BUILDING MATERIALS
A HIDDEN HEAVYWEIGHT FOR THE CLIMATE

How can financing and policy support the decarbonisation of building materials and construction?

24 March 2022

11:00 - 12:30 CET

Online Webinar

Picture: Shivendu Shukla/Unsplash

Global Alliance for Buildings and Construction

Africa-Europe Bioclimatic Collaboration 21

ACT ASSESSING LOW CARBON TRANSITION®

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BUILDING MATERIALS
A HIDDEN HEAVYWEIGHT FOR THE CLIMATE

How can policy and finance address embodied carbon from building materials?

Jérémy Bourgault | Agence Française de Développement (AFD)

Picture: Shivendu Shukla/Unsplash

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EMBODIED CARBON – A HIDDEN HEAVYWEIGHT FOR THE CLIMATE

How can financing and policy reduce the footprint of building materials and construction?

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THE GLOBAL BUILDING FLOOR AREA IS EXPECTED TO DOUBLE BY 2060

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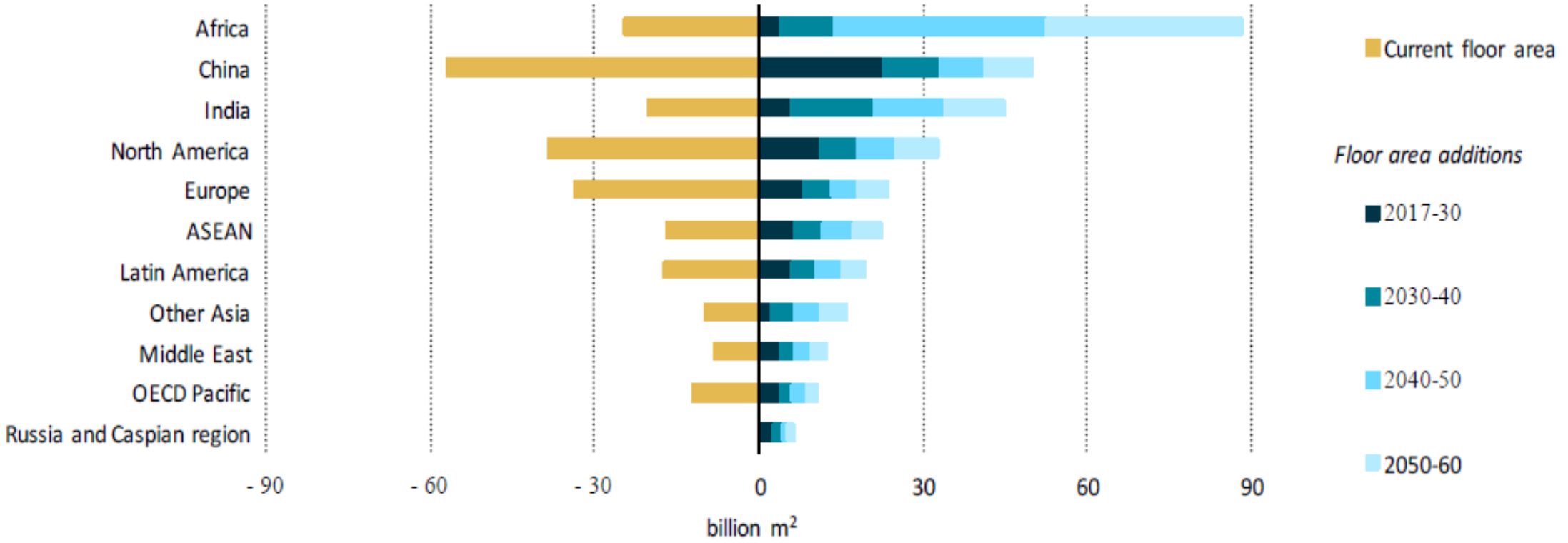

Sources: Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme: 2017 Global Status Report: towards a zero-emission, efficient and resilient buildings and construction sector, GlobalABC, 2017

BUILDING MATERIALS: A MASSIVE CARBON FOOTPRINT

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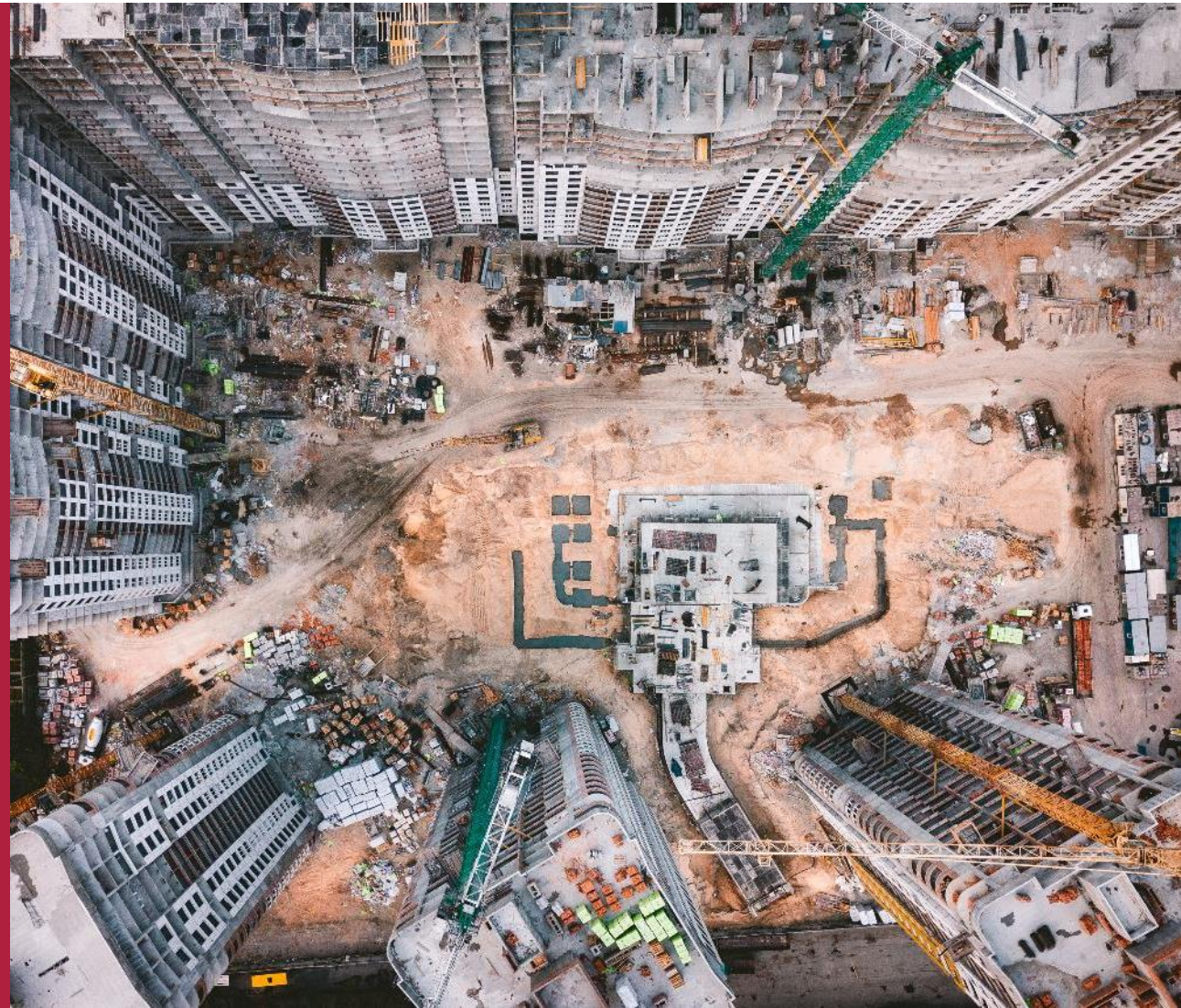
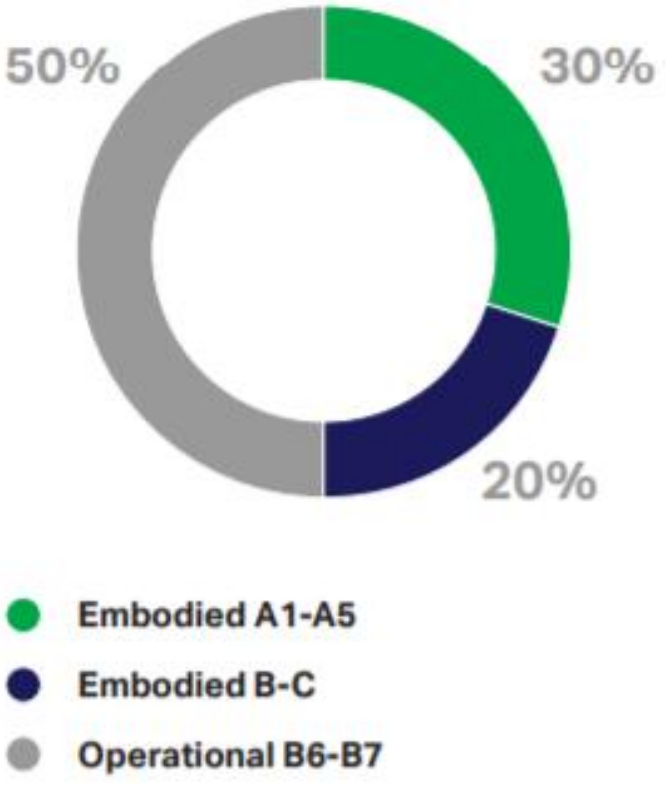
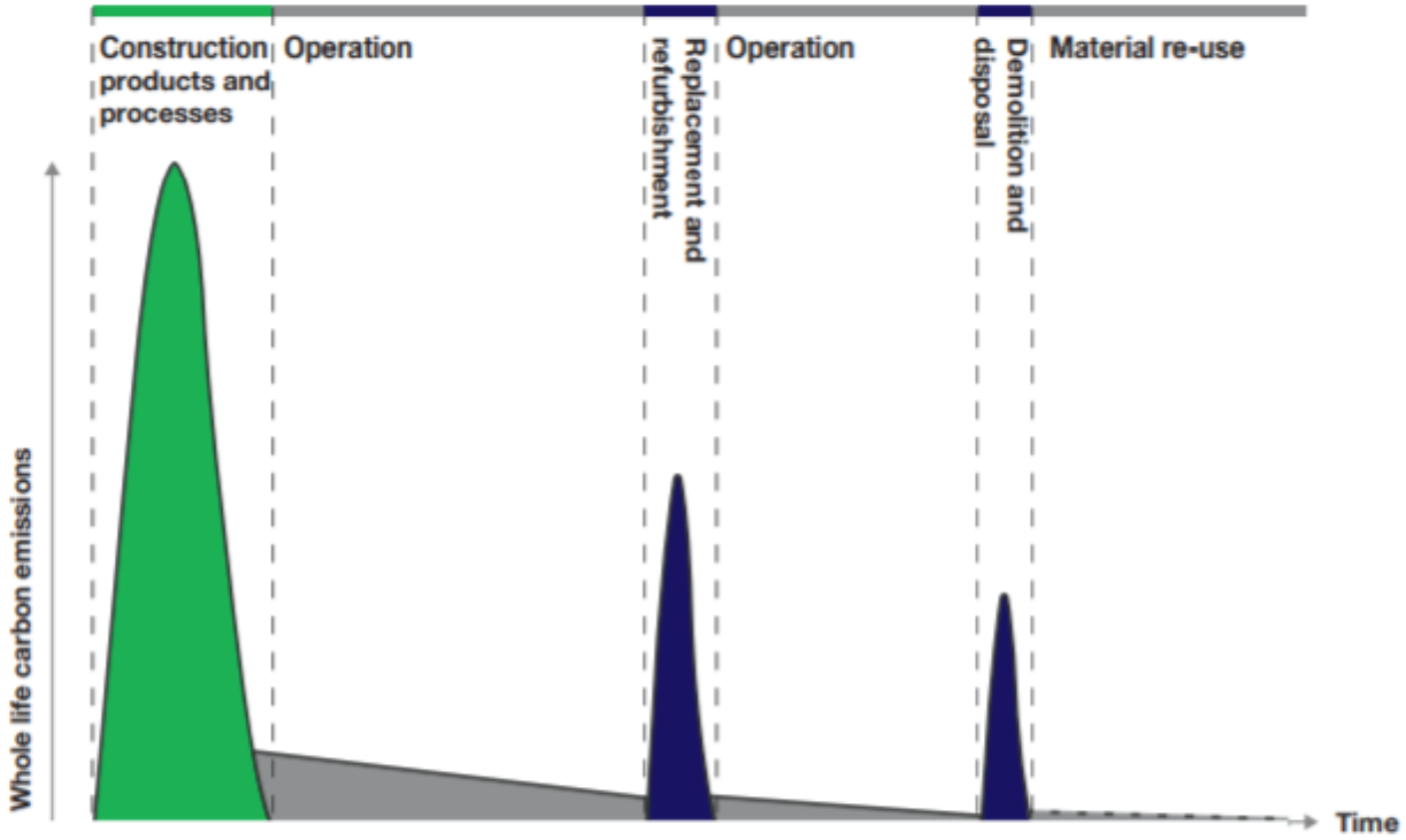
The production of building materials and construction activities cause **10% of global energy-related greenhouse gas emissions**.

