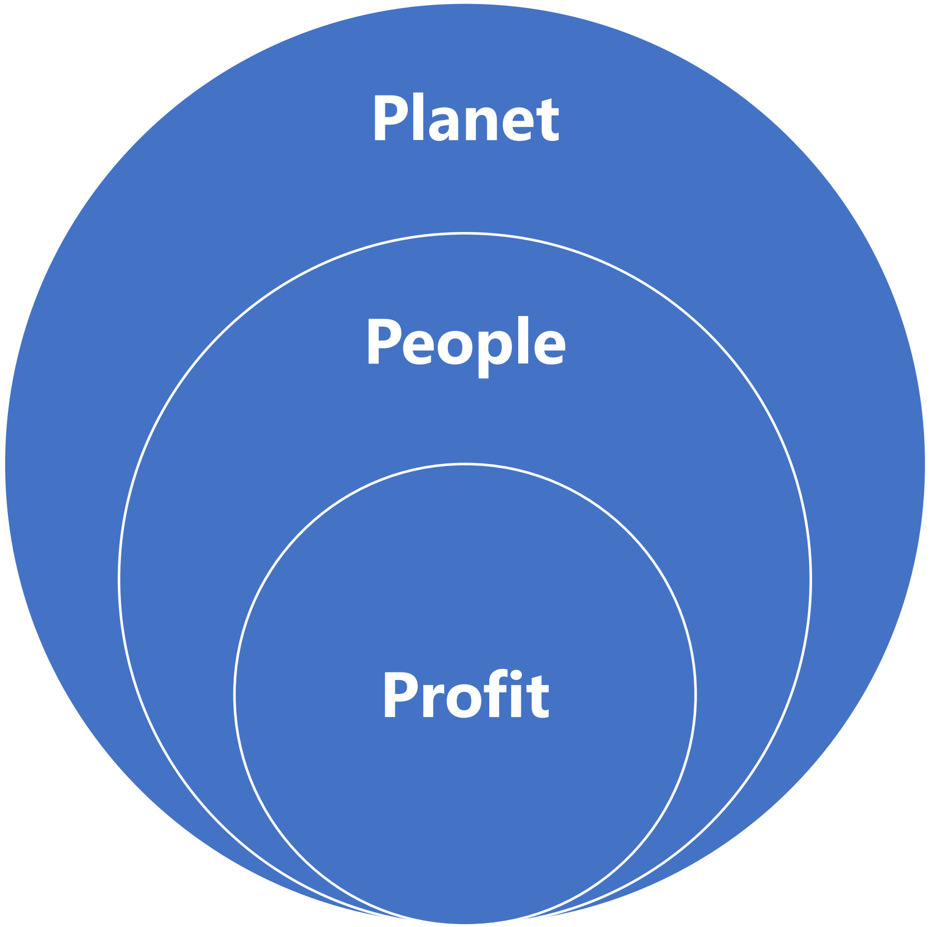
SDG11 – Sustainable Cities and Communities	Value	Year	Rating	Trend
Proportion of urban population living in slums (%)	32.7	2020	●	↗
Annual mean concentration of particulate matter of less than 2.5 microns in diameter (PM2.5) (μg/m³)	80.4	2019	●	↓
Access to improved water source, piped (% of urban population)	55.3	2020	●	↓
Satisfaction with public transport (%)	49.0	2022	●	→

Source: Sustainable Development Report 2023



3. THE HOME WE WANT – Sustainable





Balancing Cost, Environmental Performance, and Affordability: A Pathway to Sustainable Housing Solutions Using Emerging Building Information modelling (BIM)

