

HOUSING, HEAT, HEALTH

**Co-producing Passive Cooling Strategies and
Promoting Health in Informal and Precarious Settlements**

Extreme Heat Action in Cities and Communities

Cool Talks - Cool Coalition - UNEP

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Introduction: People & Funding

U-M Faculty and Researchers

Ana Paula Pimentel Walker, PhD in Anthropology, M.U.R.P.; Law Degree, Associate Professor in Urban and Regional Planning Program

Lars Junghans, PhD in Building Science, Associate Professor of Architecture Program

Gabriel Harp, Director of Research and Creative Practice Development, Taubman College

Ana Morcillo Pallarés, PhD, Associate Professor of Architecture

Jonathan Rule, MArch, Assistant Professor of Practice

Carina J. Gronlund, PhD, MPH, Research Associate Professor, Institute for Social Research and School of Public Health

María Arquero de Alarcón, MArch, MASLA, MLAUD, Associate Professor of Architecture and Urbanism

Marie O'Neill, PhD, Professor in Environmental Health Sciences and Epidemiology

Mieko Yoshihama, PhD, LMSW, ACSW, Distinguished Professor of Social Work

Odessa Gonzalez Benson, PhD, MSW, Assistant Professor of Social Work

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Support

Seed Grant, U-M Center for Global Health Equity

Pressing Matters Grant, Taubman College of Architecture and Urban Planning

2023 BOOST Program, UM-OVPR's Bold Challenges

University of Heidelberg Institute for Global Health (HIGH)

Global Heat Health Information Network (GHHIN)

Research Catalyst and Innovation (RCI) Award, Survey Validation,

Taubman College of Architecture and Urban Planning

Building Better Futures Grant, Office of the Vice President for Research (OVPR) and the National Center for Institutional Diversity

Introduction: Research Partners

BRAZIL - SÃO PAULO - UMM - UNIÃO DOS MOVIMENTOS DE MORADIA DE SÃO PAULO

Marilene Ribeiro de Souza and Sheila Cristiane Santos Nobre, União dos Movimentos de Moradia de São Paulo (UMM-SP)
Dr. Benedito Roberto Barbosa, Coordinator of the Central de Movimentos Populares (CMP), Co-founder of the União dos Movimentos de Moradia de São Paulo and Lawyer of the Center Gaspar Garcia for Human Rights

BRAZIL - SÃO PAULO - ULCM Unificação das Lutas de Cortiço e Moradia

Sidnei Pita, coordenador da UMM and co-fundador da ULCM
Pai Ale Padilha, community leader, Estrela de Davi.
Martinha Araujo, coordinator of ULCM

BRAZIL - SÃO PAULO -PEABIRU TRABALHOS COMUNITÁRIOS E AMBIENTAIS

Caio Santo Amore, Professor at University of São Paulo (USP), architect with Peabiru Trabalhos Comunitários e Ambientais
Larissa Hiratsuka and Beatriz Lustosa Ribeiro Cieto, Peabiru Trabalhos Comunitários e Ambientais and University of São Paulo (USP)
Nunes Lopes Reis, architect
Dr. Cintia Fidelis, Social worker and researcher

COLOMBIA - BUCARAMANGA - LUZ DE SALVACIÓN II

Julian Constantino Carvajal Miranda, Research Associate and legal expert in land regularization
Dr. Carlos E. Vecino Arenas, Professor of Engineering and Director of External Affairs, Universidad Industrial de Santander, Bucaramanga, Colombia.
Junta de Acción Comunal de Luz de Salvación II
Jesus Adolfo Peñaloza Contreras, Angie Natalia Gil Martinez, Sergio Andres Ortiz Rodriguez, architects with Alcaldia de Bucaramanga

Introduction: The Issue

Heat is the deadliest of all extreme weather events.

- U.S - heat kills more people each year than hurricanes, tornadoes, and floods combined.
- Heat-wave excess deaths were $\sim 20\times$ higher than landslide deaths across 14 Brazilian metros between 2000 and 2018.

Indoor heat significantly exacerbates heat stress and heat-related illness.

- **Homes**—especially self-built or precarious structures—can become **heat traps**.

Yet most heat-planning and climate-adaptation efforts focus almost entirely on outdoor temperatures.

- Indoor heat in precarious housing remains unmeasured, unregulated, and overlooked — even though it is where people spend most of their time during heat waves.

HOUSES CAN BECOME HEAT TRAPS!



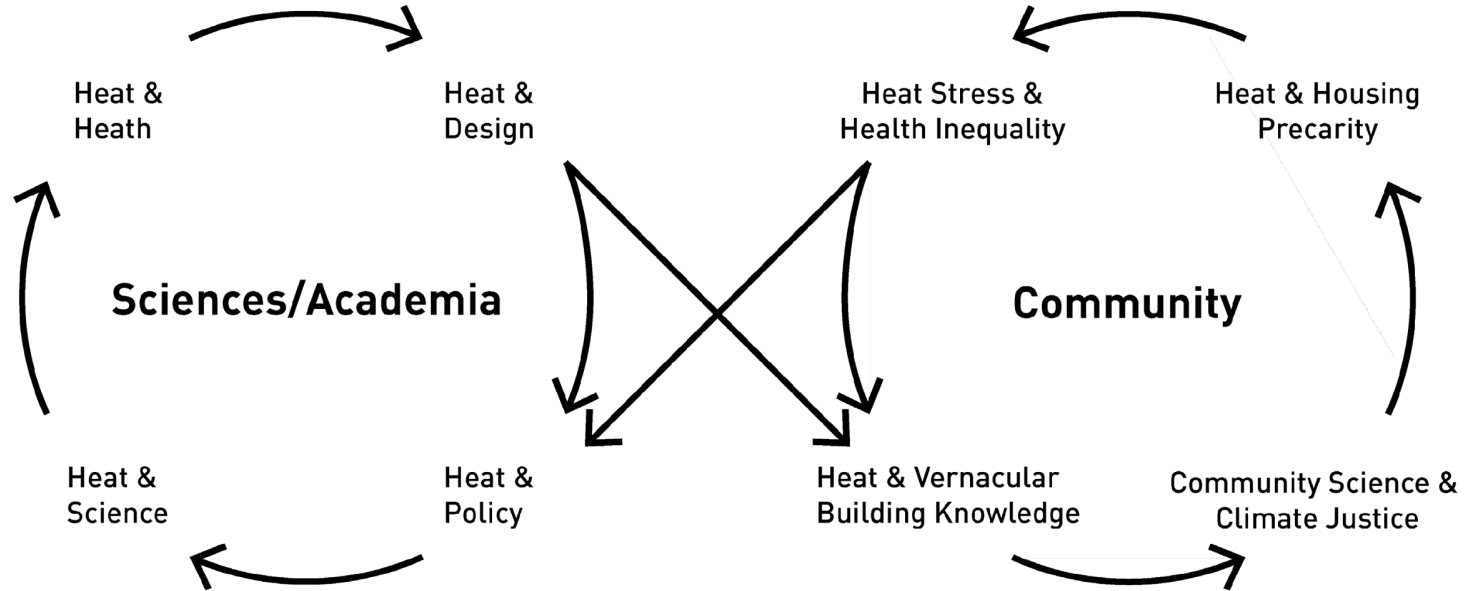
Introduction: Research Objective

Our research collective advances work on **housing modifications that improve indoor thermal comfort** and reduce the health harms of extreme heat by **co-designing passive cooling retrofits with residents of informal and precarious settlements**.

Grounded in **participatory action research (PAR)**, we combine **thermal modeling, low-cost retrofit prototyping** (roof treatments, secondary roofs, shading, ventilation and insulation), and **community-led implementation** to generate culturally appropriate, scalable interventions that protect health, strengthen local capacity, and **reclaim the home as a climate-resilient refuge**.

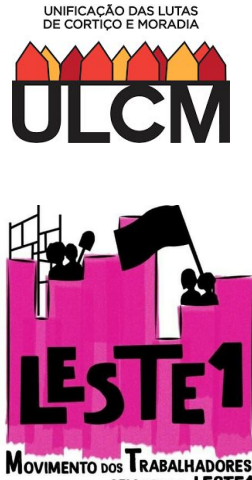
Introduction: Participatory Action Research Approach

Science-Community Co-Production



Introduction: Research Partners in São Paulo, Brazil

Some Local Movements Affiliated with UMM – SP



UMM-SP Union of Housing Movements (state level)



UNMP National Union for Popular Housing (national level)



Some National & International Coalitions



Secretaría
Latinoamericana de
la Vivienda y el
Hábitat Popular



Introduction: Research Partners in São Paulo, Brazil

Favela Secretariat:
Tenure security
Land regularization
Grassroots upgrading plans



Social Services
Legal Aid
Policy Advocacy
Technical Assistance
Popular Education
Organizing

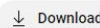
Collectively managed,
“autogestão” via mutual
aid/joint effort “mutirão”



Introduction: Activist Participatory Action Research (PAR)



Autogestão, Já!



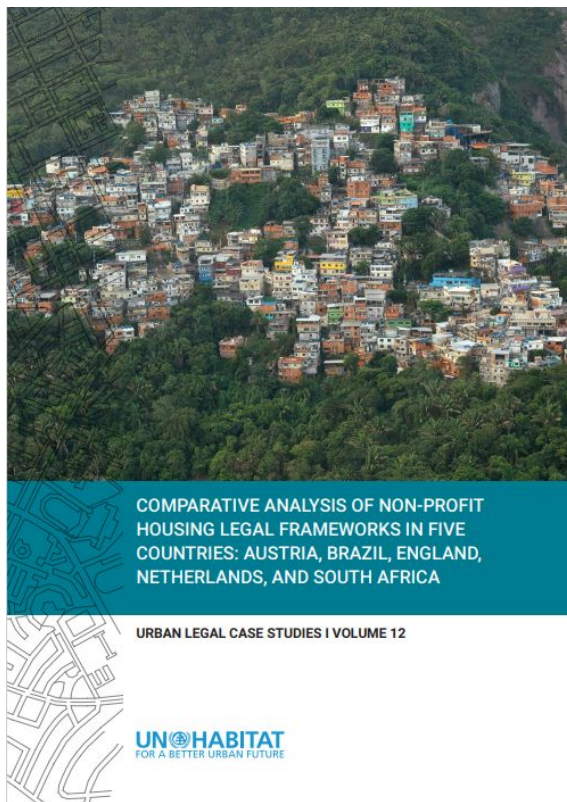
831 views 4 years ago

No description has been added to this video.

Policy Analysis &
Advocacy
Campaign

Supporting the
UMM Bill in
Congress
Institutionalizing
Movement-Led,
Self-Management
Low-Income
Housing at the
Federal Level in
Brazil

Introduction: Activist Participatory Action Research (PAR)



Comparative Analysis of Non-Profit Housing Legal Frameworks in Five Countries: Austria, Brazil, England, Netherlands, and South Africa

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COVER PHOTO:

Vidigal Favela at Dois Irmaos Hill (Morro Dois Irmaos) - Rio de Janeiro, Brazil by Diegograndi. source: envato elements.

URBAN LEGAL CASE STUDIES | VOLUME 12

Introduction: Activist PAR in São Paulo, Brazil

Greening low-income, collectively managed housing projects.