The manufacturing of **cement and steel** makes up almost three-fifths of these emissions. Aluminum, glass and insulation materials also cause high emissions.



THE RELATIVE WEIGHT OF EMBODIED CARBON INCREASES, AS BUILDINGS BECOME MORE EFFICIENT





Source: *Net-Zero Buildings – Where do we stand?, WBCSD,2021*

THROUGHOUT THE LIFE-CYLE - FROM PLANNING TO END-OF-LIFE

WE NEED TO RETHINK HOW WE DESIGN, CONSTRUCT AND REUSE OUR BUILDINGS.

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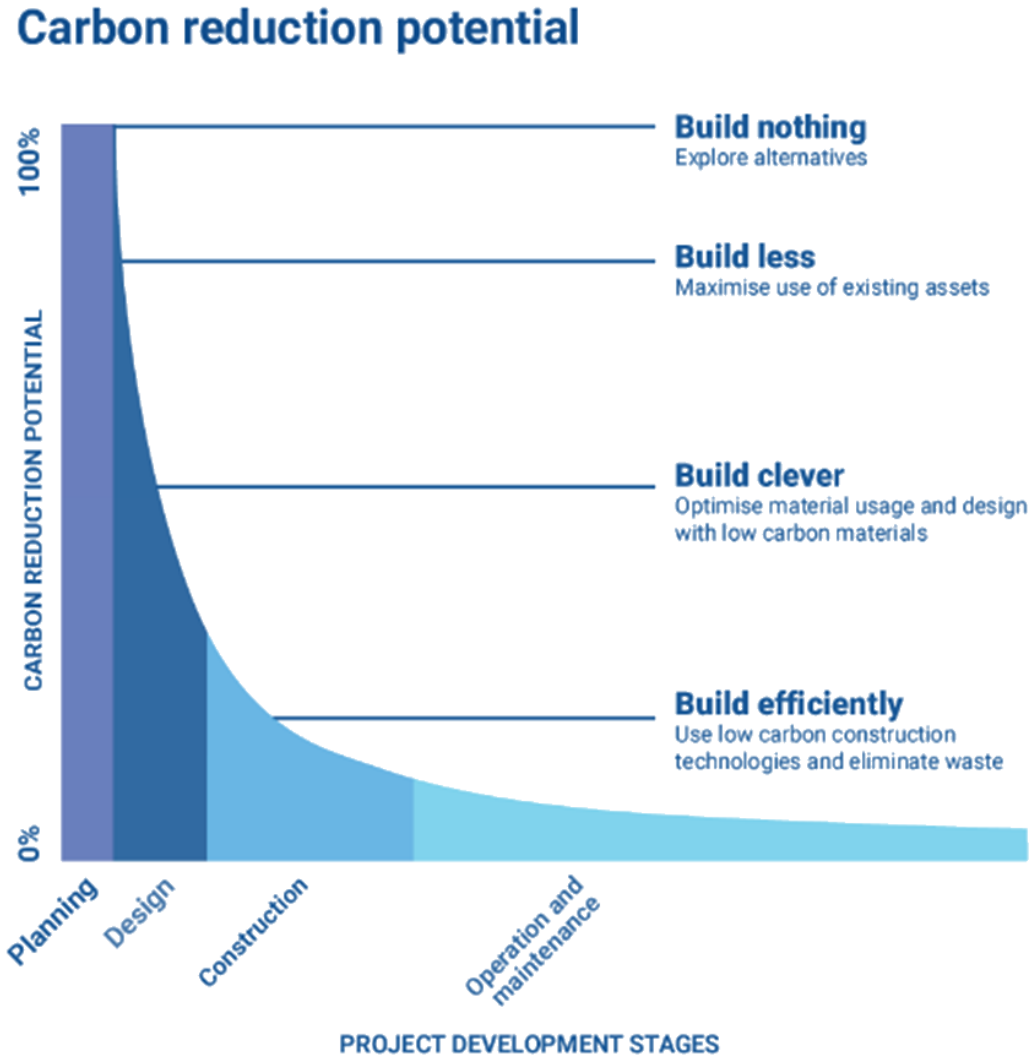

Embodied emissions **must be considered from the early planning and design stages onwards**.

Source: World Green Building Council: Bringing embodied carbon upfront – coordinate action for the building and construction sector to tackle embodied carbon, WorldGBC, 2019

PLANNING
BUILD LESS, BUILD SMARTER

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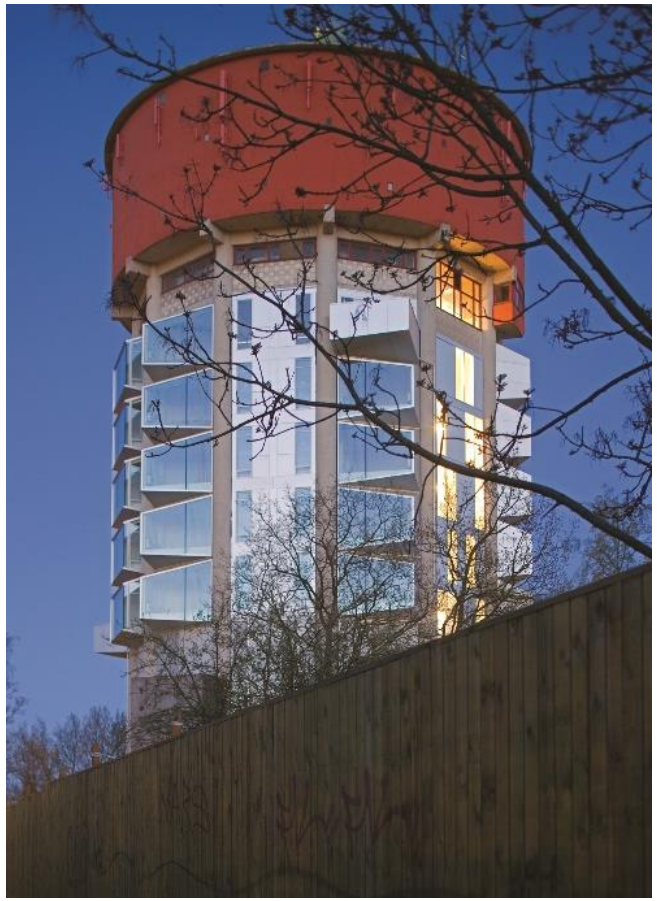