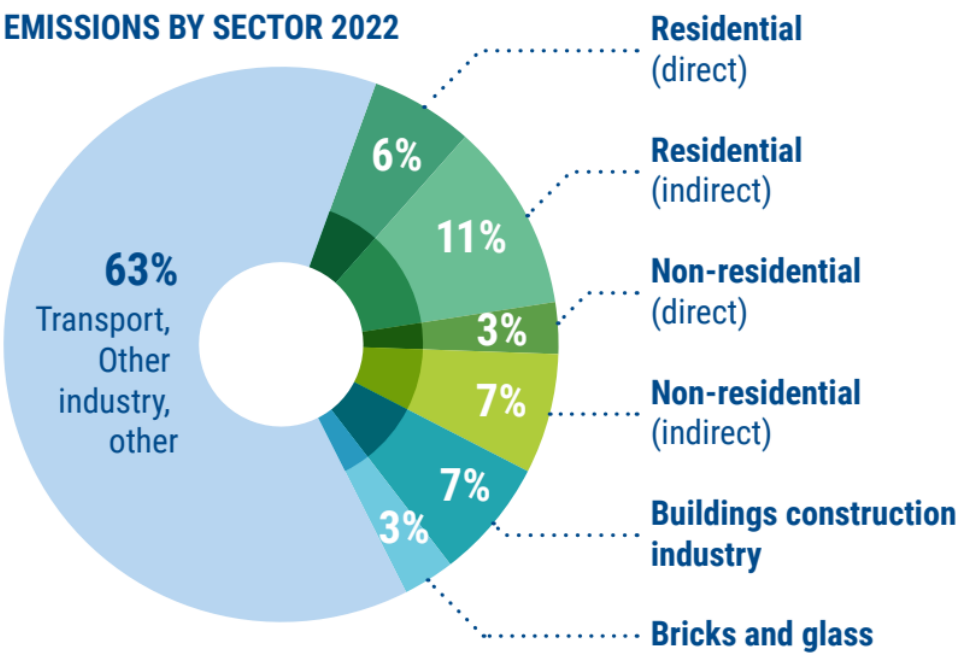
Henry Abanda

Reader (Associate Professor)– School of the Built Environment, Oxford Brookes University

CONTEXT/MOTIVATION

COP27 SHARM EL-SHEIKH EGYPT 2022

- According to the World Business Council for Sustainable Development, every week, globally, we build new surfaces equivalent to a city the size of Paris in France



- Releases 37% of all global greenhouse gas (GHG) emissions

What does this data really mean?

CONTEXT/MOTIVATION

nature
COMMUNICATIONS

ARTICLE

https://doi.org/10.1038/s41467-021-24487-w OPEN

The mortality cost of carbon

R. Daniel Bressler[1,2,3]

- The lifetime emissions beyond 2020 levels of 3.5 Americans will result in 1 additional heat-related death during this century (2020-2100).
- It would take the combined CO_2 emissions of 146.2 Nigerians (1 death, 2020-2100).

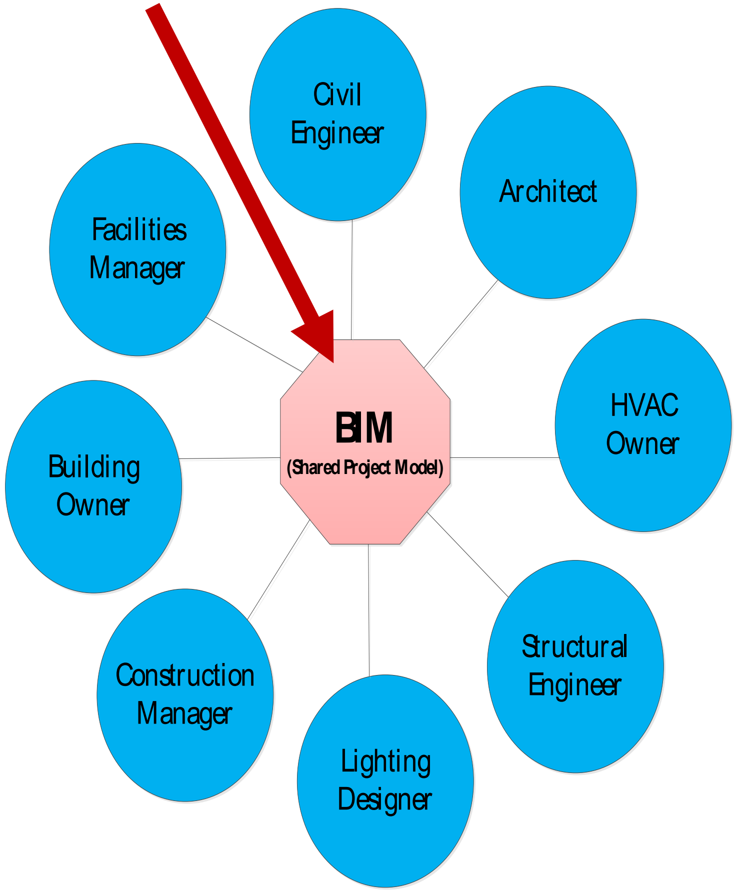
15% of Americans are climate change deniers:
[341 665,542×0.15=51 249 831.3

51 249 831.3/3.5=14 642 809.8

100m of Americans population are climate change deniers

100m/3.5=28 571 428.57

WHAT IS BIM?



The CIC defines BIM as …

an innovative and collaborative way of working that is underpinned by digital technologies which support more efficient methods of designing, creating and maintaining the built environment.

Embodied energy of a building is the energy expended in the extraction of its raw materials (indirect energy), as well as the energy used in the transportation of finished product to the job site and installation thereafter

Operational energy, on the other hand, is the energy required to run and maintain a building over its lifetime. This includes energy for heating, cooling, lighting, ventilation, and operating appliances and systems.