TREE SPECIES

List of Tree Species for the Atlantic Forest. Small and Medium to Large sized trees

(P = Pioneer Species, NP = Non-Pioneer Species; Zoo = Zoocoric, Ane = Anemocoric, Aut = Autochoric)

Scientific Name	Popular Name	Type	Groups	Disperse
<i>Citronella megaphylla</i> (Miers) Howard. (9), (24)	Congonha	Tree	NP	Zoo
<i>Lacistema pubescens</i> Mart. (21), (30a), (34)	Pipira food	Tree	NP	Zoo
<i>Cryptocarya moschata</i> Mez. (14), (23b)	Cinnamon	Tree	NP	Zoo
<i>Mollinedia oligantha</i> Perkins. (17)	Pepper	Tree	NP	Zoo
<i>Nectandra puberula</i> Nees. (14)	Brown cinnamon	Tree	NP	Zoo
<i>Bauhinia longifolia</i> (Bong.) Steud. (16)	Cow's claw	Tree	P	Aut
<i>Inga fagifolia</i> Willd. (35)	Inga	Tree	P	Zoo
<i>Andira antherlmia</i> (Vell.) J.F. Macbr. (8), (17)	Garacui	Tree	P	Zoo
<i>Lonchocarpus guilleminianus</i> (Tulle) Malme (13b), (21)	Frog Embira	Tree	P	Ane
<i>Aromatic Campomanesia</i> (35)	Guabironinha	Tree	P	Zoo



Follow the QR code for a complete list of Atlantic Forest species permissible to plant in an APP zone.

Viveiro de mudas é inaugurado na Zona Leste de SP para recuperar área de preservação

Os organizadores afirmam que o viveiro pode servir como apoio na arborização urbana de outros mutirões da cidade. A ideia é unir a luta por moradia à luta ambiental.

Por SP2 — São Paulo

07/05/2022 21h31 · Atualizado há 2 anos



Viveiro de mudas é inaugurado na Zona Leste da cidade de SP

Introduction: Activist PAR in São Paulo, Brazil

Article

Planning
Theory

Activist Co-production for the Right to Occupy, Hold Ground, and Upgrade

Planning Theory
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Abstract

This article theorises a multi-year participatory action research engagement focusing on young land occupations and consolidated favelas in São Paulo's south periphery, providing an arsenal of tools for activist-scholars. Building on Paulo Freire's legacy, we call on academia to embrace activist co-production, learn from and support informal dwellers' everyday urbanisms, and join social movements' struggles for social transformation. We advance three modalities of action: awareness raising through emancipatory education and capacity building; *articulação* through knowledge exchange between young and

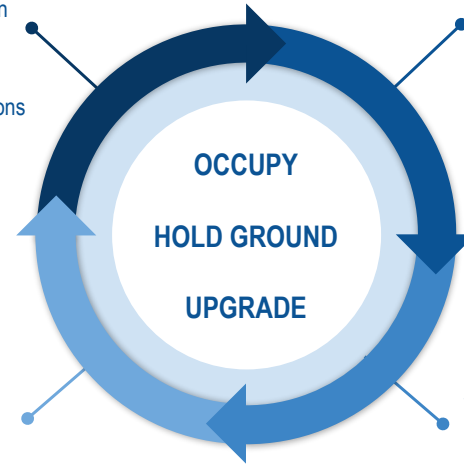
Activist PAR For the Right to Occupy, Hold Ground and Upgrade

PARTICIPATORY ACTION RESEARCH

Community Organizing Coalition
Capacity Building+Advocacy
Right to the city realized
E.g. 14 Favelas + Land Occupations
2016-ongoing

INTERNATIONAL SERVICE LEARNING

Studio + Capstone
Ocupação Anchieta, Forward!
2016-ongoing



CREATIVE PRACTICE
Grant-seeking + Network building +
Prototyping
Alumni, Students,
Faculty, Local partners at E.g. Jd. Gaivotas
2019-ongoing

SCHOLARLY DISSEMINATION
Academic publications
Conference presentations, including
professional conferences
2018-ongoing

With Prof. Arquero de Alarcón

Introduction: Activist PAR in São Paulo, Brazil

Ocupação Anchieta: History of Collaboration



Anchieta Association Headquarters, UM capstone-studio collaboration, Dow 2017



Peabiru Technical Advisory Firm, mutual aid housing project

Introduction: Activist PAR in São Paulo, Brazil

Ocupação Anchieta: History of Collaboration



Housing Policy Debate



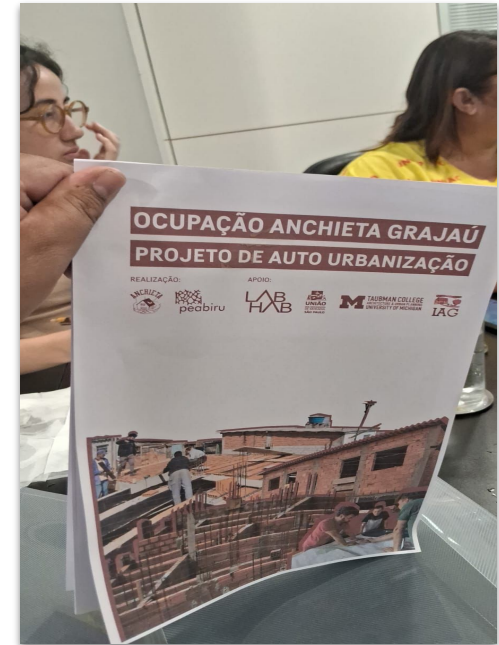
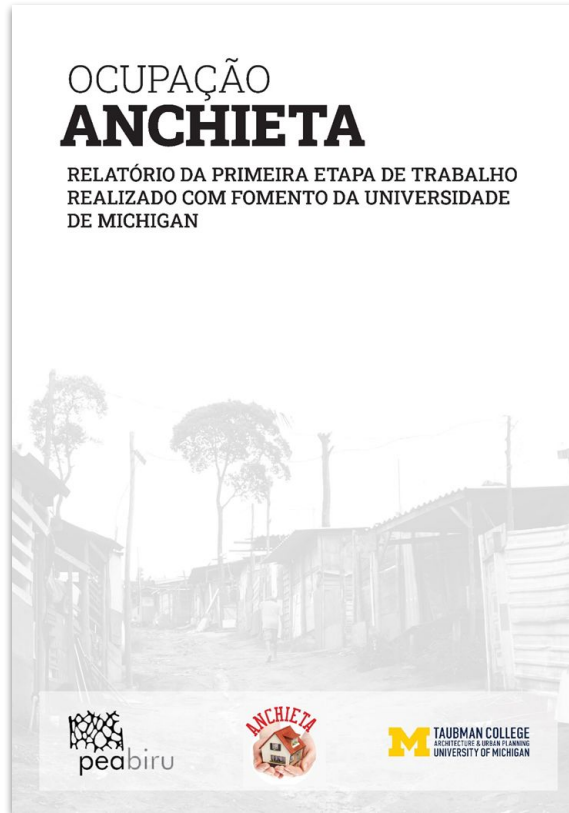
ISSN: (Print) (Online) journal homepage: www.tandfonline.com/journals/rhpd20

Young Land Occupations and the Failure of Housing Policy in Brazil

Ana Paula Pimentel Walker, María Arquero de Alarcón, Caio Santo Amore,
Nunes Lopes dos Reis, Neetu Rajkumar Nair, Jessica Yelk & Yunsong Liu

To cite this article: Ana Paula Pimentel Walker, María Arquero de Alarcón, Caio Santo Amore,
Nunes Lopes dos Reis, Neetu Rajkumar Nair, Jessica Yelk & Yunsong Liu (2023) Young Land
Occupations and the Failure of Housing Policy in Brazil, Housing Policy Debate, 33:3, 597-618,
DOI: [10.1080/10511482.2021.1924825](https://doi.org/10.1080/10511482.2021.1924825)

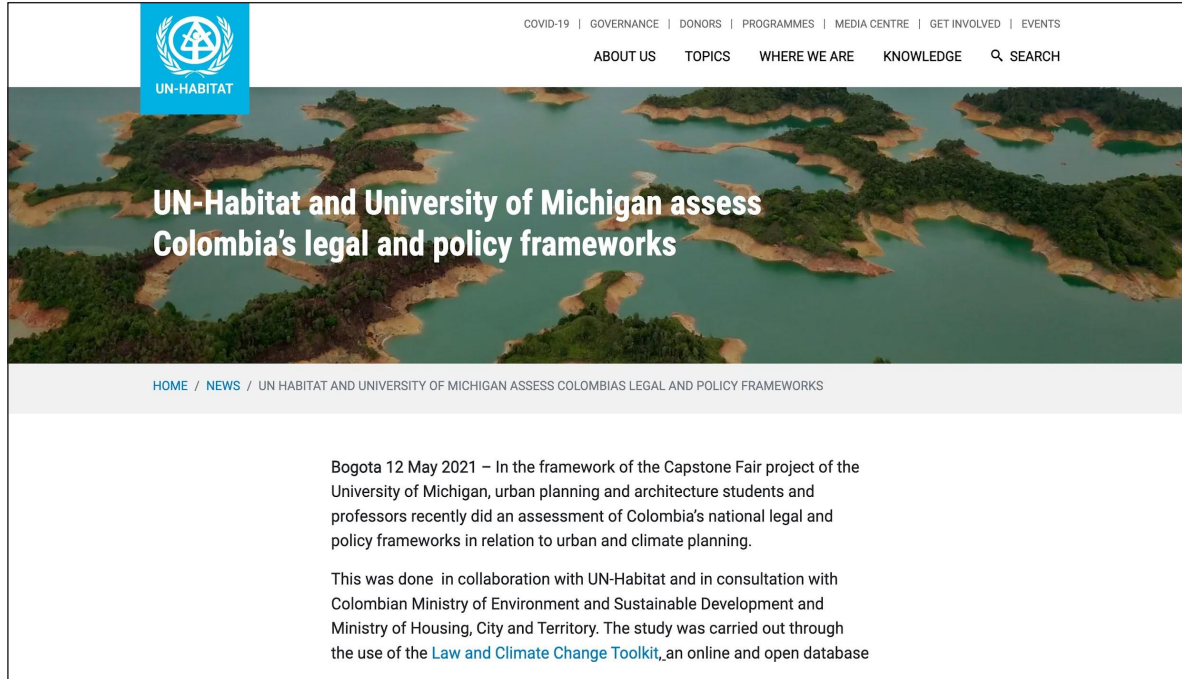
To link to this article: <https://doi.org/10.1080/10511482.2021.1924825>



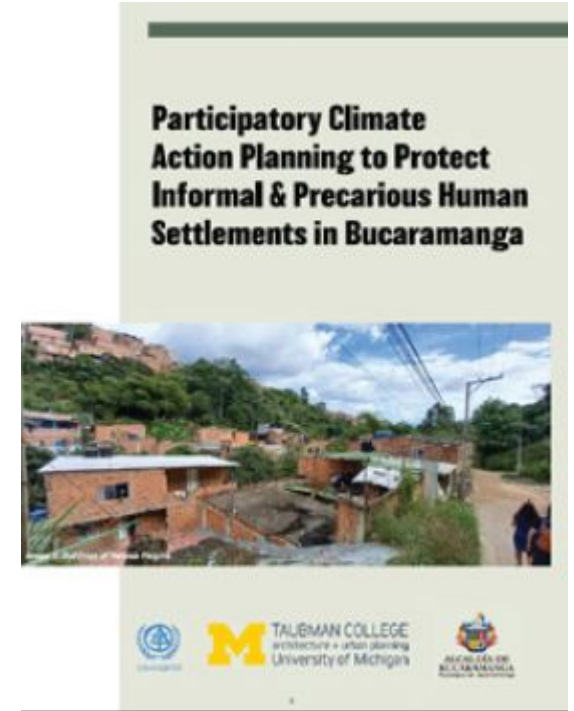
Anchieta Occupation Collecilly
Managed, Resident-Led Upgrading
Project led by Peabiru

Introduction: Community-Based PAR in Colombia

History of Collaboration with Luz de Salvación's II Community Action Board



The screenshot shows a UN-Habitat news article. The header includes the UN-Habitat logo and navigation links: COVID-19, GOVERNANCE, DONORS, PROGRAMMES, MEDIA CENTRE, GET INVOLVED, EVENTS, ABOUT US, TOPICS, WHERE WE ARE, KNOWLEDGE, and a search icon. The main headline reads: "UN-Habitat and University of Michigan assess Colombia's legal and policy frameworks". Below the headline is a breadcrumb trail: HOME / NEWS / UN HABITAT AND UNIVERSITY OF MICHIGAN ASSESS COLOMBIAS LEGAL AND POLICY FRAMEWORKS. The article text begins with: "Bogota 12 May 2021 – In the framework of the Capstone Fair project of the University of Michigan, urban planning and architecture students and professors recently did an assessment of Colombia's national legal and policy frameworks in relation to urban and climate planning. This was done in collaboration with UN-Habitat and in consultation with Colombian Ministry of Environment and Sustainable Development and Ministry of Housing, City and Territory. The study was carried out through the use of the Law and Climate Change Toolkit, an online and open database".