Jaegersborg Water Tower was transformed into a modern student dormitory, Architects: Dorte Mandrup

- **Renovate** existing assets rather than construct new ones
- **Mix and optimise uses** rather than plan for single use
- **Promote compact urban spaces** rather than low-density sprawl
- **Chose project sites** where less material, foundation work and transport are needed

DESIGN
MATERIALS, QUANTITIES, DURABILITY AND RECYCLING

The METI-School in Rudrapur combines climate-friendly design with regional low-carbon building materials , Architects: Anna Heringer & Eike Roswag

- **Reduction of materials needed** through design
- **Low-carbon building materials** including recycled materials
- **High durability** of components and design
- **Adaptability** to successive uses
- **Less appliances,** following concepts of **sufficiency**

→ *Conduct early **Life Cycle Assessment***

CONSTRUCTION, REFURBISHMENT AND END-OF-LIFE
MORE EFFICIENCY, LESS WASTE

Urban Mining and Recycling (UMAR) Experimental Unit uses prefabricated elements made of recycled materials.Architects: Werner Sobek, Dirk E. Hebel & Felix Heisel

- **Optimised construction works** save time, energy and money
- **Clever refurbishment** can bring efficiency gains on resources such as water, energy and materials
- **Circular economy / Cradle-to-Cradle** approaches: reusing, recovering and recycling materials
- **Investing in material recycling chains**

BUILDING MATERIALS - FROM DECARBONISING CONCRETE AND STEEL TO ALTERNATIVE MATERIALS

CONVENTIONAL vs ALTERNATIVE ? WE NEED BOTH !

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HOW TO REDUCE EMBODIED CARBON?

AVOID

DESIGN BETTER
BUILD (WITH) LESS

- Life-cycle analysis
- Resource-efficiency
- Circular approaches
- Durability and recycling
- Local value chains

SHIFT

USE ALTERNATIVE
BUILDING MATERIALS

- Develop supply chains
- Standardise and certify products
- Mainstream alternative materials in conventional construction

IMPROVE

DECARBONISE
CONVENTIONAL
MATERIALS

- Energy-efficiency
- Decarbonised energy
- Process innovation
- Substitute with materials and natural fibres

AVOID
RESOURCE EFFICIENT DESIGN AND CIRCULARITY

We need to **strive for resource efficiency and circularity** in the way we produce and use building materials, both for conventional and alternative building materials:

- Building materials adapted to the local climate
- Resistant materials with a longer lifespan
- Low-processed materials and single-variety separation.
- Circularity and reuse of materials (“urban mining”)
- Local value chains to lower transport emissions

The Urban Mining and Recycling (UMAR) Experimental Unit is an experimental building mostly constructed with fully reusable, recyclable and compostable building materials.

SHIFT

ALTERNATIVE BUILDING MATERIALS

Bio-based materials, such as wood and bamboo, clay and earth, natural fibres such as canes, hemp, wood wool, or **recycled materials** can reduce the carbon footprint.

Worldwide, specialized value chains are being developed to produce these materials as “modern” building materials with excellent static and thermal properties.

- Develop supply chains for locally available materials
- Standardise and certify bio-based and recycled materials
- Integrate in „conventional“ construction

Clay materials have excellent moisture absorption properties and increase thermal comfort in buildings. Jiyan Health Garden, Iraq. ZRS Architekten.

Especially in moderate climate zones, wood can be a climate-friendly building material with excellent thermal properties. ARTIS GmbH in Berlin

IMPROVE
CONVENTIONAL MATERIALS

There is no alternative to reducing the emissions of the most used building materials: steel-reinforced concrete and other conventional building materials like aluminium, plastic and glass.

- Energy-efficient production
- Decarbonised energy supply
- Process innovation to reduce CO2
- Substitution with waste materials or natural fibers

HOW CAN POLICY AND FINANCING REDUCE EMBODIED CARBON ?

HOW TO ACCELERATE THE SHIFT TO LOW CARBON BUILDINGS?

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POLICY

- **Climate Targets** - NDCs to guide policy and attract climate financing
- **Regulations** - life-cycle emissions reporting requirements and limits
- **Standards and Norms** - certification of new low carbon materials and adaptation of standards.
- **Labels** for low embodied emission buldings
- **Public procurement** - life-cycle carbon, resource-efficient design and recycling.

FINANCE

- **Financial incentives** - green building programmes and incentives such as tax rebates
- **Investors**- support investor in implementing decarbonization policies and transparency through reporting requirement.
- **Development Banks** – embodied carbon accounting in projects and including embodied carbon as a criteria for financing

KNOWLEDGE & CAPACITY

- **Technical Knowledge** - applied research, innovation among manufacturers and suppliers, knowledge of architects and construction companies and national testing facilities.
- **Data** – country-specific building material databases to calculate emissions.
- **Market development-** business skills for sustainable building materials; market potentials and customer awareness.

PEEB WORKING PAPER

Embodied Carbon - A hidden heavyweight for the climate

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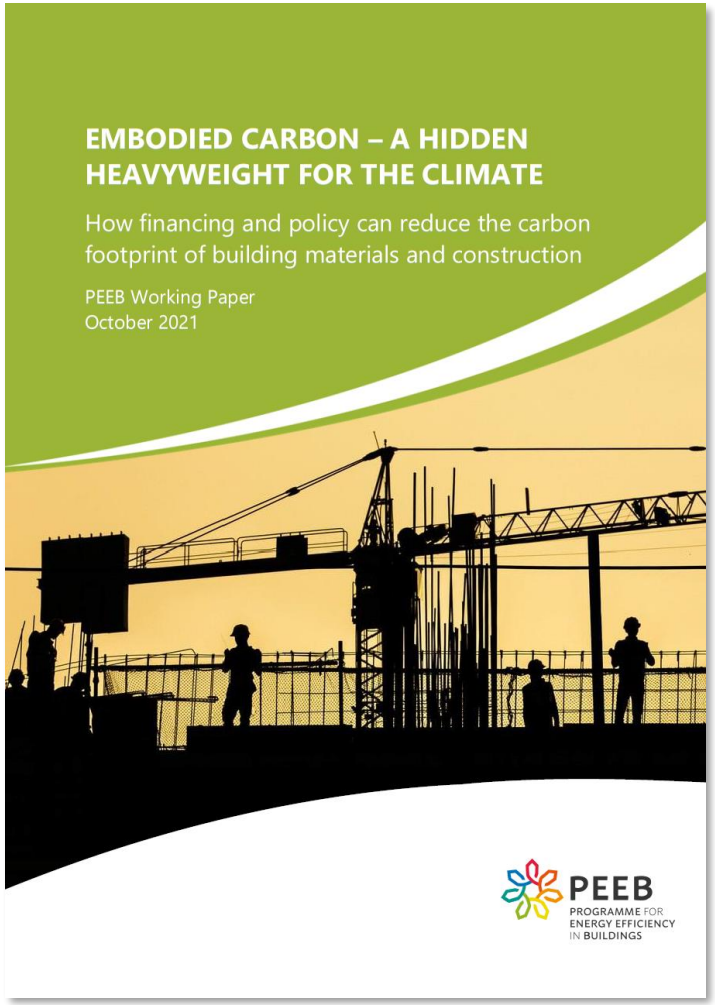

Let's get in touch !

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BUILDING MATERIALS
A HIDDEN HEAVYWEIGHT FOR THE CLIMATE

How can resource efficiency and circular economy in construction reduce greenhouse gas emissions?

Chitra Vishwanath | Architect and MD, Biome Solutions

Picture: Shivendu Shukla/Unsplash

Global Alliance for Buildings and Construction

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CONSTRUCTION MATERIALS – THE BIOME WAY

Webinar: ‘Building materials – A hidden heavyweight for the climate. How can financing and policy support the decarbonization of building materials and construction?

Organized by – Programme for Energy Efficiency in Buildings (PEEB) and Global Alliance on Building and Construction (Global ABC)