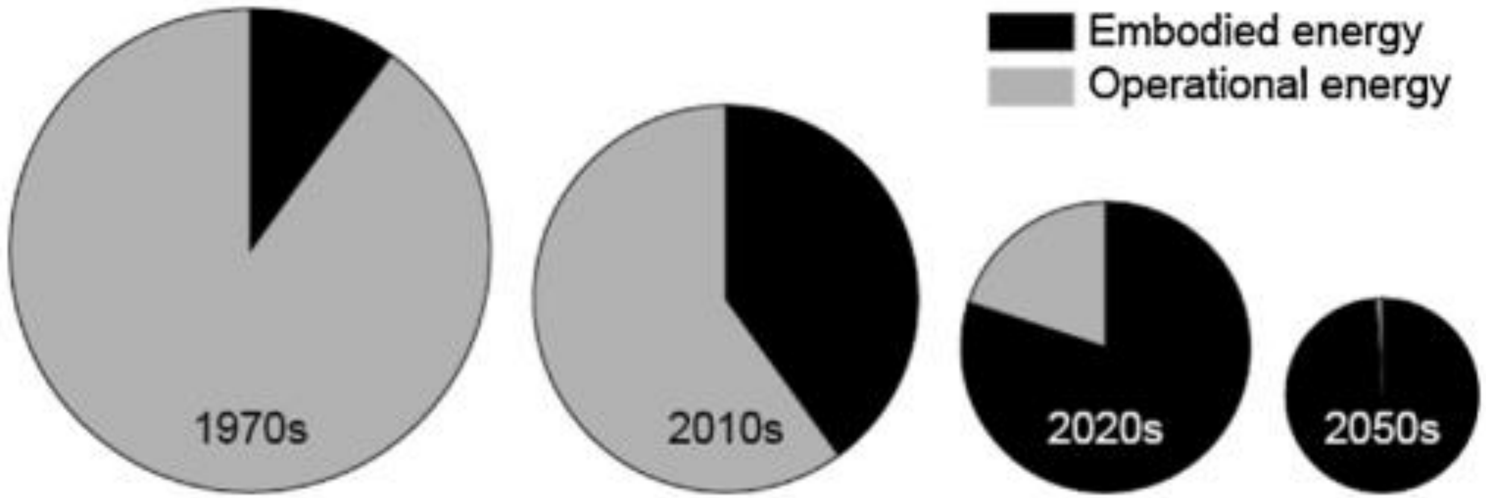


Fig. 1. The increasing importance of embodied energy (approximate data for UK built environment). (Allwood et al., 2011; Thirion, 2012; Thormark, 2002).

Embodied energy for extraction + energy used in the transportation of finished product to the job site and installation thereafter

- Complex supply chain
- Complex energy sources, food, petrol, transport
- Many different equipment

$$EE_k = \sum_{k=1}^{n} (1+\xi_k) \cdot Q_k \cdot I_k$$

$$EC_k = \sum_{k=1}^{n} (1+\lambda_k) \cdot Q_k \cdot \tau_k$$

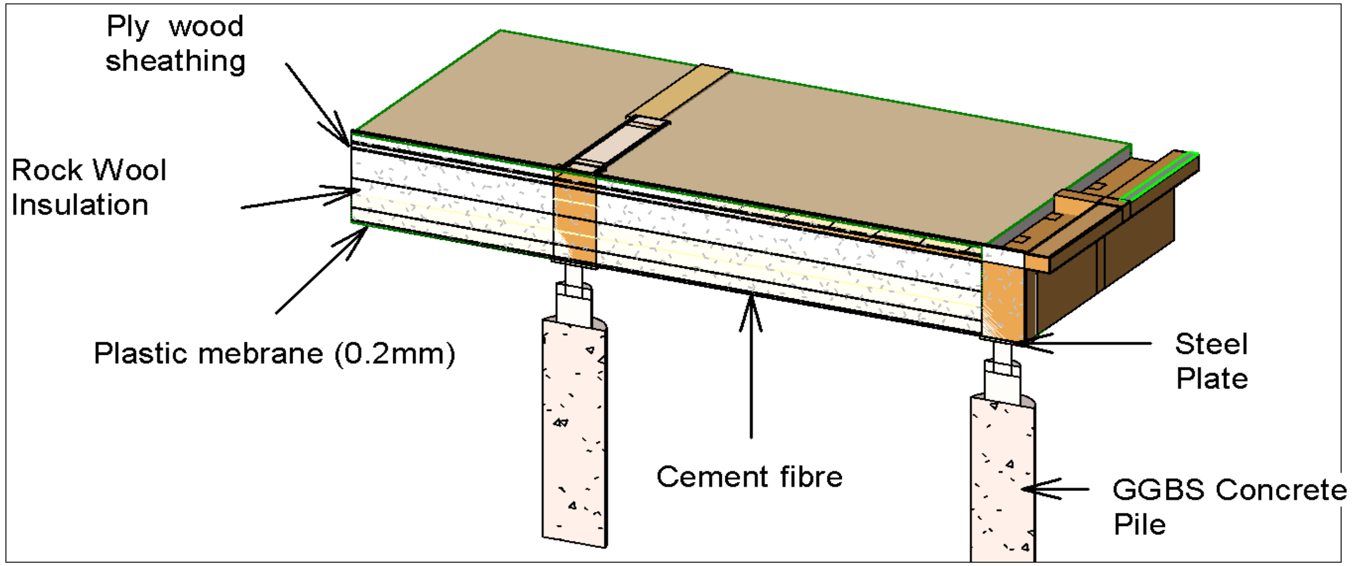


Fig. 1a

Where,

- EE_k = Embodied energy
- EC_k = Embodied CO_2
- ξ_k = Waste factor for embodied energy
- λ_k = Waste factor for embodied CO_2
- Q_k = Mass of substance (kg)
- I_k = Intensity value for embodied energy(J/kg)
- τ_k = Intensity value for embodied CO_2 ($kgCO_2/kg$)