The image shows the cover of a report. The title is "Participatory Climate Action Planning to Protect Informal & Precarious Human Settlements in Bucaramanga". Below the title is a photograph of a hillside with informal settlements. At the bottom, there are logos for UN-Habitat, Taubman College of Architecture & Urban Planning at the University of Michigan, and the Municipality of Bucaramanga.

Introduction: Community-Based PAR in Bucaramanga, Colombia

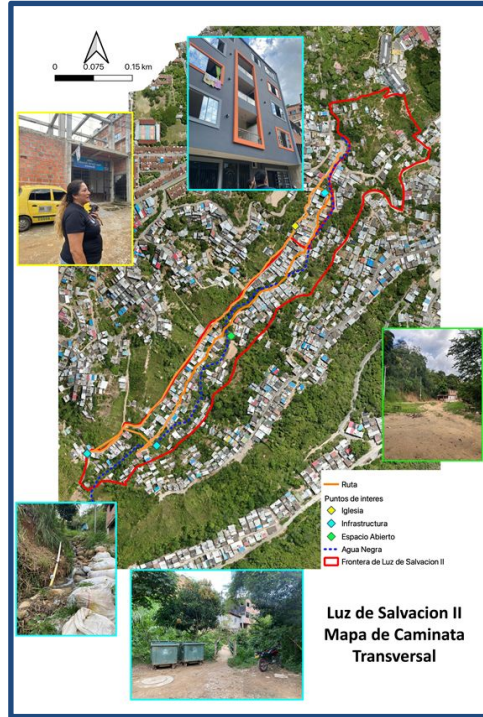
2022 Climate Action Workshops in Luz de Salvación II



Participatory Mapping and Community Chronology in Luz De Salvación II with the **Community Action Board**, Dr. Julian Constantino Carvajal Miranda, legal legalization department of Bucaramanga City, and University of Michigan team August 2022

Introduction: Community-Based PAR in Bucaramanga, Colombia

2022 Climate Action Workshops in Luz de Salvación II



Transect Walk in Luz De Salvación II with the **Community Action Board**, Dr. Julian Constantino Carvajal Miranda, legal legalization department of Bucaramanga City, and University of Michigan team August 2022

Introduction: Community-Based PAR in Bucaramanga, Colombia

Direct Observation Checklist

(ask questions, take pictures as you walk)

- ☐ Fire in the past (question) (Incendio)
- ☐ Dangerous electricity (next to trees)
- ☐ Flood (Inundacion)
- ☐ Trash accumulation (Basura)
- ☐ Open Dumpsite (Botero Abierto)
- ☐ Trash Bins (Contenedor de Basura)
- ☐ Mudslide (Deslizamiento de Lodo)
- ☐ Landslide (Deslizamiento)
- ☐ Washout (Avalancha, erosión causado por lluvia fuerte)
- ☐ Erosion (Erosion)
- ☐ Open sewage (Alcantarillado Abierto)
- ☐ Water tank (Caja D'agua)
- ☐ Visible provisory hose (Manguera provisorio de Agua)
- ☐ Water meter (Reloj Dagua)
- ☐ Well water (Pozo de agua)
- ☐ Paved roads (Carretera pavimentada)
- ☐ Dirt road (Camino de Tierra/Calle no Pavimentada)
- ☐ Cobblestone roads

2022 Climate Action Workshops in Luz de Salvación II: Direct Observation Checklist



Introduction: Community-Based PAR in Bucaramanga, Colombia

2022 Climate Action Workshops: HEAT AND WATER INSECURITY AS MAJOR ISSUES



Community Center

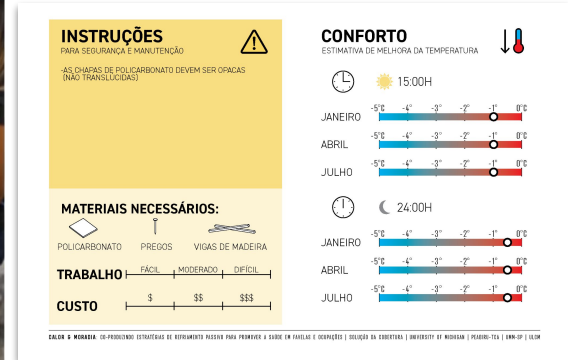
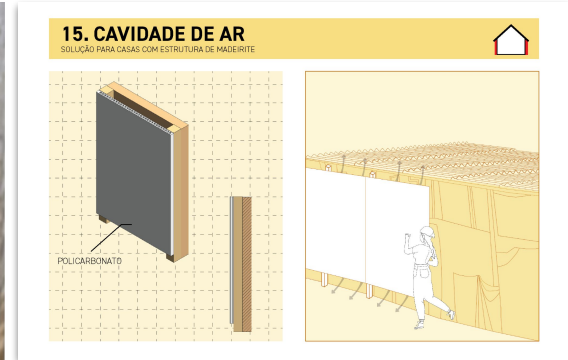
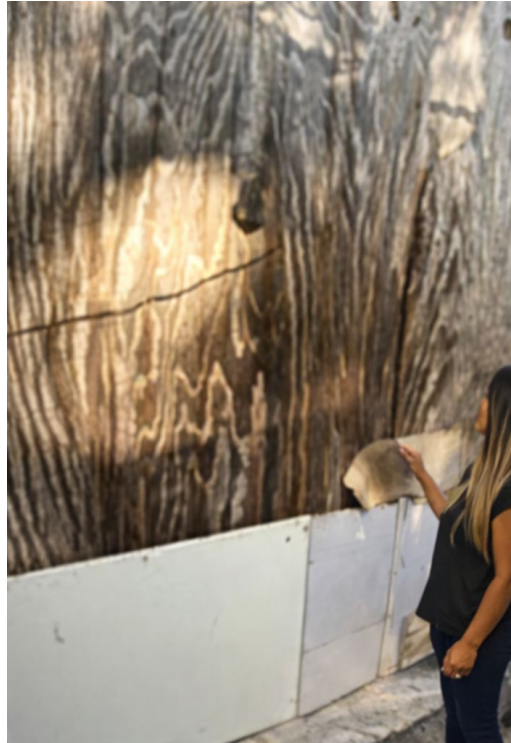
Theory of Change: Scaling Societal Impact: Level #1

Learning and doing with what you have

Zero-investment, self-built practices strengthened through *popular architectural education*, *thermal comfort literacy*, and *health-focused capacity building*.

Pursuing immediate action

Simple, no-cost modifications that improve indoor heat conditions using existing materials, skills, and routines.



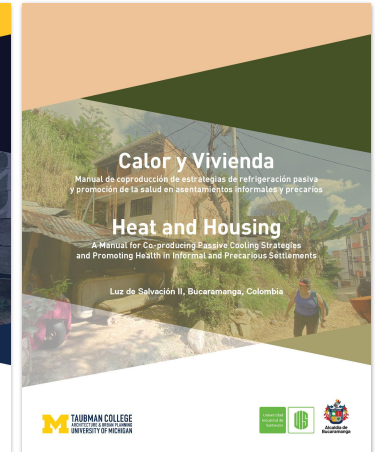
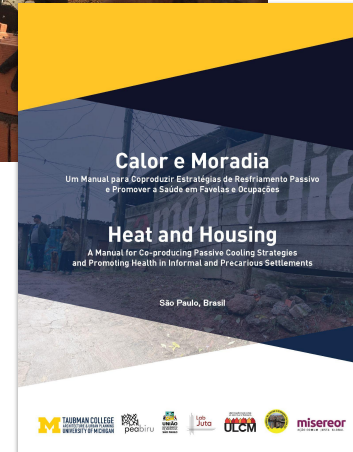
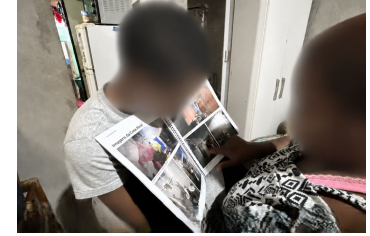
Theory of Change: Scaling Societal Impact: Level #2

Accelerating mutual aid

Savings groups, housing movements, and neighborhood associations act as **multipliers** of community-led implementation.

Strengthening collective power

Organized groups accelerate adoption, reinforce shared learning, and sustain low-cost passive cooling practices.



Theory of Change: Scaling Societal Impact: Level #3

Transforming Policy through Advocacy and Collaboration

Integrating passive cooling into housing and settlement planning.

Promoting Industry Engagement, Tax Incentives and Building Code Reform



Research Sites & Communities

BRAZIL
SÃO PAULO
OCUPAÇÃO ANCHIETA



COLOMBIA
BUCARAMANGA
LUZ DE SALVACIÓN II



BURKINA FASO
NOUNA



Introduction: Climate Matters

BRAZIL

SÃO PAULO STATE



Af, Ecuatorial o tropical húmedo
Tropical rainforest

Am, Tropical monzónico
Tropical monsoon

Aw, Tropical de sabana
Tropical savanna

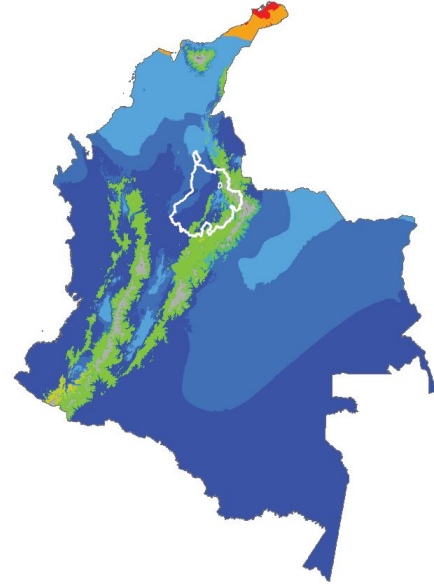
BSh, Semiárido cálido
Hot semi-arid

Csb, Mediterráneo oceánico
Warm-summer Mediterranean

Csc, Mediterráneo subalpino
Cold-summer Mediterranean

COLOMBIA

BUCARAMANGA
(WHITE BOUNDARY)