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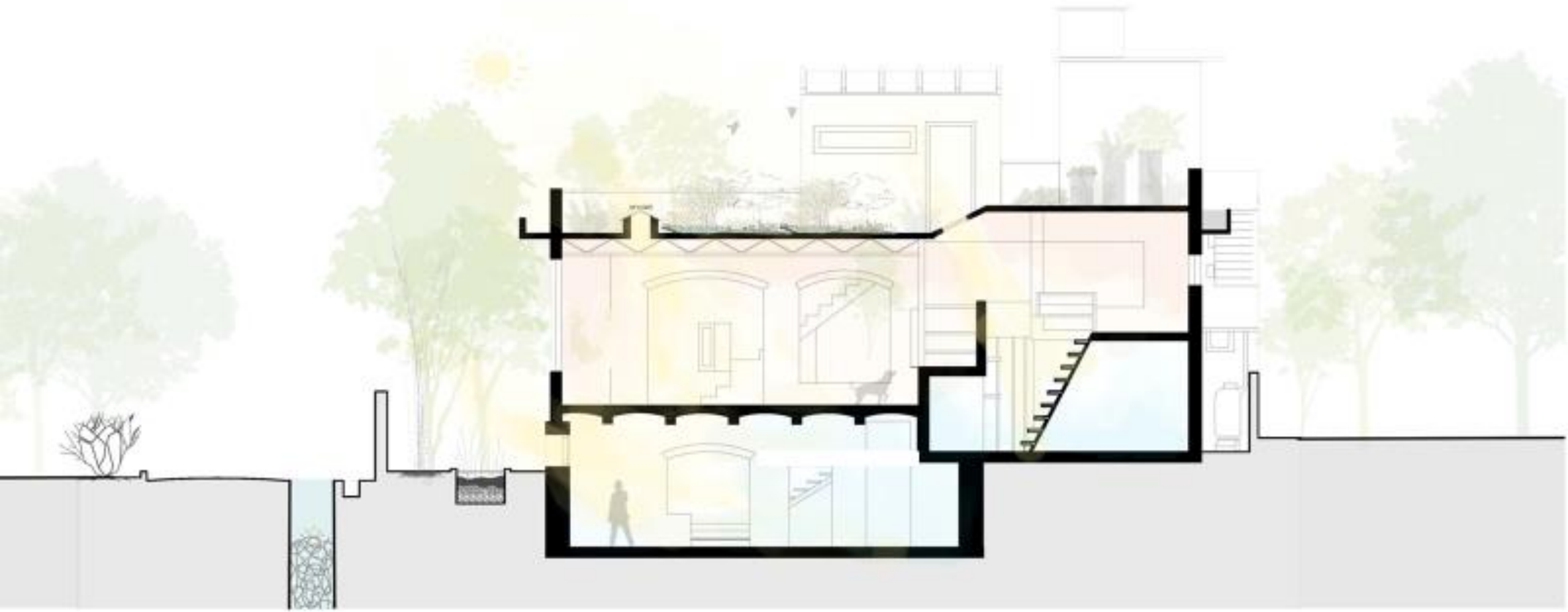
Construction Materials –The Biome Way.

- Sourced CLOSEST to the need .
- Nothing is a WASTE.
- DESIGN for nothing to be wasted.



Sourced closest to the NEED .

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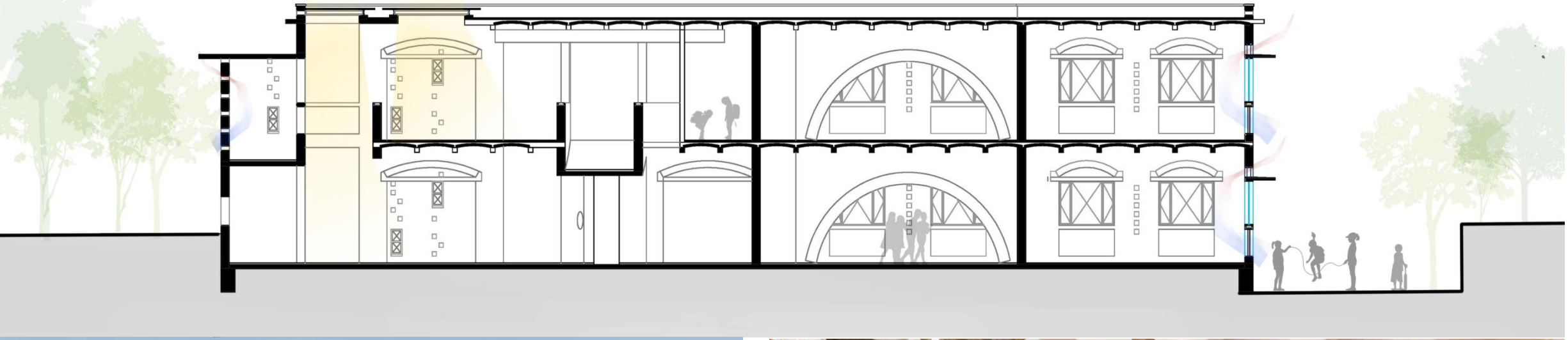

YELLOW TRAIN- SCHOOL– MOTHER OF ALL BASEMENTS -2011

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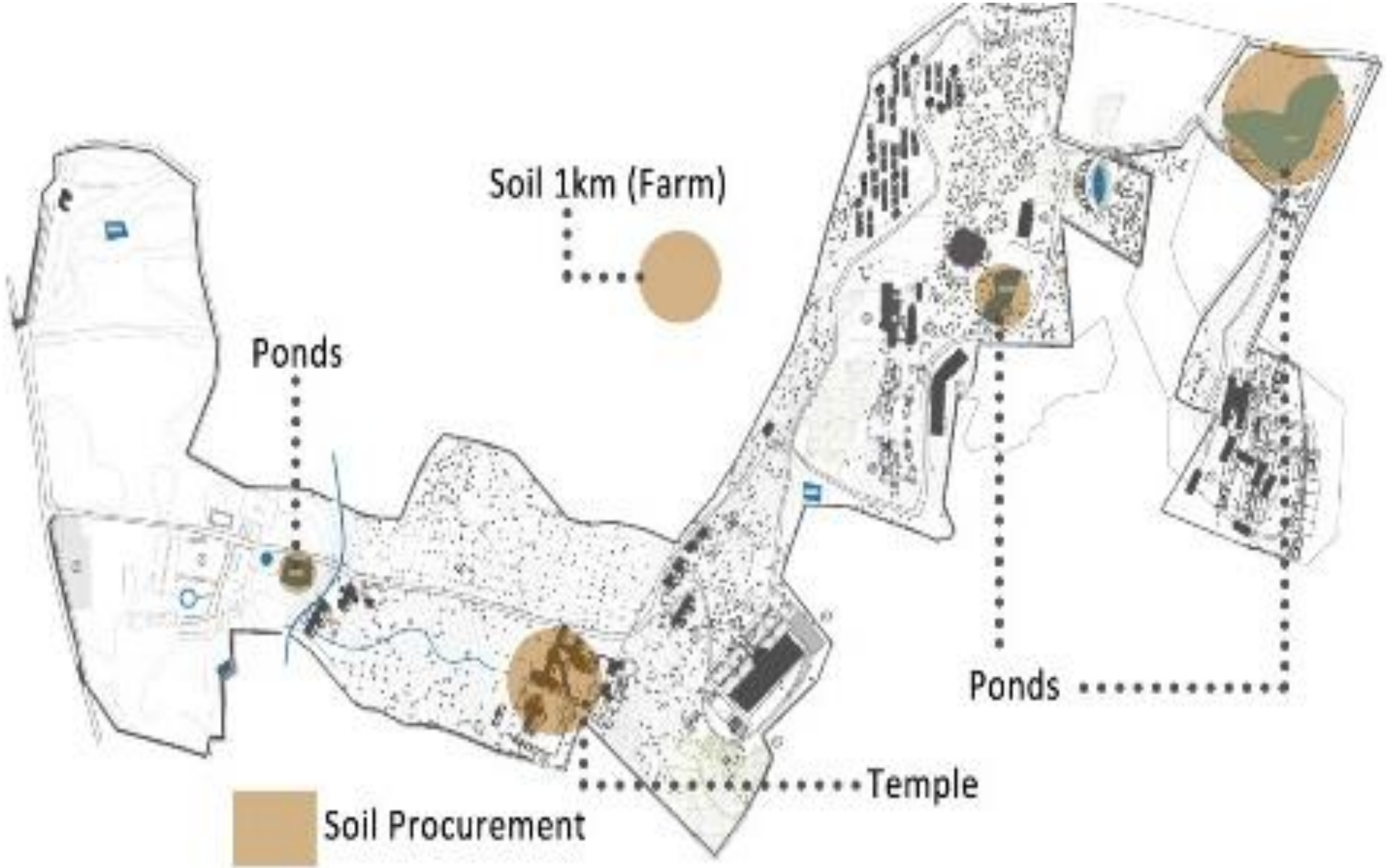

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VERSATALITY :

1. WALLING
2. ROOFING
3. FOUNDATIONS

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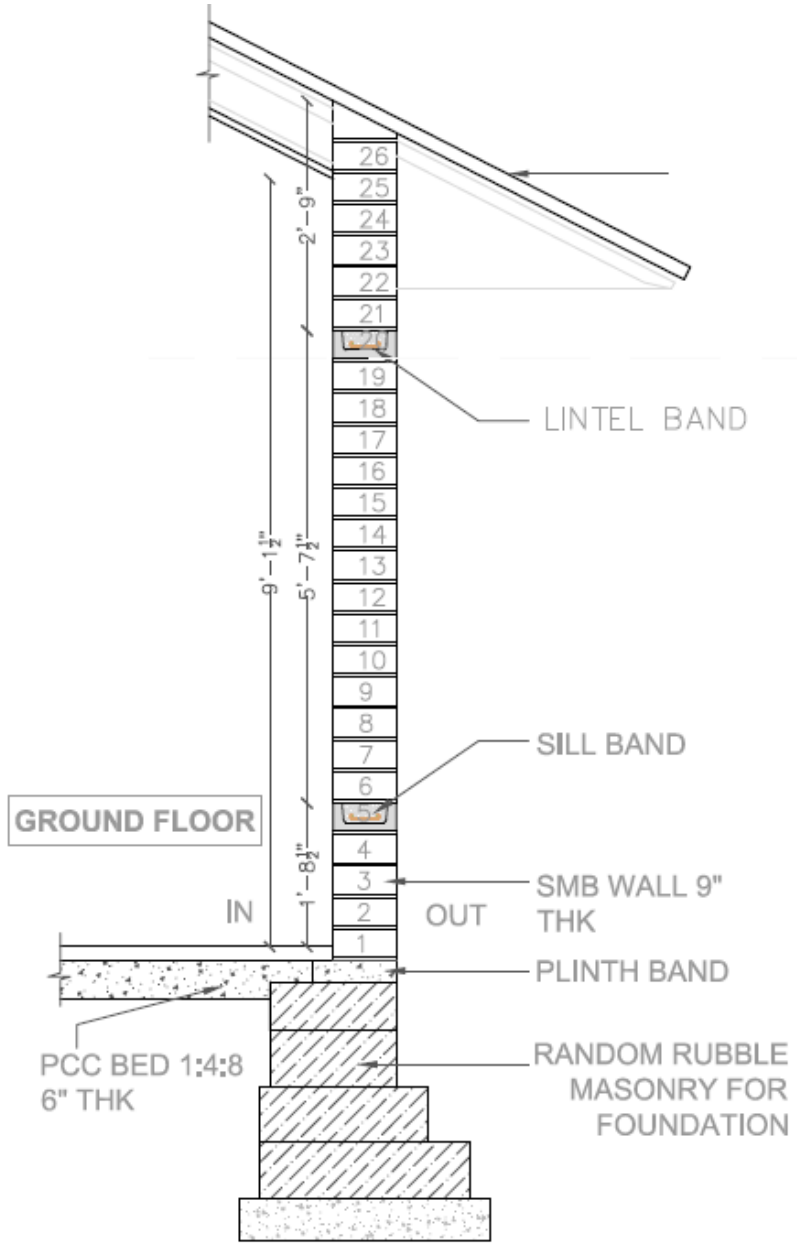