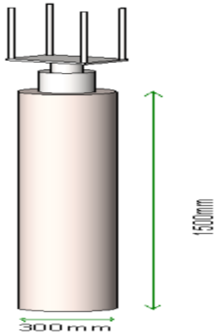


Fig. 1b

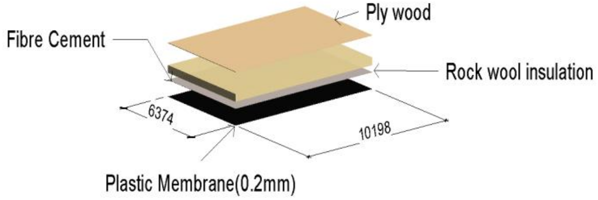


Fig. 1c

Pre-fabricated pile

In general the mass, Q of any substance is related to the Volume V through the formula:

$Q=\rho V$, where ρ is the material density

Therefore the mass of pre-fabricated pile is given by:

$Q= (24kN/m^3) \times 0.106m^3$

$Q=254.4$ Kg *[assume 1KN =100Kg]*

Total embodied energy $EE = Q \times I_{ee}$ (Also see computation models in Abanda *et al.* 2012)

$EE = 254.4\ Kg \times (2MJ/Kg)$

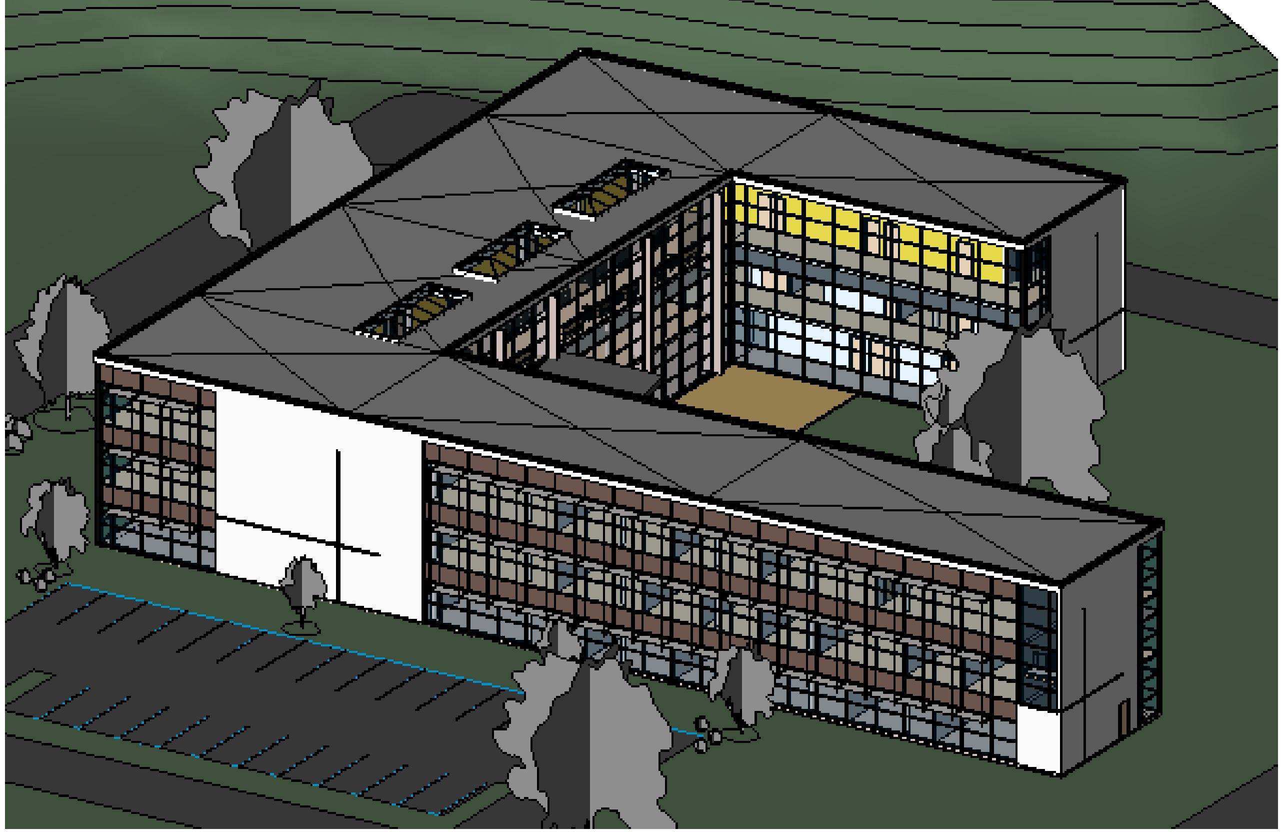
$EE = 508.8\ MJ$

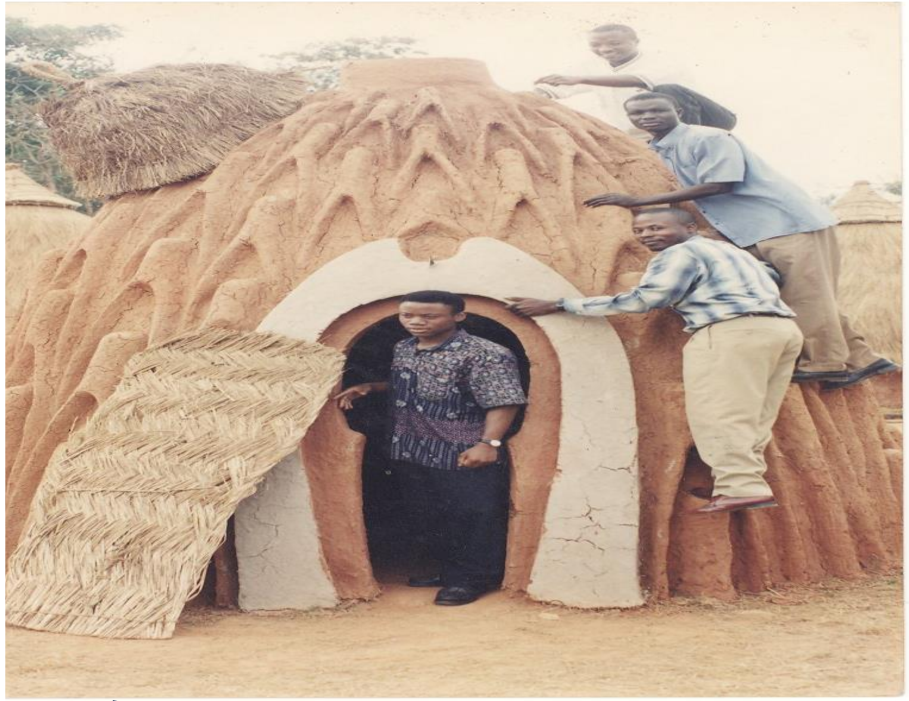
Total embodied carbon $EC = M \times I_{CO2}$

$EC = 254.4\ Kg \times (0.22KgCO_2/Kg)$

$EC = 55.97\ KgCO_2$

Exhausting, Tiring, Error-prone!!!





Complex building

Irregular shape

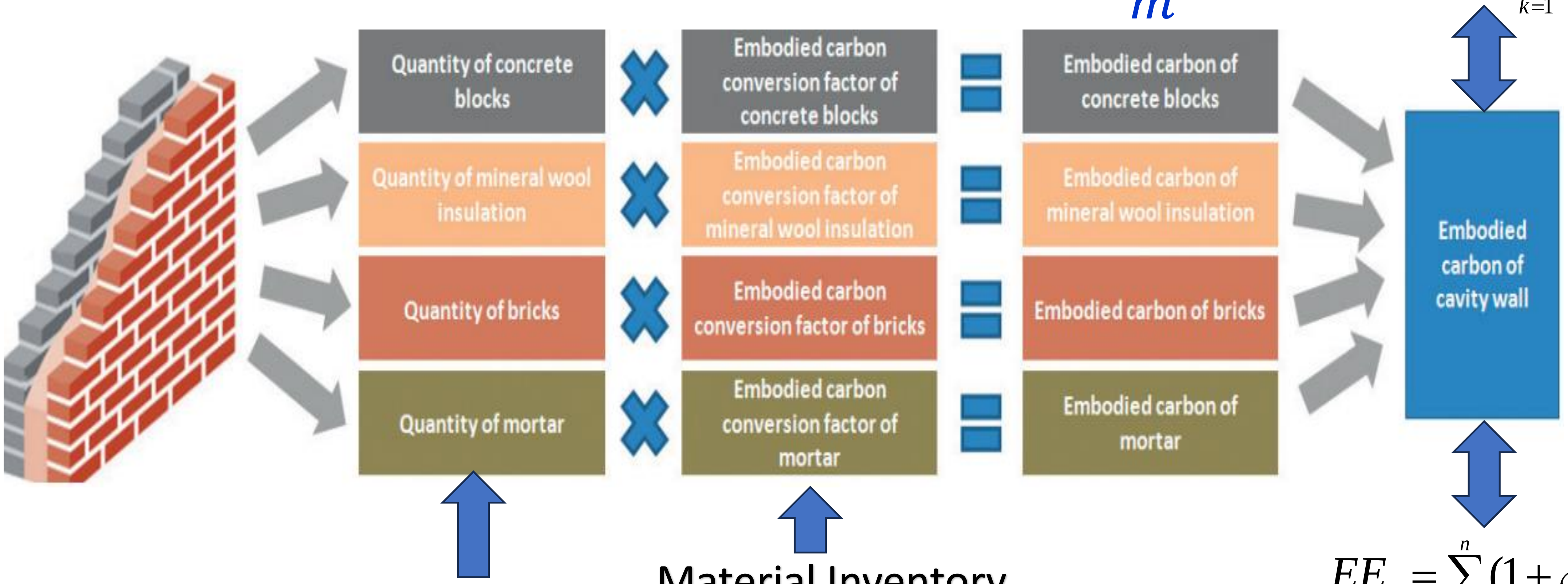
Exhausting, Tiring,
Error-prone!!!