Cwb, Templado con invierno seco
Subtropical highland

Cwc, Subalpino con invierno seco
Cold subtropical highland

Cfb, Oceánico templado
Oceanic

Cfc, Subpolar oceánico
Subpolar oceanic

ET, Tundra
Tundra

EF, Gélido o glacial
Ice cap

Introduction: São Paulo's Communities

Ocupação Anchieta, South Zone



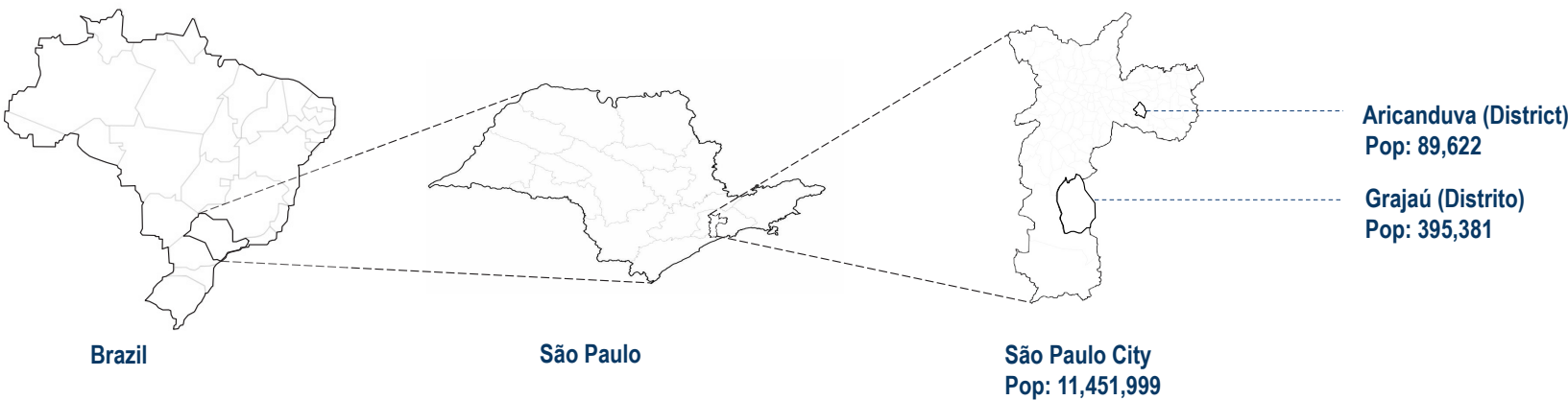
Introduction: São Paulo's Communities

Ocupação Estrela de Davi, East Zone

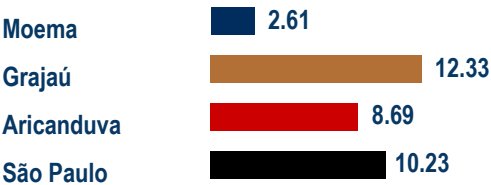


Introduction: São Paulo's Health Disparities

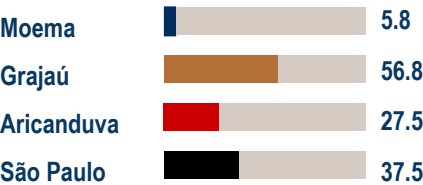
A City of Contrasts: Life Chances Across São Paulo's Districts: The settlement health effect



Infant Mortality (per 1,000 births)



% Black and Brown Population

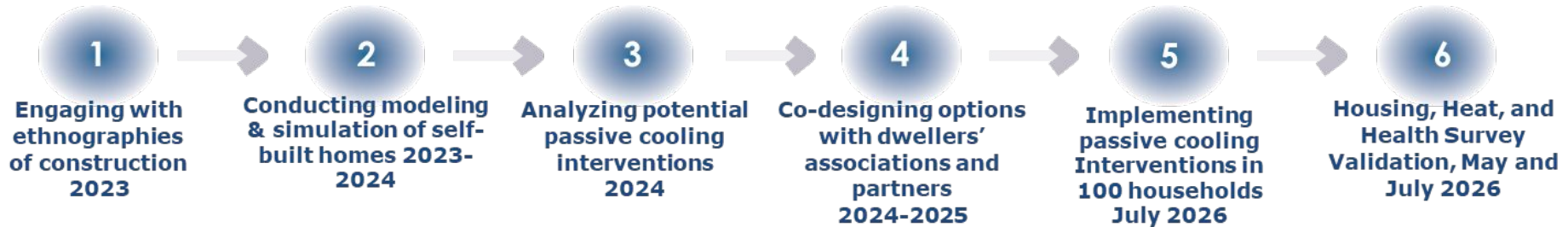
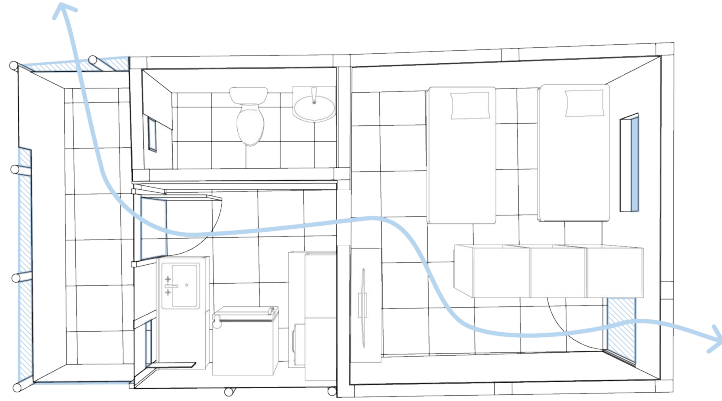


Life Expectancy (years)



Fonte: Nossa São Paulo, 2023.

Introduction: Research Process & Steps



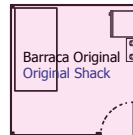
STEP 1. Engaging with ethnographies of construction

Jenny's House

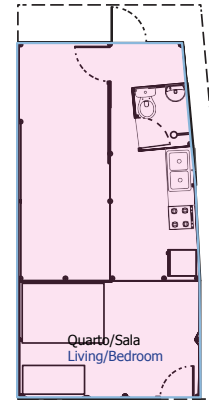
Shack made of plywood and recycled materials
17 types of material on the walls, ranging from plywood to closet boards, plastic, and fabric



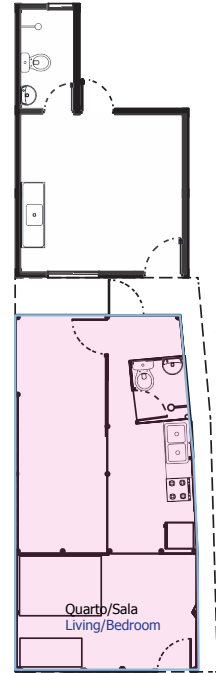
*Passive cooling retrofits
align with incremental
housing practices*



Original Shack



Current House
with Extension



Planned
Extensions

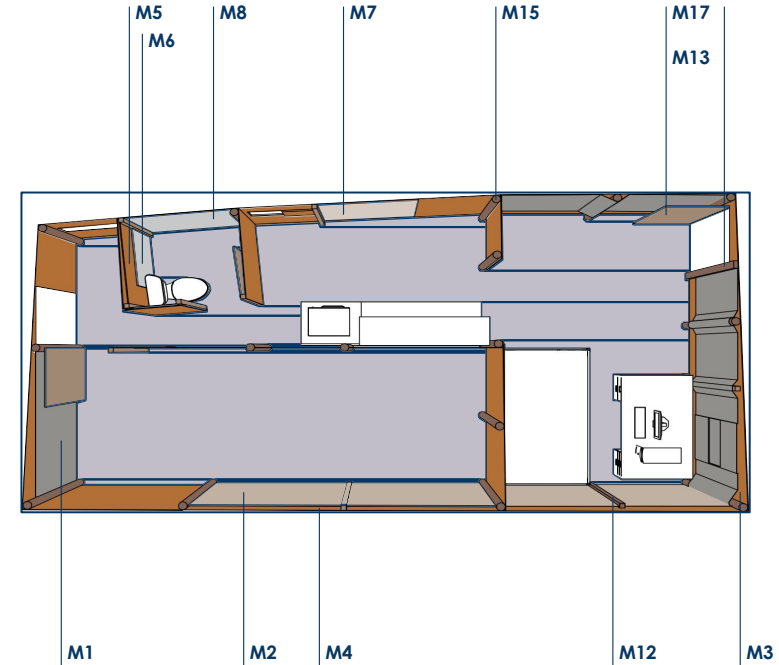
STEP 1. Engaging with ethnographies of construction

“So Aninha, I’ve been here since 2013. I started out in a very small shack, I think it was 3 by 3 [meters]. It was so small that I could barely fit a bed, a two-burner stove and a fridge. And as time went by, I had to expand this shack ..., it became a big shack, but I never took any wood out of it. So much so that when the wood gets old, we get closet doors, we get some wood that the neighbor has discarded and we put it up.”

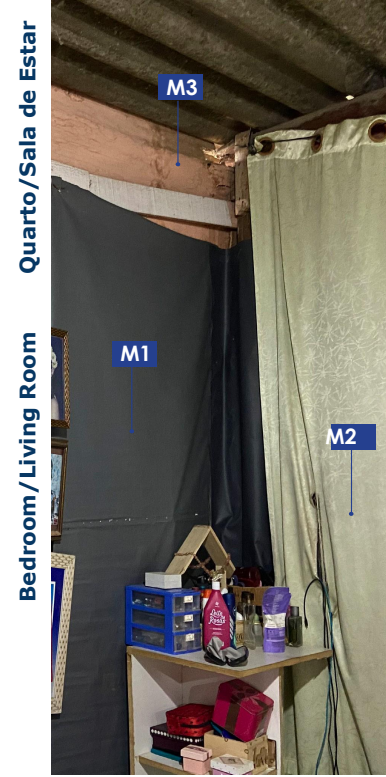
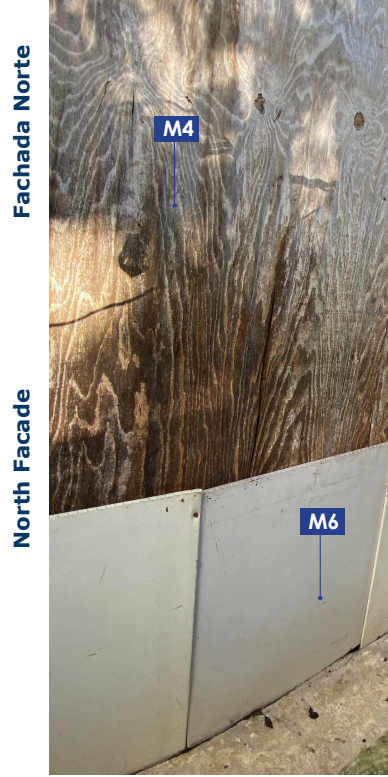
Jenny, April 2023

Legend of materials

MX	NAME	COMPOSITION	THICKNESS
M1	BANNER	PLASTIC	0.5mm
M2	CURTAIN	SYNTHETIC FABRIC	0.5mm
M3	PLYWOOD	PLYWOOD	10mm
M4	PLYWOOD	PLYWOOD	5mm
M5	WARDROBE WOOD	MEDIUM DENSITY PARTICLEBOARD (MDP)	20mm
M6	POLYCARBONATE SHEET	PLASTIC	20mm
M7	WARDROBE CEILING	MEDIUM DENSITY FIBERBOARD (MDF)	3mm
M8	PLASTIC SHEET	PLASTIC	4mm
M9	PET FOOD PACKAGE	PLASTIC	0.5mm
M10	COTTON FABRIC	COTTON	0.5mm
M11	BEAM	PINE WOOD	100mm
M12	COLUMN	WOOD	60mm
M13	RAFTER	PEROBA WOOD	50mm
M14	INSULATION	FIBER GLASS	
M15	COLUMN	EUCALYPTUS WOOD	100mm
M16	MDF	MEDIUM DENSITY FIBERBOARD (MDF)	5mm
M17	WOOD PANEL	PINE WOOD	20mm



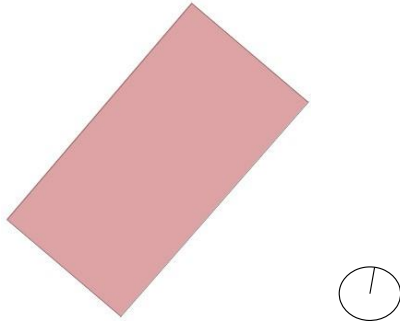
STEP 1. Engaging with ethnographies of construction



STEP 1. Engaging with ethnographies of construction

Claudiane's House

Claudiane's house is a masonry, starter core house (Peabiru design) with recycled plywood addition. Claudiane is 36 years old, she works with "bico", sporadic, informal work with different employers. She is the head of the household and lives with her two children and mother.