DEVELOPING CONTEXTUAL DETAILS

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EASE OF DESSIMINATION: LEARNING AND BUILDING AT THE SITE

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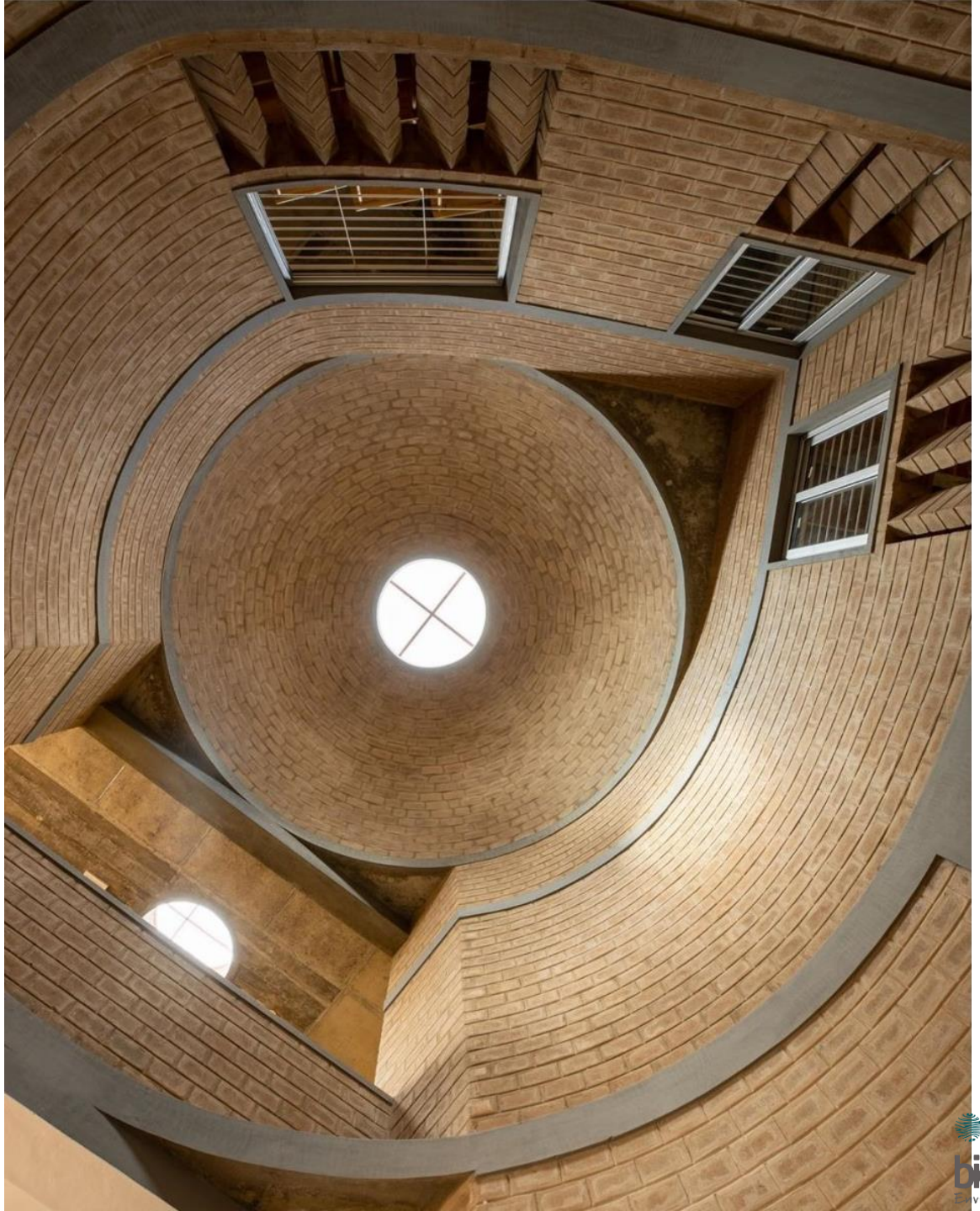

POSSIBILITIES

Photo credit: Dr Vivek / Siddhanth Raheja

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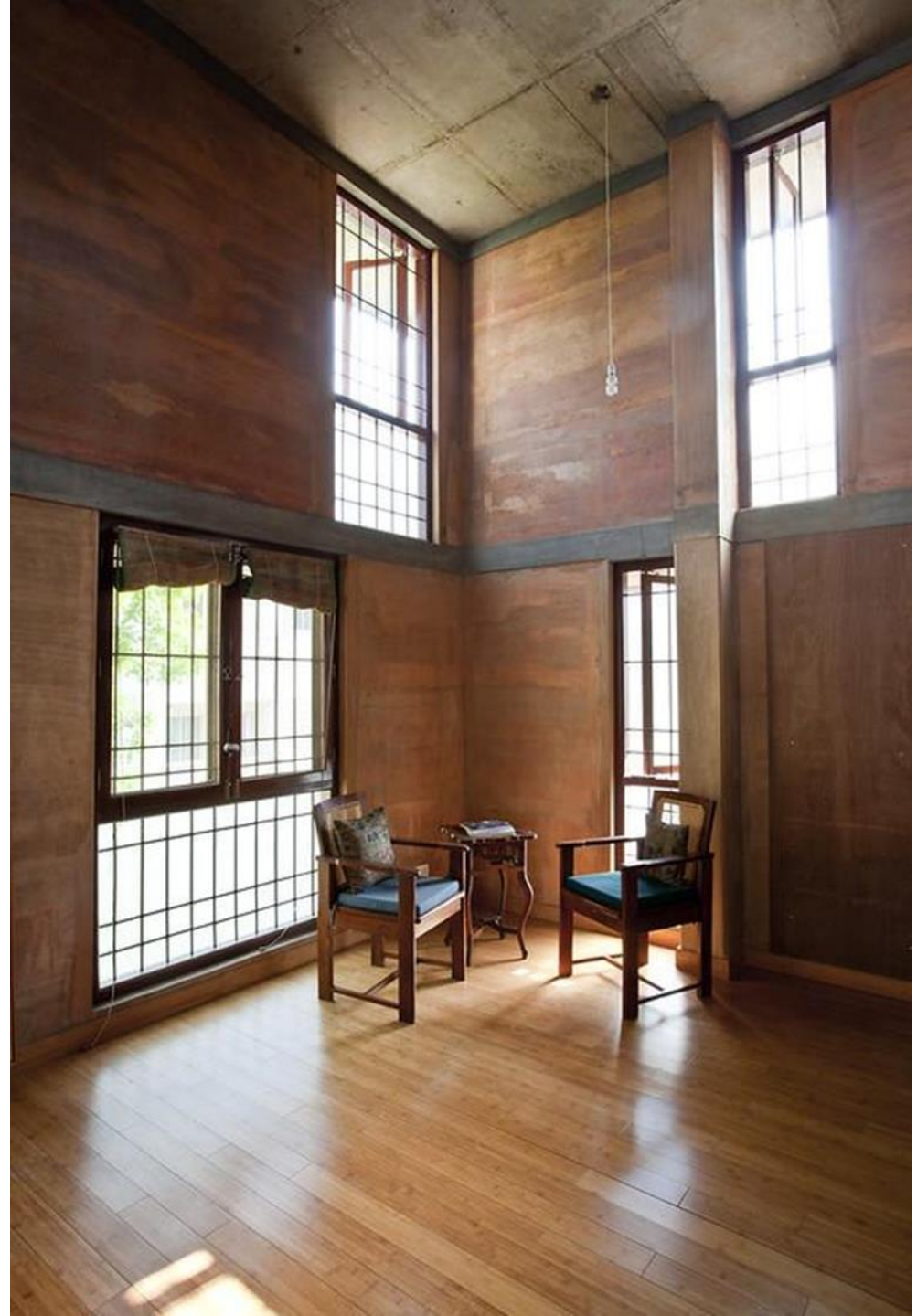

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Nothing is a WASTE.