$$EE = Q * Iee \quad [Kg * \frac{MJ}{Kg}] \qquad EC = Q * Ico_2 \quad [Kg * \frac{KgCO_2}{Kg}]$$

$$\text{Cost} = Qty * Ucost \quad [Kg * \frac{£}{Kg}]$$

$$\text{Cost of concrete} = Qty * Ucost \quad [m^3 * \frac{£}{m^3}]$$

$$EC_k = \sum_{k=1}^{n} (1 + \lambda_k) \cdot Q_k \cdot \tau_k$$



$$EE_k = \sum_{k=1}^{n} (1 + \xi_k) \cdot Q_k \cdot I_k$$

BIM

Material Inventory Databases, e.g., Bath ICE

$$EE = Q * I \quad \left[Kg * \frac{MJ}{Kg}\right]$$

Where can we find I?

INVENTORY OF CARBON & ENERGY (ICE) SUMMARY

Materials	Embodied Energy & Carbon Coefficients			Comments
	EE - MJ/kg	EC - kgCO2/kg	EC - kgCO2e/kg	EE = Embodied Energy, EC = Embodied Carbon
Aggregate				
General (Gravel or Crushed Rock)	**0.083**	**0.0048**	**0.0052**	Estimated from measured UK industrial fuel consumption data
Aluminium	Main data source: International Aluminium Institute (IAI) LCA studies (www.world-aluminium.org)			
General	**155**	**8.24**	**9.16**	Assumed (UK) ratio of 25.6% extrusions, 55.7% Rolled & 18.7% castings. Worldwide average recycled content of 33%.
Virgin	218	11.46	12.79	
Recycled	29.0	1.69	1.81	
Concrete				
General	**0.75**	**0.100**	**0.107**	**It is strongly recommended to avoid selecting a 'general' value for concrete.** Selecting data for a specific concrete type (often a ready mix concrete) will give greater accuracy, please see material profile. Assumed cement content 12% by mass.
16/20 Mpa	**0.70**	**0.093**	**0.100**	
20/25 MPa	**0.74**	**0.100**	**0.107**	Using UK weighted average cement (more representative of 'typical' concrete mixtures).
25/30 MPa	**0.78**	**0.106**	**0.113**	
28/35 MPa	**0.82**	**0.112**	**0.120**	
32/40 MPa	**0.88**	**0.123**	**0.132**	
40/50 MPa	**1.00**	**0.141**	**0.151**	

DEMO

Multi-Category Material Takeoff 2

Level	Material: Name	Family	Material: Volume	Density	Mass (Kg)	Embodied Energy (EE) intensity/(MJ/Kg)	Embodied Carbon (EC) intensity $KgCO_2/Kg$	EE emissions (MJ)	EC emissions ($KgCO_2$)
02 - Floor	Concrete - Cast In Situ	Floor	311.21 m³						
02 - Floor	Concrete - Cast-in-Place Concrete	Floor	77.80 m³						
02 - Floor	Carpet (1)	Floor	23.34 m³						
03 - Floor	Concrete - Cast In Situ	Floor	310.06 m³						
03 - Floor	Concrete - Cast-in-Place Concrete	Floor	77.52 m³						
03 - Floor	Carpet (1)	Floor	23.25 m³						
	Masonry - Concrete Block	Basic Wall	17.99 m³						
	Air Barrier - Air Infiltration Barrier	Basic Wall	0.00 m³						
	Vapour / Moisture Barriers - Vapour Retarder	Basic Wall	0.00 m³						
	Plasterboard	Basic Wall	1.24 m³						
	Insulation / Thermal Barriers - External Wall Insulation	Basic Wall	9.35 m³						
	Masonry - Concrete Block	Basic Wall	36.29 m³						
	Air Barrier - Air Infiltration Barrier	Basic Wall	0.00 m³						
	Vapour / Moisture Barriers - Vapour Retarder	Basic Wall	0.00 m³						
	Plasterboard	Basic Wall	2.48 m³						
	Insulation / Thermal Barriers - External Wall Insulation	Basic Wall	19.10 m³						
01 - Entry Level	Glass	System Panel	0.05 m³						
01 - Entry Level	Glass	System Panel	0.05 m³						
01 - Entry Level	Glass	System Panel	0.02 m³						
01 - Entry Level	Glass	System Panel	0.01 m³						
01 - Entry Level	Glass	System Panel	0.01 m³						
01 - Entry Level	Glass	System Panel	0.01 m³						
	Insulation / Thermal Barriers - Rigid insulation	Basic Roof	249.19 m³						
	Concrete - Cast In Situ	Basic Roof	318.46 m³						
	Roofing - EPDM Membrane	Basic Roof	3.19 m³						
01 - Entry Level	Concrete - Cast-in-Place Concrete	M_Concrete-Round-Column	0.26 m³						
01 - Entry Level	Concrete - Cast-in-Place Concrete	M_Concrete-Round-Column	0.26 m³						
01 - Entry Level	Concrete - Cast-in-Place Concrete	M_Concrete-Round-Column	0.26 m³						
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01 - Entry Level	Concrete - Cast-in-Place Concrete	M_Concrete-Round-Column	0.26 m³						