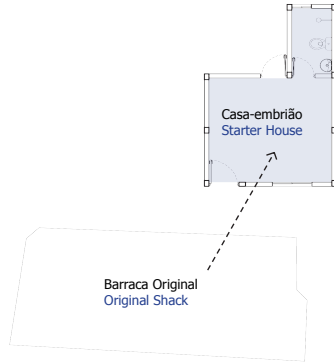
Solar orientation



Exterior

STEP 1. Engaging with ethnographies of construction

Claudiane's House Incremental, self-built housing



Original
Shack



Recommended
Extensions (Peabiru)



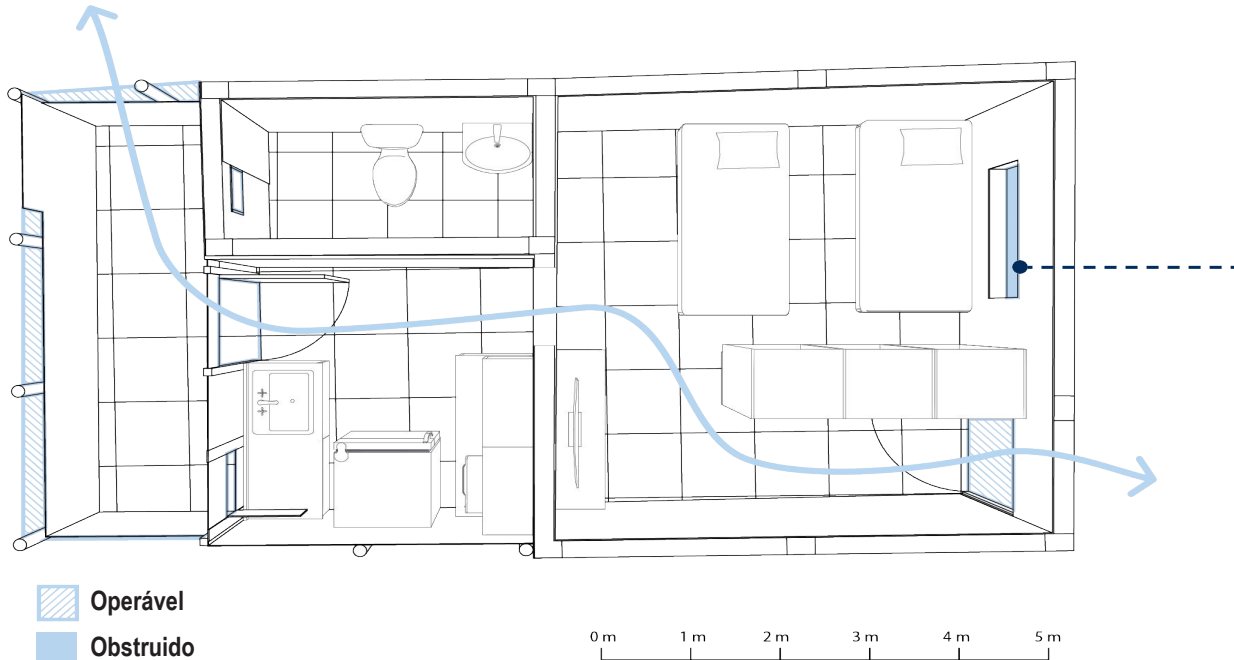
Current House
with Extension



Claudiane's Planned
Extensions

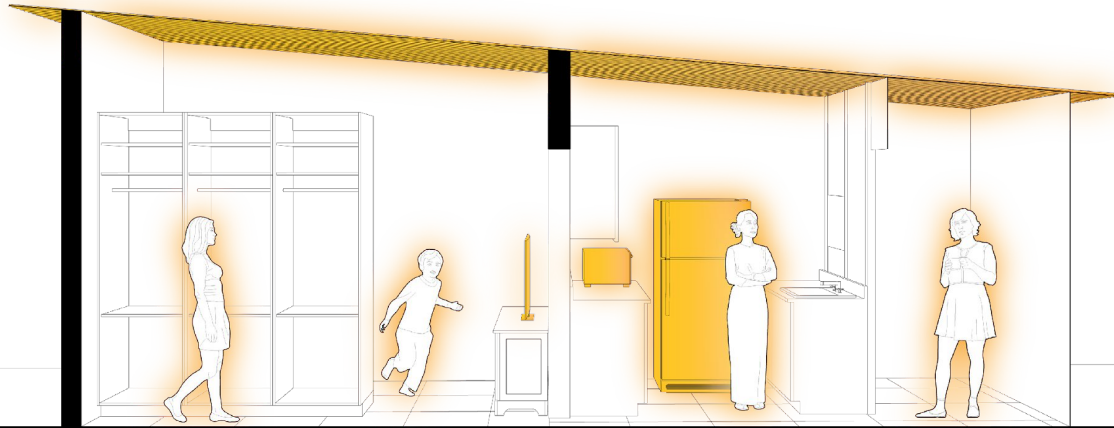
STEP 1. Engaging with ethnographies of construction

Claudiane's Core starter house with extension Ventilation and Humidity analysis



STEP 1. Engaging with ethnographies of construction

Claudiane's Core starter house with extension Heat sources analysis



Heat Sources

Gas stove
Fridge Blender
Electric oven
Mixer
Juicer
Computer
Fan
Television
Washing machine

STEP 2. Modeling & simulation



Lars Junghans, PhD
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Taubman College
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HEIDELBERG
INSTITUTE OF
GLOBAL HEALTH

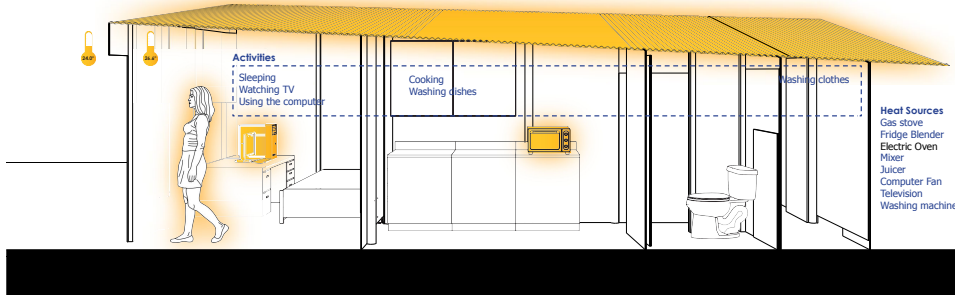


Deutsche
Forschungsgemeinschaft
German Research Foundation



STEP 2. Modeling & simulation

Heat and comfort analysis



Hot
Warm
Slightly warm
Neutral
Slightly cool
Cool
Cold

Computer simulations and comparisons of passive cooling interventions across seasons, house types, and climate zones

Baseline (No Intervention)

Day in year	111	112	113	114	115	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
	2.9	2.9	2.8	2.8	2.8	2.7	2.7	2.6	2.5	2.6	2.7	2.8	2.9	2.9	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.8	2.9					
	2.8	2.8	2.8	2.7	2.7	2.7	2.6	2.5	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.1	3.1	3.0	2.9	2.9	2.8	2.8	2.9				
	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.5	2.5	2.6	2.7	2.8	2.9	3.0	3.1	3.1	3.2	3.1	3.1	3.0	2.9	2.8	2.8	2.9					
	2.9	2.8	2.8	2.8	2.8	2.7	2.6	2.6	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.3	3.2	3.2	3.1	3.0	3.0	2.9	2.9	3.2					
	3.1	3.1	3.0	3.0	3.0	2.9	2.9	2.7	2.7	2.8	2.9	3.0	3.1	3.2	3.3	3.3	3.3	3.2	3.2	3.1	3.0	3.0	3.2						
Hour in day		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24				

Single Intervention: Reflective White Roof (Metal)

Day in year	111	2.7	2.6	2.6	2.6	2.6	2.5	2.5	2.4	2.4	2.4	2.5	2.5	2.6	2.7	2.7	2.7	2.7	2.7	2.7	2.6	2.6	2.6	2.7	
	112	2.6	2.6	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.5	2.6	2.7	2.7	2.8	2.8	2.8	2.8	2.7	2.7	2.6	2.6	2.7	
	113	2.6	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.4	2.5	2.6	2.6	2.7	2.7	2.8	2.8	2.8	2.8	2.7	2.7	2.6	2.6	2.6	
	114	2.6	2.6	2.6	2.5	2.6	2.6	2.5	2.5	2.5	2.6	2.7	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.7	
	115	2.9	2.8	2.8	2.8	2.7	2.7	2.7	2.6	2.6	2.6	2.7	2.7	2.8	2.9	2.9	3.0	3.0	3.0	2.9	2.9	2.8	2.8	2.9	
Hour in day		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

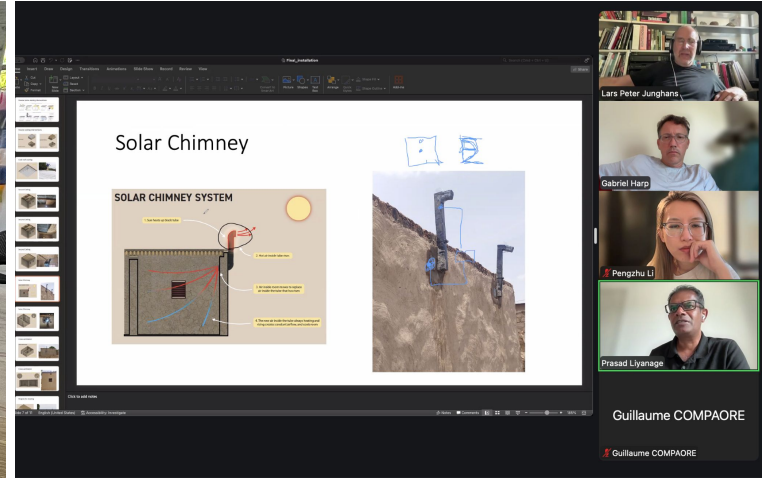
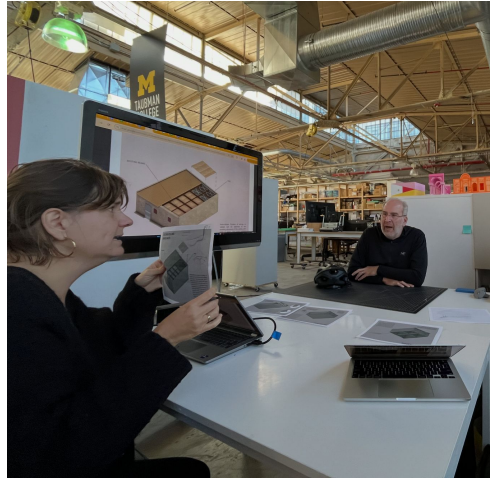
Intervention Combination: White Roof, Fabric Insulation, and Cavity Wall

Day in year	111	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.5	2.5	
	112	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	
	113	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	
	114	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.6	2.6	2.6	2.6	2.5	2.5	2.5	2.5	2.6	
	115	2.6	2.6	2.6	2.6	2.7	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.6	2.7	2.7	2.6	2.6	2.6	2.6	2.6	2.6	2.7	
Hour in day		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24