1. BUILDINGS AS WASTE SINKS
2. USE OF CONSTRUCTION DEBRIS

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RESIDENCE FOR NIRODI 1994

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RESIDENCE FOR RAGHAVANS

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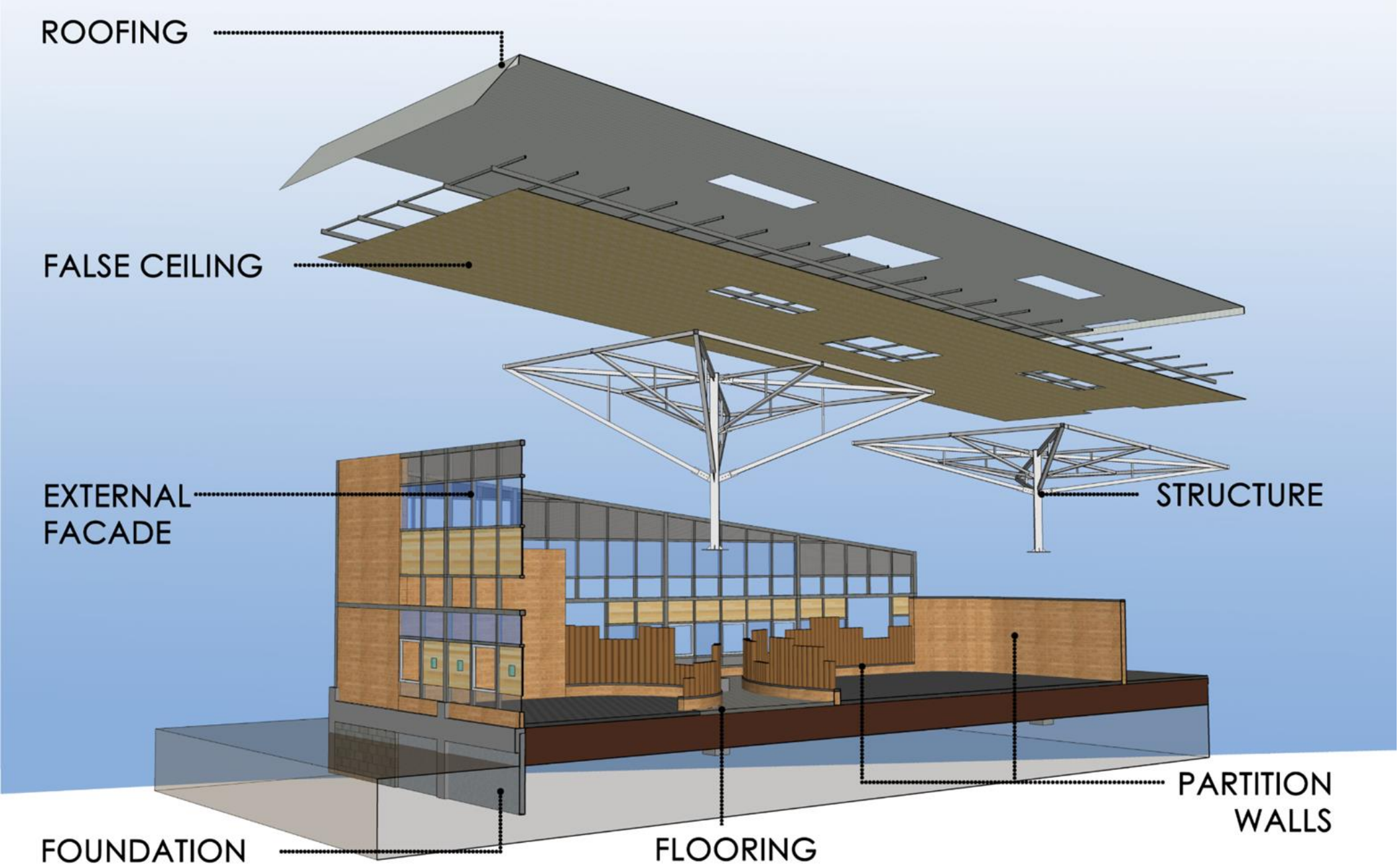

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THANKS

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	Units	Mini	Amit	Vasanthi	Uma	Ghosh	Sheeba
Plot Area	sq.m.	368.0	218.5	220.8	147.2	346.7	220.8
Built Up Area	sq.m.	290.9	272.0	389.6	175.5	151.4	225.0
Basement Area	sq.m.	80.9	64.7	126.0	0.0	0.0	0.0
Soil Available	cu.m.	**149.3**	**149.3**	**263.8**	**0.0**	**0.0**	**0.0**
Soil Required for Earth blocks	cu.m.	**55.2**	**55.6**	**38.8**	**43.9**	**27.1**	**47.0**
Embodied Energy/ Earth Walls	KJ/m3	406.0	412.0	290.0	333.0	270.0	348.0
Embodied Energy/ Burnt Brick	KJ/m3	1027.0	1043.0	734.0	844.0	683.0	881.0

Co-operative Collaborative Design Process

Embodied energy calculations from Auroville Earth Centre website

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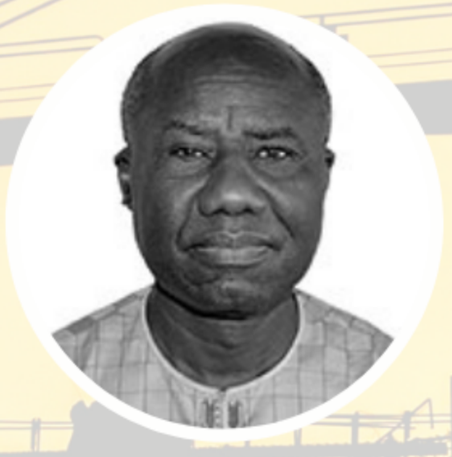
BUILDING MATERIALS
A HIDDEN HEAVYWEIGHT FOR THE CLIMATE



Asmae Khaldoun
Associate Professor, AUI, Morocco

Ernest Dione
Deputy Director, DEEC, Senegal

How can we scale-up local and bio-based materials to protect the climate?

Picture: Shivendu Shukla/Unsplash

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Africa-Europe BioClimatic buildings for XXI century

Strategies to tackle embodied carbon

Shift: local and bio-based materials

جامعة الأخوين
ⵜⴰⵙⴷⴰⵡⵉⵜ ⵏ ⵉⵅⴰⵡⵉⵏ
AL AKHAWAYN UNIVERSITY

Building materials – A hidden heavyweight for the climate
How can financing and policy support the decarbonisation of building materials and construction?

24 March 2022

Asmae Khaldoun
Al Akhawayn University
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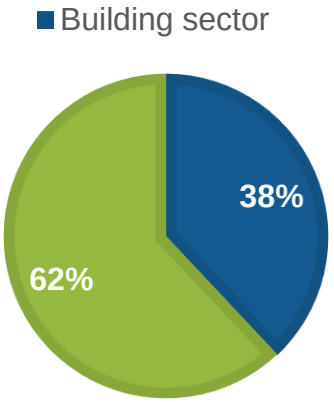
www.abc21.eu

ABC 21 project has received funding from the EU's Horizon 2020 research and innovation programme under Grant Agreement No. 894712.

Introduction

- **38% of total global energy-related CO2 emissions in 2020 is generated from building activities.**



Source: Programme and Construction 2020

- **Europe and Africa have a long history of Earth construction and therefore an accumulated experience of thousands of years. However, a noticeable switch to concrete based constructions can be observed in overall the word, this is leading to a loss of expertise in the field, loss of local jobs, increase of greenhouse gases and CO2 emission and decrease of the energy efficiency of the buildings.**

- **The ABC21 project gives special interest to design strategies that involve local bioclimatic approaches.**
- **Reduce energy consumption during material manufacturing, building construction and energy demand for cooling.**
- **Inspiration solutions already exist and are just waiting to be disseminated and adapted to other regions.**
- **Inspiration from nature: Saharan silver ants, Radiative cooling**

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Introduction

AFRICA-EUROPE BIOCLIMATIC COLLABORATION FOR THE 21ST CENTURY
ABC 21

Participant No. *	Participant short name	Participant organization name	Country
1	PoliMI	Politecnico di Milano	Italy
2	AMEE	Moroccan Agency for Energy Efficiency	Morocco
3	e7	e7 Energie Markt Analyse GmbH	Austria
4	FC.ID	Faculdade de Ciências da Universidade de Lisboa	Portugal
5	UN-Habitat	United Nations Human Settlements Programme UN-Habitat	Kenya
6	DEEC	Direction de l'Environnement et des Etablissements Classés/ Ministère de l'Environnement et du Développement Durable	Senegal
7	MATNUHPV	Ministry of National Territory Planning, Urban Planning, Housing and City Policy	Morocco
8	UR	University of La Réunion	France
9	EAMAU	Ecole Africaine des Métiers de l'Architecture et de l'Urbanisme	Togo
10	AUI	Al Akhawayn University in Ifrane	Morocco

ABC 21 project has received funding from the EU's Horizon 2020 research and innovation programme under Grant Agreement No.894712

Review of infrastructure for production of local construction materials in N-W Africa and EU

1. Active organizations in the context

2. Active manufacturers in production of construction materials

3. Green projects in Africa and EU

Country	Company	Contact	Activity	Examples of projects achieved

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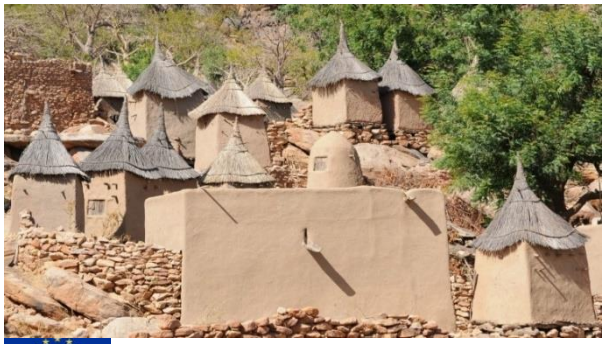
Review and analysis of materials and construction practices (local and/or adapted to local conditions)

Bio-climatic Materials Studied:

- Earth-based constructions, Adobe, Clay bricks with additives, Rammed earth and Earth-bags construction
- Stone
- Cork-based bricks
- Hempcrete
- Straw, Straw-bale construction and thatched roof
- Typha-based Bricks
- Wood
- Bamboo
- Wool