Type/ Material	Volume (m^3)	Density (KN/m^3)	Quantity (Kg)	Embodied Energy (EE) intensity/(MJ/Kg)	Embodied Carbon (EC) intensity $KgCO_2/Kg$	EE emissions (MJ)	EC emissions ($KgCO_2$)	EE emissions (MJ)/GIFA	EC emissions ($KgCO_2$)/GIFA
1 SUBSTRUCTURE									
1.1 Foundations									
Bullivant concrete - prefab pile	1.909	24	4581.60	2	0.22	9,163	1,008		
Galvanised mild steel	0.045	78.5	353.25	35	2.75	12,364	971		
						21,527	1,979	202	19
1.4 Ground Floor									
Plywood	1.37	5	685	15	0.81	10,275	555		
Rock wool insulation	20.8	0.398	827.84	16.8	1.05	13,908	869		
Fibre cement	0.78	12	936	10.9	2.11	10,202	1,975		
Plastic membrane (0.20mm)	0.013	8	10.4	80.5	2.53	837	26		
						35,222	3,425	331	32
Total:						56,749	5,405		
2 SUPERSTRUCTURE									
2.1 Frame									
Glue laminated timber **(GL24h)**	12.908	3.7	4775.96	12	0.65	57,312	3,104		
SW.Timber **(C18)**	3.866	3.8	1469.08	7.4	0.45	10,871	661		
C1 Cross brace members	0.032	78.5	251.20	24.6	1.71	6,180	430		
C2 high yield bracing bars	0.019	78.5	149.15	24.6	1.71	3,669	255		
						78,031	4,450	734	42
/GFA:									
2.2 Upper Floors									
Concrete - grout (screed)	0.49	30	1470	1.4	0.213	2,058	313		
Concrete - precast concrete slabs	3.473	14.8	5140.04	2	0.215	10,280	1,105		
Plywood	3.648	5	1824	15	0.81	27,380	1,477		
						39,698	2,896	373	27
/GFA:									
2.3 Roof									
Aluminium covering	0.04	27	108	155	8.24	16,740	890		
Plywood	2.2	5	1100	15	0.81	16,500	891		
Rock wool insulation	3.37	0.398	134.126	16.8	1.05	2,253	141		

COST	
UC (£)	TC(£)

SUSTAININABILITY/AFFORDABILITY

Affordability is defined by the conventional price ratio criterion as the ratio of housing costs to incomes.

This criterion defines affordable housing as housing expenses (basic utilities, maintenance, insurance, property taxes, and mortgages or rents) that are less than 30% of household budgets or income (Adabre, 2021; Anącker, 2019; Litmąn, 2023; Tighè, 2010).

BIM helps in designing energy-efficient homes by simulating the building's performance under various environmental conditions. This can lead to reduced operational costs for residents through lower energy consumption, which is crucial for affordable housing.

SUSTAININABILITY/AFFORDABILITY

Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/jobe

Integrating BIM and new rules of measurement for embodied energy and CO_2 assessment

F.H. Abanda*, A.H. Oti, J.H.M. Tah

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Engineering Science and Technology, an International Journal

Volume 20, Issue 2, April 2017, Pages 443-459

open access

Full Length Article

BIM – New rules of measurement ontology for construction cost estimation

F.H. Abanda [a], B. Kamsu-Foguem [b], J.H.M. Tah [a]

SUSTAININABILITY/AFFORDABILITY

AIMS Energy, 2014, 2(1): 18-40. doi: 10.3934/energy.2014.1.18.

Research article

Embodied Energy and CO_2 Analyses of Mud-brick and Cement-block Houses

Abanda F.Henry[1], , Nkeng G.Elambo[2], Tah J.H.M.[1], Ohandja E.N.Fabrice[2], Manjia M.Blanche[3]

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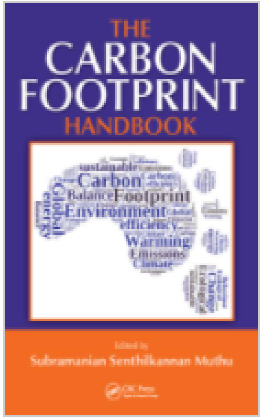

Digitizing the Assessment of Embodied Energy and Carbon Footprint of Buildings Using Emerging Building Information Modeling

Authored by: **F.H. Abanda , A.H. Oti , J.H.M. Tah**

The Carbon Footprint Handbook

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10.1201/b18929-17

Do we have an environmental inventory database for Cameroon?