STEP 3. Analyzing & **Visualizing** passive cooling options

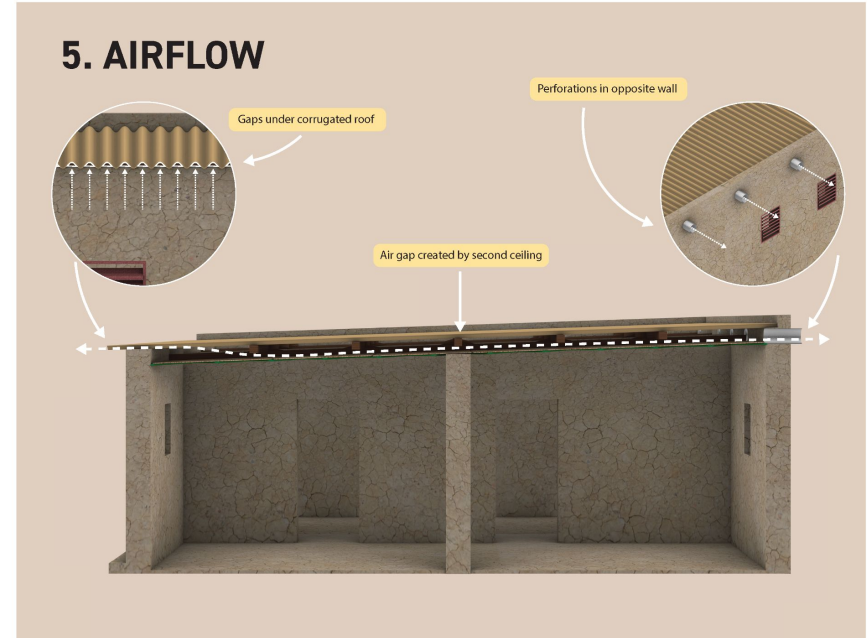
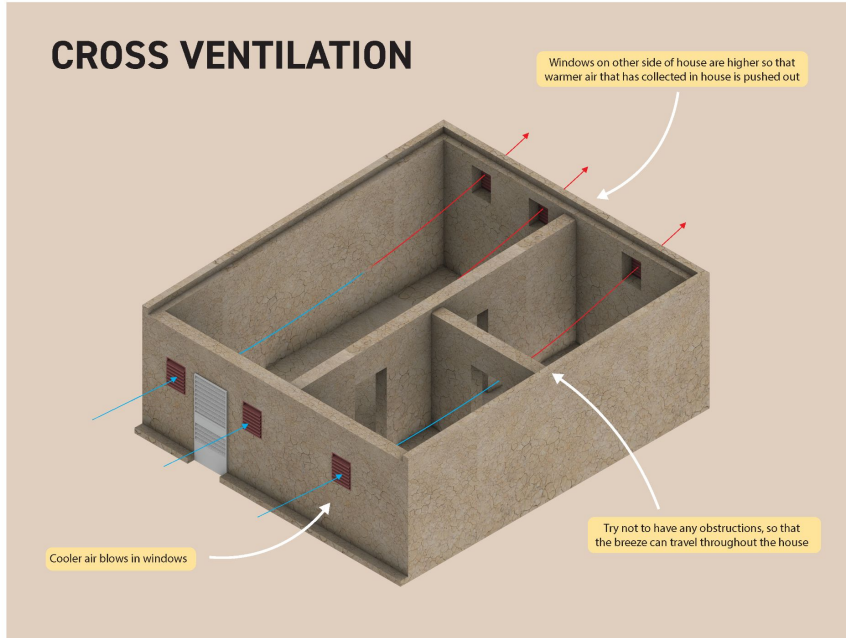
Designed visual and communication materials create shared understanding for research and co-design

Ana Morcillo Pallarés | Jonathan Rule | Gabriel Harp | Lars Junghans | María Arquero de Alarcón



STEP 3. Analyzing & Visualizing passive cooling options

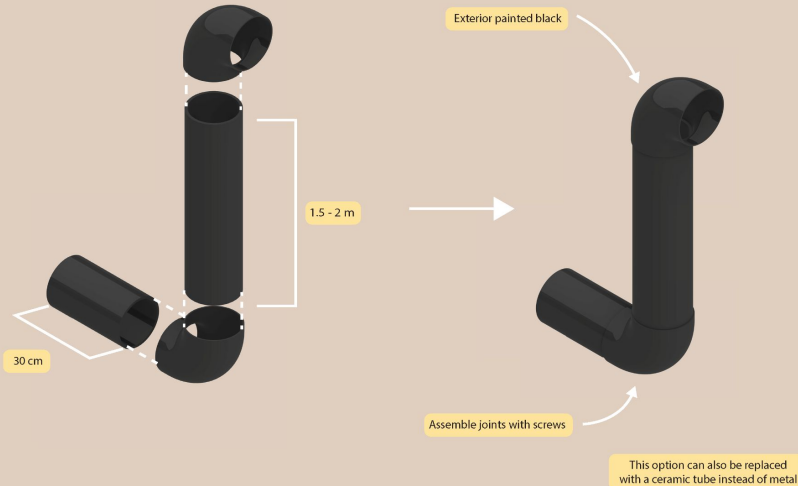
Cross ventilation and air flow



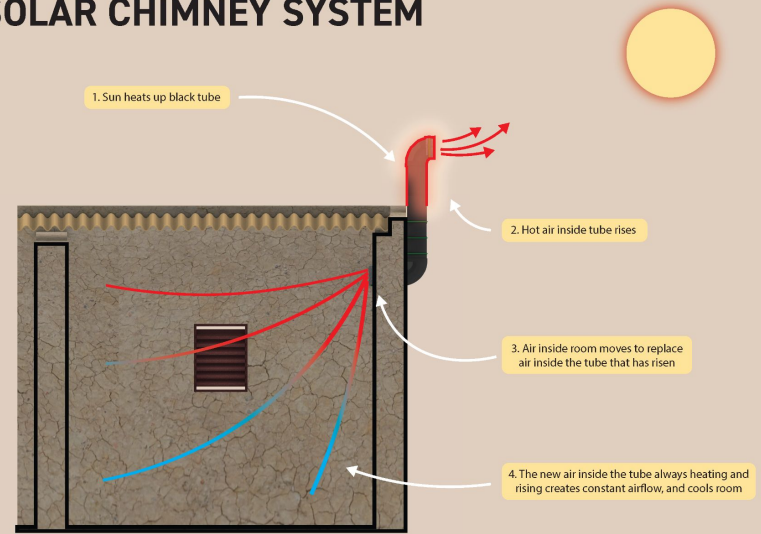
STEP 3. Analyzing & Visualizing passive cooling options

Solar Chimney

3. ASSEMBLE TUBE



SOLAR CHIMNEY SYSTEM



STEP 3. Analyzing & Visualizing passive cooling options

Final_Installation

Solar Chimney

SOLAR CHIMNEY SYSTEM

1. Sun heats up black tube
2. Hot air inside tube rises
3. Air inside room moves to replace air inside the tube that has risen
4. The cool air inside the tube always heating and rising creates constant airflow, and cools rooms

Click to add notes

Slide 7 of 11 English (United States) Accessibility: Investigate

Notes Comments

100%

Lars Peter Junghans

Gabriel Harp

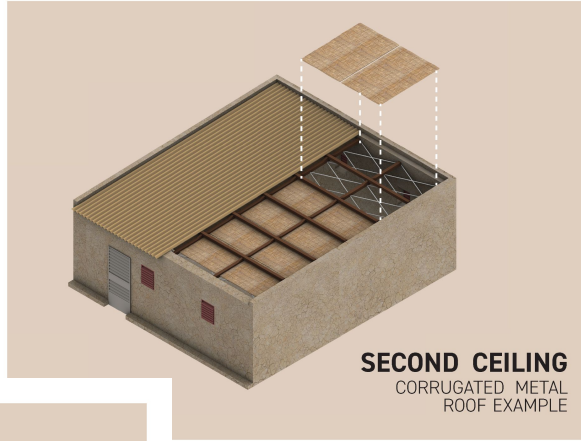
Pengzhu Li

Prasad Liyanage

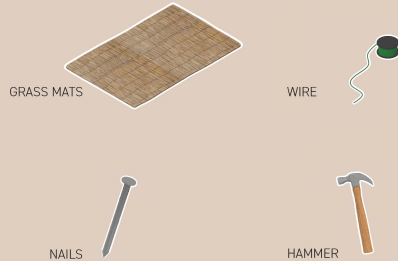
Guillaume COMPAORE

Guillaume COMPAORE

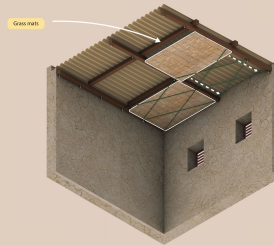
STEP 3. Analyzing & Visualizing passive cooling options



MATERIALS NEEDED:

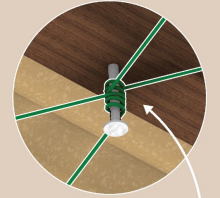
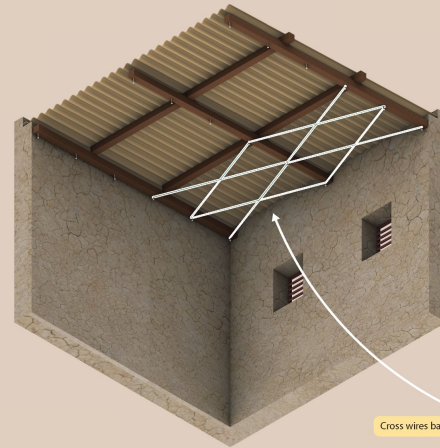


3. SLIDE MATS ON TOP OF LATTICE



Second ceiling

3. CREATE A LATTICE



STEP 3. Analyzing & Visualizing passive cooling options

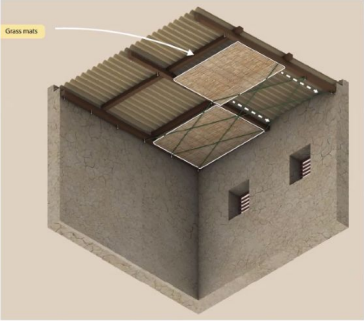
Final_installation

Insert Draw Design Transitions Animations Slide Show Record Review View

Layout View Section

Second Ceiling

Glenn mats



Click to add notes

Page 5 of 11 English (United States) Accessibility: Investigate

Notes Comments

100%

Pengzhu Li

Gabriel Harp

Lars Peter Junghans

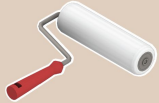
Prasad Liyanage

Guillaume COMPAORE

Guillaume COMPAORE

STEP 3. Analyzing & Visualizing passive cooling options

MATERIALS NEEDED:



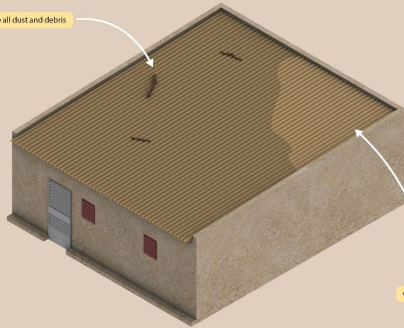
PAINT BRUSH/ROLLER



REFLECTIVE WHITE PAINT

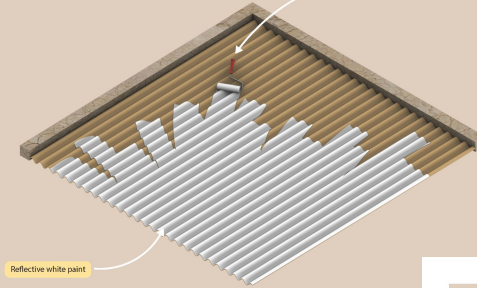
1. CLEAN AND REPAIR ROOF SURFACE

Remove all dust and debris



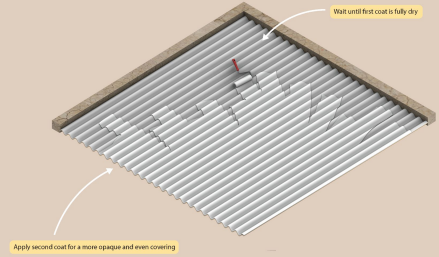
2. APPLY PAINT

Paint roller or brush



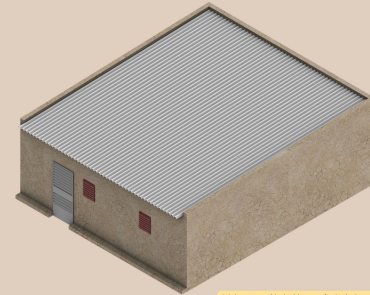
3. APPLY SECOND COAT OF PAINT

Wait until first coat is fully dry



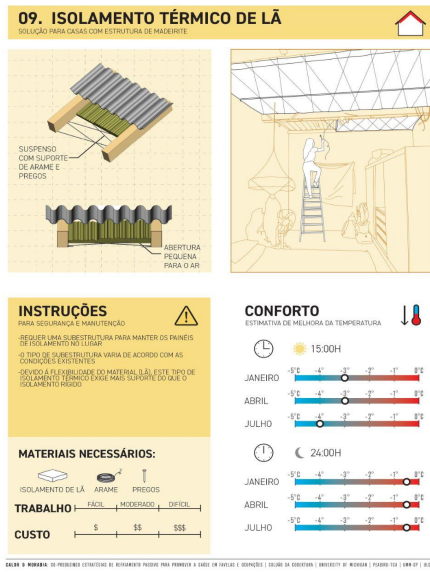
Reflective roof

COMPLETED WHITE ROOF



It is important this double coat of paint be inspected yearly, cleaned of debris, and repainted every 3-4 years to maintain its reflective properties.