Methodology Followed during this study

- Properties analysis
- Obtainment process
- Construction practices and methods of application
- Cost assessment of bio-climatic constructions
- Regulations for bioclimatic construction and materials



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Review and analysis of materials and construction practices (local and/or adapted to local conditions)

Earth-based constructions

The adobe

Clay bricks with additives

Rammed earth

The Nubian vault technique

Earth-bags construction

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Earth-based constructions

Unfired clay bricks incorporating additives

- agro-additives with Rice husk, Date palm fiber, Palm bark fiber, Oil palm fruit bunch, Straw, Pineapple leaf fiber and nut shells
- industrial additives with Fly ash, Bottom ash, Molybdenum tailing, Waterworks sludge, Ceramic waste and Steel slag
- natural additives with Typha

Material	Comments	ρ (g/cm3)	C.S. (MPa)	λ (W/m.K)
Unfired pure clay bricks	When a high pressure is applied during the manufacturing of bricks, they are called Compressed Earth Bricks/Blocks (CEB). The addition of a chemical binder makes them stabilized.	1.50 to 2.00	0.35 to 7	0.21 to 0.5
Unstabilized Rammed Earth	The composition is about: 5% – 40% clay 15% – 40% silt 25% – 70% sand and fine gravel 25% – 46% liquid limits	1.79 to 2.19	0.81 to 2.46	0.6 to 1.6
Earth Bags	0.28 m thick roof system 0.35 m thick wall system	2.19	–	2.18

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Review and analysis of materials and construction practices (local and/or adapted to local conditions)

Organic residues-based bricks and blocs

Material	Comm.	ρ (g/cm3)	C.S. (MPa)	λ (W/m.K)
Cork	50% cement, 50% cork	0.77	2.65	0.29
	25% cement, 75% cork	0.61	1.72	0.19
Hempcrete	_	0.291 to 0.920	0.18 to 4.0	0.179 to 0.542
Papercrete	Composition: Paper/ Cement/Sand λ and C.S. decrease with increase of paper content	0.4 to 1	1.6 to 5	0.79 to 1.21
Typha	Clay and Typha	0.2 to 1.5	0.31 to 1	0,04 to 0,2

Cork

Hempcrete

Papercrete

Typha

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Review and analysis of materials and construction practices (local and/or adapted to local conditions)

Stone

	Sandstone	Limestone	Granite	Basalt	Marble	Slate
ρ (g/cm³)	2.00 to 2.53	1.63 to 2.70	2.60 to 2.67	2.68 to 2.71	2.65 to 2.7	2.7 to 3.1
λ (W/m,K)	0.65 to 1.69	0.76 to 2.04	1.34 to 3.69	0.51 to 2.03	1.59 to 4.00	–
C.S (MPa)	25 to 100	25 to 165	130 to 300	115 to 200	75 to 135	90 to 220

House built with stones in Ifrane – Morocco

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Straw bale construction

Comm.	ρ (g/cm3)	δ (MPa)	λ (W/m.K)
Type of application (load-bearing or not) and the orientation of bale are highly affecting those properties. A load-bearing application requires a density not less than 130 Kg/m3, but as a second application, no restrictions are dictated.	0.06 to 0.18	0.05 to 0.9	0.03 to 0.194

- Individual straw bales are laid in courses to form walls of buildings without a binder, then coated.
- Straw bales buildings have significantly lower embodied energy and embodied carbon than conventional materials.

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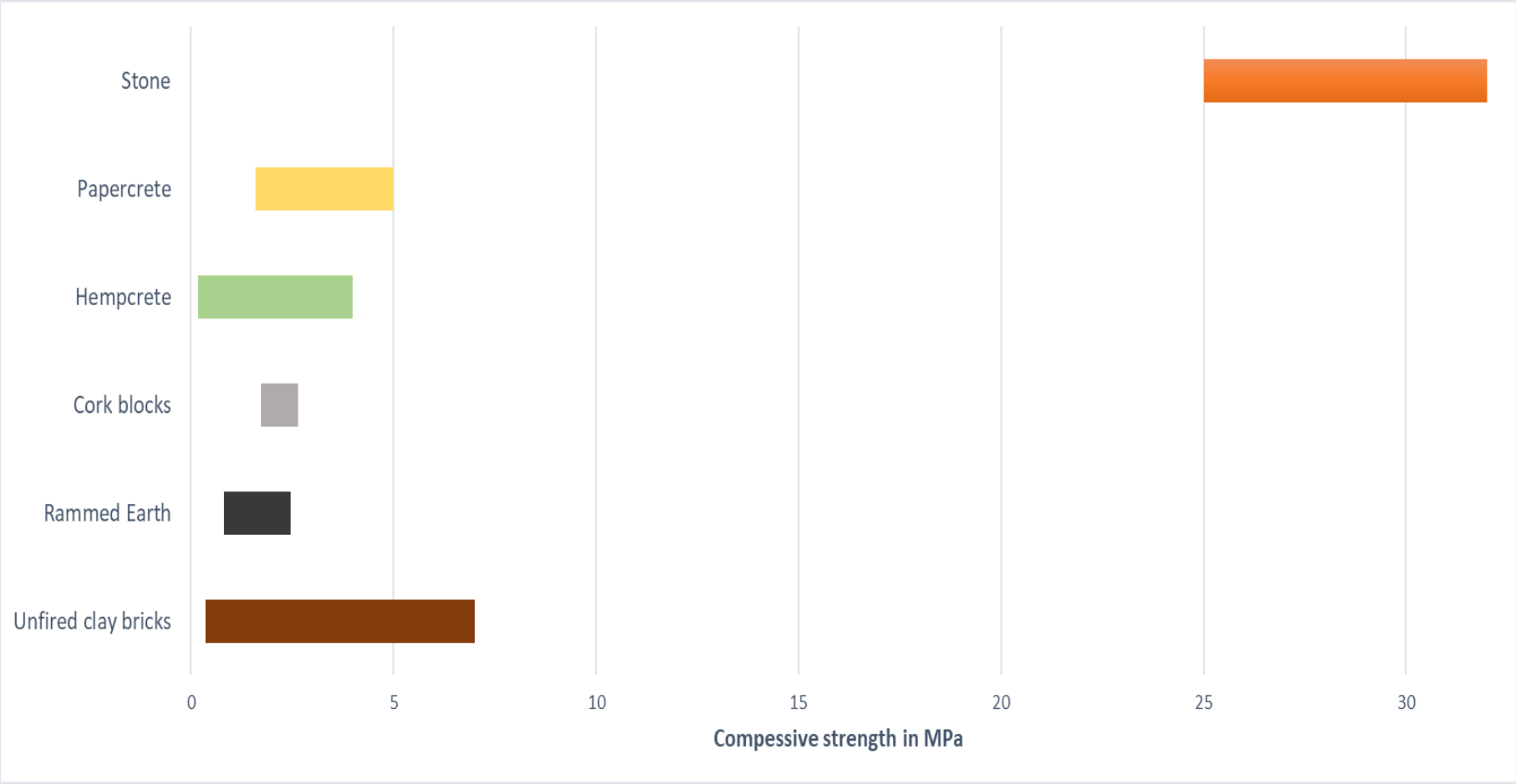
Review and analysis of materials and construction practices (local and/or adapted to local conditions)

Mechanical properties



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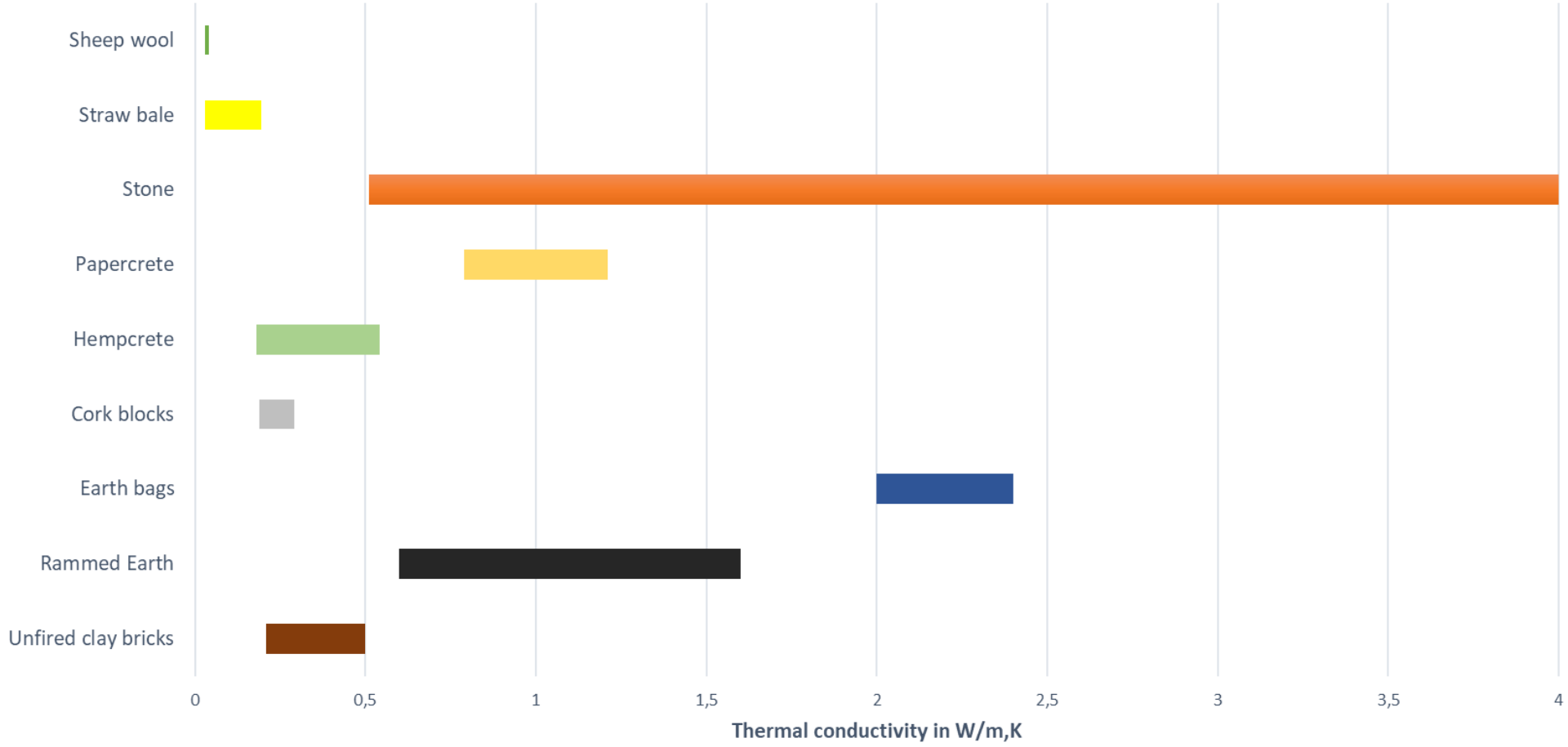
Review and analysis of materials and construction practices (local and/or adapted to local conditions)