Are our engineers, especially the youths BIM proficient?

THANKS FOR YOUR KIND ATTENTION!

Q & A session after presentations

1.PART II: The Indigene and the Stakes

- A. EFFORTS MADE IN CAMEROON TOWARDS A SUSTAINABLE BUILT ENVIRONMENT
- B. LAGS
- C. YOUTH ACTION

Round table discussions questions

A. EFFORTS MADE IN CAMEROON TOWARDS A SUSTAINABLE BUILT ENVIRONMENT

1. What do you refer to as indigenes?
2. What is the relationship between the indigene and the current environmental and socio-economic crisis that is calling for better ways of constructing? How important is their role in the whole process of building better?
3. What efforts are currently being made by the government and individuals to ensure a sustainable cities and communities?

Round table discussions questions

B. LAGS

1. How do we measure the sustainability in a construction project?
2. To what extent is that implemented in Cameroon?
3. What do you have to say about the contextualization of sustainable and affordable housing in Cameroon?
4. Do you think there are enabling policies that support sustainability in the built environment?
5. Is more to be expected concerning the establishment of these policies?

Round table discussions questions

C. YOUTH ACTION

1. What is your advice to students looking forward to working in building and construction sector?
2. How can the existing work force who for the longest time worked conventionally, adapt to required changes?
3. How can they be empowered to do better?

1.PART III: The Paradigm shift

- THE AFRICAN MANISFESTO FOR CITIES AND THE BUILT ENVIRONMENT

Paradigm shift, the home we want

African manifesto for sustainable cities and the built environment

Introduction

- **What is the African Manifesto for Sustainable Cities?**
- Brief introduction to the African Manifesto for Sustainable Cities and the Built Environment.
- Purpose: Addressing urbanization challenges, social equity, and sustainability.
- Connection to affordable housing and urban resilience.

The Challenges We Face

- **Key Issues Addressed by the Manifesto:**
  - Rapid urbanization in African cities.
  - Shortage of affordable, sustainable housing.
  - Environmental degradation due to unsustainable building practices.
  - Social inequities and inadequate infrastructure.

The Paradigm Shift – Why It's Necessary

- **Why We Need a Paradigm Shift:**
- Traditional urban development models are no longer sufficient.
- Emphasis on inclusivity, sustainability, and resilience.
- Need for a shift from purely economic-driven housing to sustainable urban solutions that balance environmental, social, and economic goals.

Core Principles of the African Manifesto

- **Principles Driving the Paradigm Shift:**
  - Inclusivity and social equity.
  - Environmental sustainability.
  - Community participation and empowerment.
  - Innovative and eco-friendly construction practices.
  - Policy and governance reform for sustainable urban development.

Key Elements of the Paradigm Shift

- **Sustainable Housing and Urban Development:**
- Affordable and eco-friendly housing.
- Energy-efficient and climate-resilient buildings.
- Access to basic services and green spaces.
- **Policy and Governance Reform:**
- Policy alignment with sustainable development goals (SDGs).
- Strengthening local governance to promote sustainable building codes.
- **Community Participation:**
- Empowering local communities to be part of urban planning.
- Collaborative development approaches with stakeholders.

The Role of Stakeholders in the Shift

- **Key Stakeholders:**
  - Governments and local councils.
  - Community organizations.
  - Private sector (developers, architects, and builders).
  - NGOs and civil society.
  - International partners (like World GBC).
- **How They Contribute:**
  - Policy enforcement.
  - Funding and investment in green infrastructure.
  - Community-driven initiatives.

Building The Home We Want

- **The Vision:**
- A home that is affordable, inclusive, and sustainable.
- Emphasis on mixed-use urban spaces that promote economic activities and green spaces.
- **What "The Home We Want" Should Look Like:**
- Energy-efficient designs.
- Local materials and sustainable building methods.
- Connectivity to essential services like transport, schools, and healthcare.

Policy and Action Framework

- **How to Make the Paradigm Shift a Reality:**
  - Develop and implement national sustainable housing policies.
  - Align local government policies with the African Manifesto.
  - Incentivize green building practices and provide training for professionals.

What's Next?

- **Actions to Take After This Workshop:**
  - Engage policymakers to adopt the African Manifesto's principles.
  - Build local and international partnerships to fund sustainable housing projects.
  - Promote awareness and training on eco-friendly building techniques.

Conclusion

•**A Call to Action:**

•We all have a role to play in this paradigm shift.

•It’s time to embrace the principles of the African Manifesto and work together to create

The Home We Want—one that is sustainable, inclusive, and resilient.

•**Thank You!**

• **info@gbccam.org**

THANKS FOR YOUR KIND ATTENTION!

Q & A

THANK YOU
MERCI