Development of passive cooling intervention cards and physical model

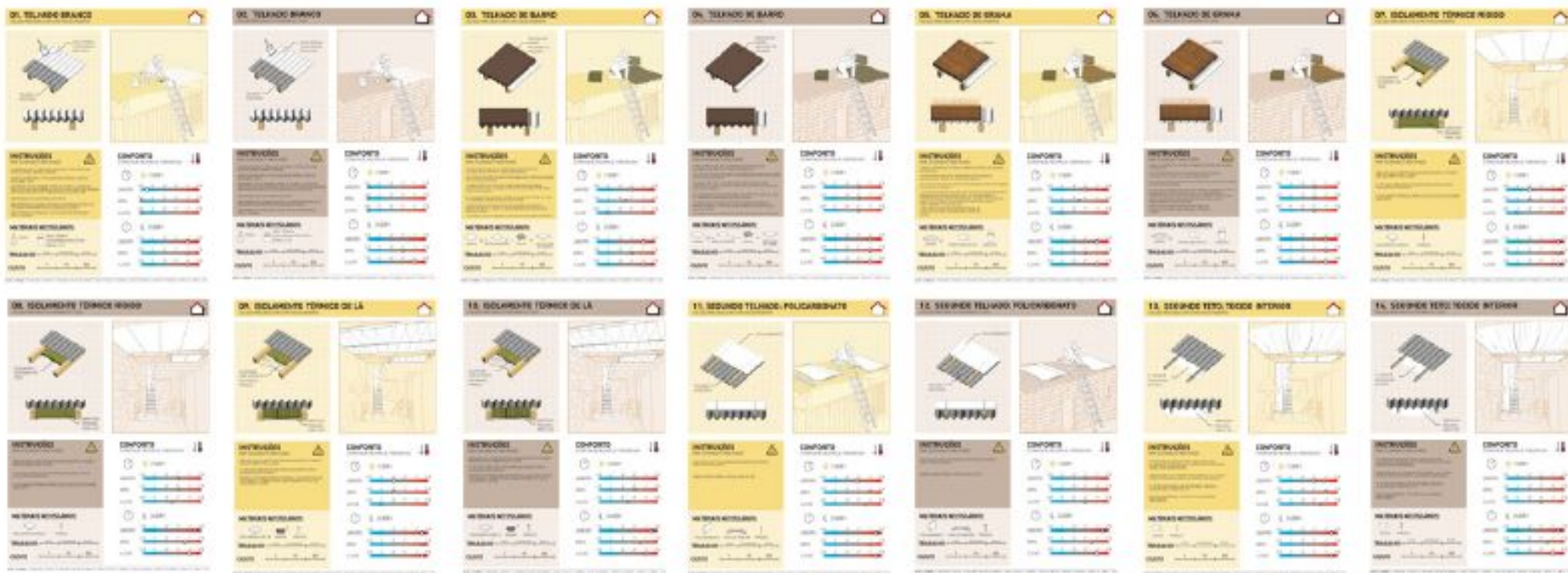


Roof cooling paint (white, reflective)

STEP 3. Analyzing & Visualizing passive cooling options

Passive cooling intervention cards

Synthesizing simulation results with architectural visualization for community engagement and co-design



STEP 4. Co-designing with dwellers' associations and partners

Multimodal knowledge sharing

Visualization cards, surveys, dialogue circles & storytelling, hands-on demonstrations, presentations, and digital repository



Dialogue Circle, MST Leste 1, 2024

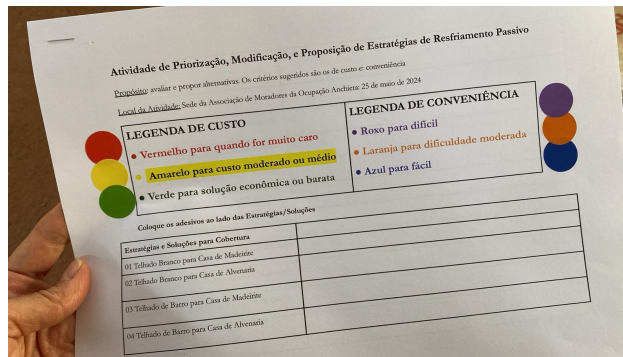
Passive Cooling Workshop, Estrela de Davi, ULCM, 2024

STEP 4. Co-designing with dwellers' associations



EQUIPE

Sidnei Pita, ULCM
 Pai Ale Padilha, ULCM
 Cíntia Fidelis, Peabiru
 Vera Lucia Dias Padilha, ULCM
 Benedito Roberto Barbosa, UMM-SP, Lab-Juta
 Ana Paula Pimentel Walker, University of Michigan
 Moacir Medeiros, Ocupação Anchieta
 Jenny Casemiro, Ocupação Anchieta
 Nunes Lopes dos Reis, Peabiru
 Larissa Hiratsuka, Peabiru
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 Anderson Pé, Ocupação Anchieta
 Marilene Ribeiro de Souza, UMM-SP
 Ana Morcillo Pallares, University of Michigan
 Lars Junghans, University of Michigan
 Gabriel Harp, University of Michigan
 Jonathan Rule, University of Michigan
 Eunsoo Hyun, University of Michigan
 Ann Borek, University of Michigan
 Jimmy Grote, University of Michigan
 Mostafa Salama, University of Michigan



STEP 5. Implementing passive cooling in Burkina Faso

Multifaceted housing adaptations can be more effective than single, isolated fixes.



STEP 5. Implementing passive cooling in São Paulo, Brazil

Pilot: ~ 100 cool-roof retrofits in Estrela de Davi, São Paulo, to be completed by September 2026.



STEP 5. Implementing passive cooling in São Paulo, Brazil

Pilot: ~ 100 cool-roof retrofits in Estrela de Davi, 196 households.
Cool roof treatment, 5C reduction, according building simulations.
Monitor indoor temperatures and humidity.



STEP 5. Implementing passive cooling in Bucaramanga, Colombia

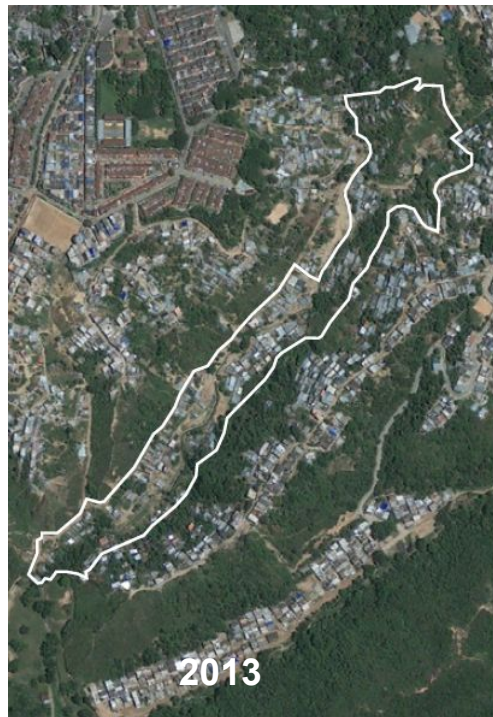
Luz de Salvación II



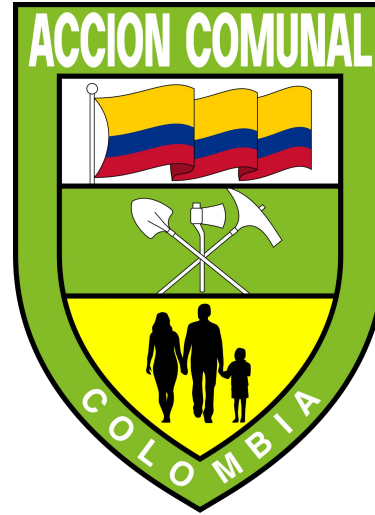
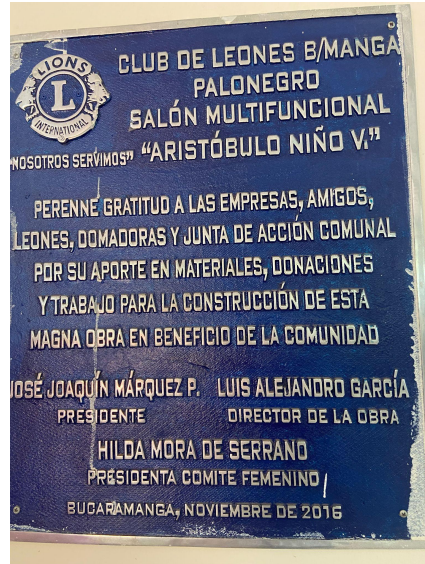
- Approximately 400 houses, over 1,000 inhabitants.
- Started as an **illegal subdivision** in 2001.
- Partnership with La Juntas de Acción Comunal (Community Action Boards), the municipal land legalization department, and Alcaldia de Bucaramanga.

STEP 5. Implementing passive cooling in Colombia

Luz de Salvación II, Comunas 10 & 11



STEP 5. Implementing passive cooling in Bucaramanga, Colombia

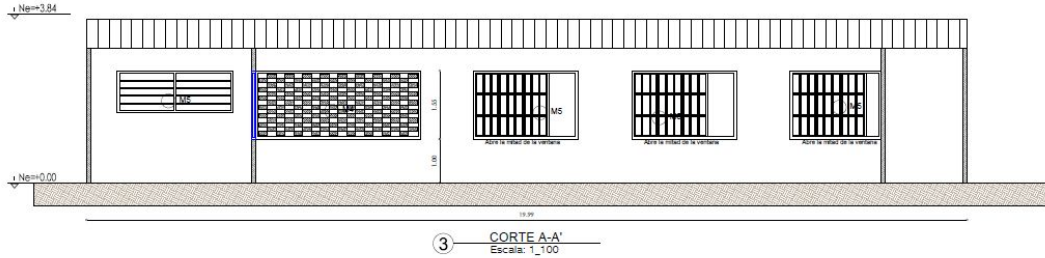


STEP 5. Implementing passive cooling in Bucaramanga, Colombia

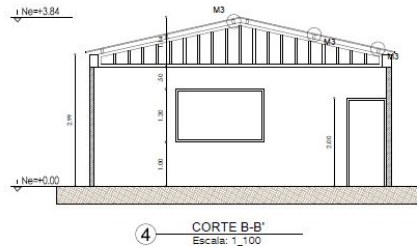


STEP 5. Implementing passive cooling in Bucaramanga, Colombia

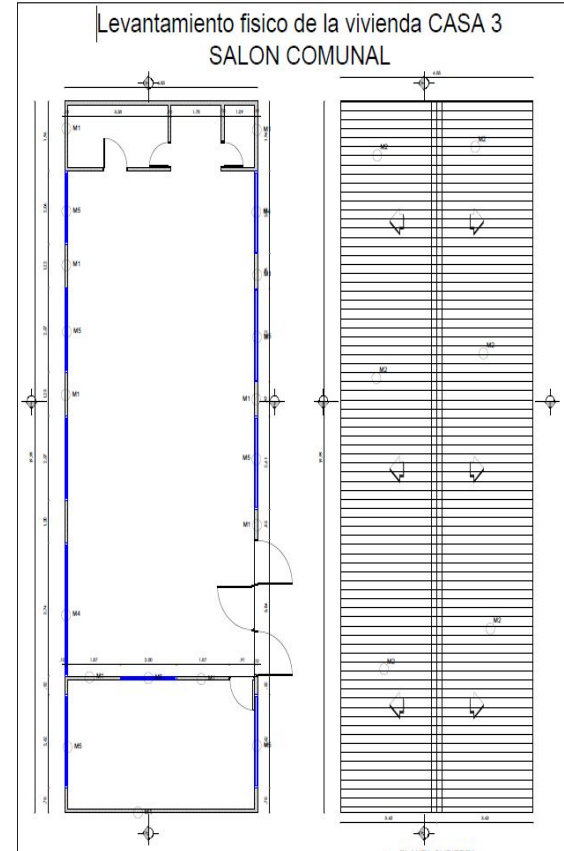
Levantamiento físico de la vivienda CASA 3 SALON COMUNAL