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Thank You!
Q & A

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www.abc21.eu

Africa-Europe BioClimatic Collaboration 21

Africa-Europe BioClimatic buildings for XXI century

BUILDING MATERIALS
A HIDDEN HEAVYWEIGHT FOR THE CLIMATE

What is needed to reduce emissions from materials such as cement and steel?

Anupam Badola
Assistant General Manager,
Dalmia Cement

Marlène Dresch
Development lead,
ACT Initiative

Picture: Shivendu Shukla/Unsplash

Global Alliance for Buildings and Construction

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How can ACT help decarbonize conventional materials?

PEEB webinar
Building materials – A hidden heavyweight for the climate

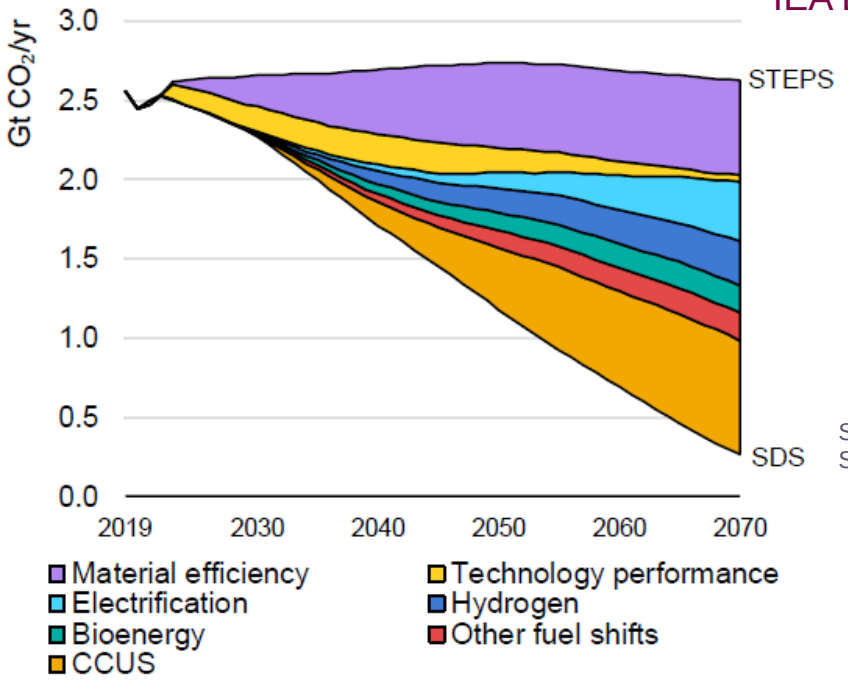
Marlène DRESCH – ADEME / ACT Initiative

24th March, 2022

Challenges for conventional materials

Global CO2 emissions reductions by mitigation strategy

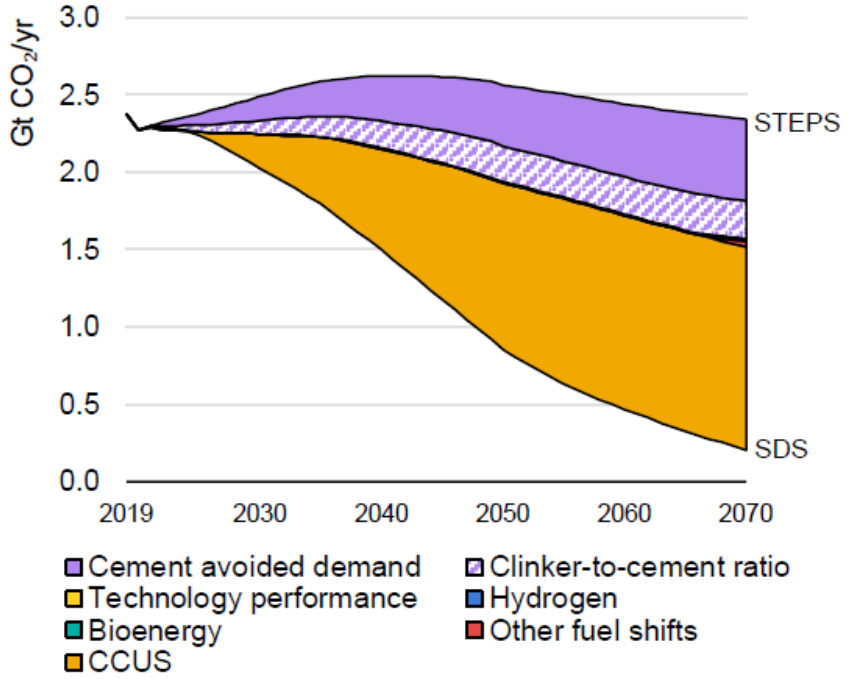
IEA Energy Technology Perspectives, 2020



IRON & STEEL

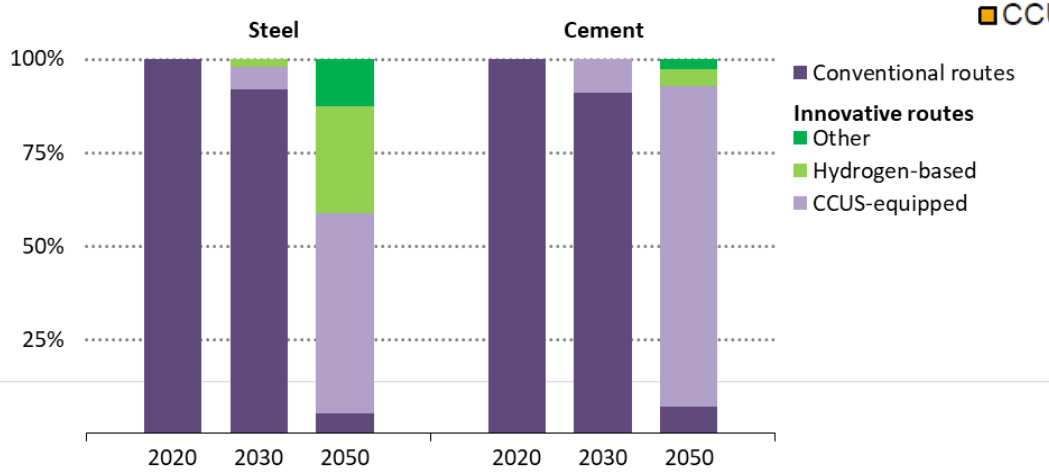
CEMENT

SDS: Sustainable Development cenario
STEPS: Stated Policies Scenario



Global industrial production of steel and cement by production route

IEA (2021), Net Zero by 2050



What does ACT provide?

ACT | ASSESSING LOW CARBON TRANSITION®

ACT

ACT STEP BY STEP

Companies can be assisted by a trained advisor

Goal: Develop low-carbon strategy with associated transition plan and implement it

For: Early-stage companies

1. Current situation
2. Issues & challenges
3. Vision
4. New strategy
5. Action plan

4 PRACTICAL TOOLS

3 CHECKPOINTS TO VALIDATE PROGRESS

Low-Carbon Transition Strategy

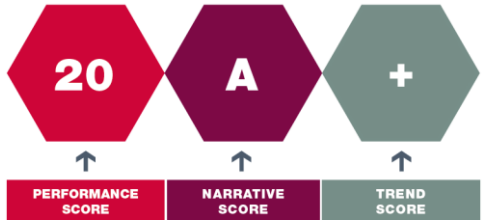
1 Target
2 Material Investment
3 Immaterial investment
4 Sold product performance
5 Management
6 Supplier engagement
7 Client engagement
8 Public engagement
9 Business Model

ACT ASSESSMENT

Companies can be assisted by a trained assessor

Goal: Measure the alignment of low-carbon strategy with the Paris Agreement goal

For: Companies with science based targets and transition plan



Sectoral methodologies for high emissive sectors - Among them:

IRON & STEEL

CEMENT

BUILDING

How can ACT help decarbonize conventional materials ?

IRON & STEEL

CEMENT

ACT helps companies explore decarbonisation levers…

- Improve their low-carbon strategy
- Communicate

Company

…and ACT also helps stakeholders challenge companies, have a view on their decarbonisation transition and foster them to make progress

- Dialogue
- Compare companies within the same sector

Investor

- Challenge companies

e.g. WBA benchmarks

NGO

- Subsidies
- National voluntary programs

Policy maker

Co-founded by

Recognized by

Thank you!

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