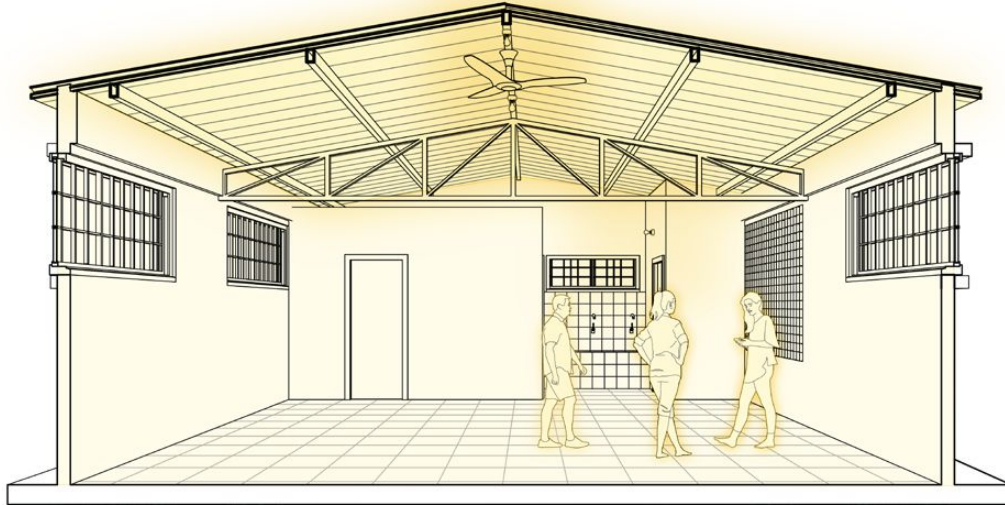
Mxx	NOMBRE DEL MATERIAL-AÑO	COMPOSICION	ESPESSURA	HABITACION
M1	Ladrillo H-10	Arcilla	10 cm	
M2	Teja de zinc	Zinc		
M3	Correas - Cubierta	2" x 1" Pulg		
M4	Ventanas en ladrillo	Arcilla		
M5	Ventanas Metalicas	Hierro		



Jesus Adolfo Peñaloza Contreras
Angie Natalia Gil Martinez
Sergio Andres Ortiz Rodriguez
13 de Julio de 2023
July 12, 2023



STEP 5. Implementing passive cooling in Bucaramanga, Colombia



STEP 5. Implementing passive cooling in Bucaramanga, Colombia

Combined Second Ceiling + Cool roof



STEP 6. Assessing housing, heat, and health outcomes

Household Housing, Heat & Health Survey Colombia survey validation (in progress)

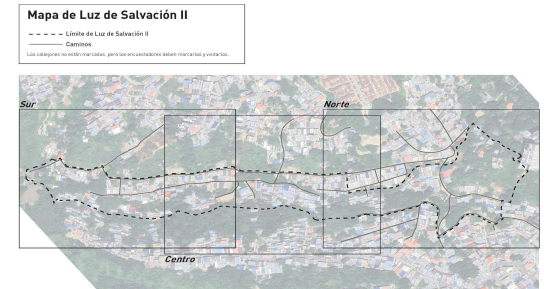
Household & Housing Characteristics

- Section 1 Demographic Information
- Section 2 Tenure Security and Incremental Housing
- Section 3 Housing Structural Characteristics
- Section 4 Home Heating and Cooling
- Section 5 Household Energy Use
- Section 6 Water Access and Reliability
- Section 7 Neighborhood and Environmental Conditions
- Section 8 Health Questions



Validated Health Instruments

- HWISE Household Water Insecurity Experiences
- CARAT 10 Control of Allergic Rhinitis and Asthma Test
- Pittsburgh Sleep Quality Index PSQI
- GAD-7 Generalized Anxiety Disorder Scale
- PHQ-9 Patient Health Questionnaire



STEP 6. Assessing housing, heat, and health outcomes

Household Housing, Heat & Health Survey

Examine how tenure insecurity, socio-economic status, housing structure, cooling practices, and water intermittency shape indoor heat exposure and adoption of passive cooling strategies.

Household Survey administration to help model how structural and social factors influence thermal comfort, heat stress, and residents' willingness or ability to adopt passive cooling modifications.

Establish associations between indoor heat exposure and health outcomes, including respiratory function, sleep quality and quantity, cognitive function, and mental health.

STEP 6. Assessing housing, heat, and health



Dr. Érin Cameron is an impact scholar with the CGHE and Taubman College.



Dr. Carina Gronlund is a research associate professor with the Institute for Social Research

Validated Health Instruments

- HWISE Household Water Insecurity Experiences
- CARAT 10 Control of Allergic Rhinitis and Asthma Test
- Pittsburgh Sleep Quality Index PSQI
- GAD-7 Generalized Anxiety Disorder Scale
- PHQ-9 Patient Health Questionnaire

Integrated Scientific & Socio Environmental Benefits

Improved thermal modeling tailored to self-built housing across climate zones.

Tested passive cooling retrofits that measurably improve indoor comfort and reduce heat stress.

Community capacity building through trained dweller-educators who teach and sustain passive strategies.

Lower household costs by reducing reliance on active cooling and cutting electricity use.

Climate mitigation co-benefit by avoiding widespread adoption of air conditioning as the only cooling option.

Policy-ready evidence with actionable recommendations for integrating passive cooling into climate action and housing and settlement planning.



THANK YOU!

Contact: Ana Paula Pimentel Walker | appiment@umich.edu



Cooling Cities with Nature

Advancing Urban Heat Resilience,
Biodiversity and Human Well-being

Eva Gurría

Partnerships & External Relations Lead
NBSAP Accelerator Partnership

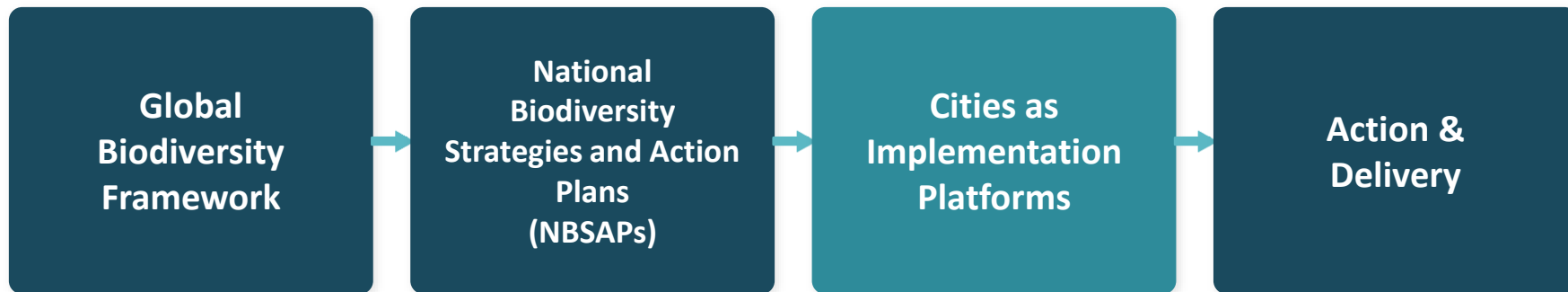


UNEP Cool Coalition · June 2026

nbsapaccelerator.org



Cities are becoming critical implementation platforms for biodiversity action.

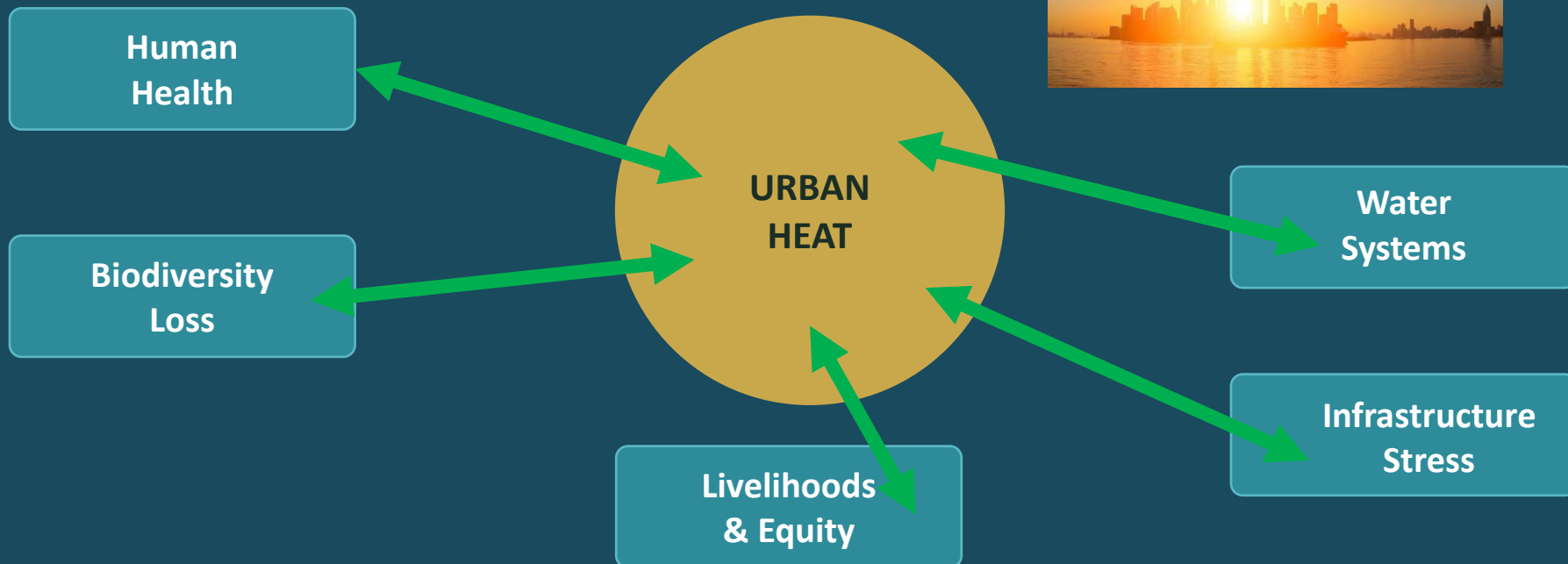


The NBSAP Accelerator Partnership supports 60+ countries in accelerating biodiversity implementation. We are increasingly seeing cities emerge as the critical spaces where national commitments become real, on-the-ground, action.



Urban heat is not only a climate challenge.

It is also a biodiversity and resilience challenge.



Nature-based solutions help cities cool — and generate multiple co-benefits at the same time.



Trees & Urban Forests

⚡ Shade + evapotranspiration

✓ Air quality · habitat · carbon sequestration



Wetlands & Blue-Green Spaces

⚡ Evaporative cooling + flood buffering

✓ Water security · species habitat



Green Corridors & Parks

⚡ Urban heat island reduction

✓ Ecological connectivity · human well-being



Urban Biodiversity Systems

⚡ Ecosystem-based resilience

✓ Multiple SDG targets — simultaneously

Global frameworks are converging on urban nature as essential infrastructure.



GBF Target 12

Global Biodiversity Framework

Protect and expand urban green and blue spaces; strengthen ecological connectivity in cities.

CBD COP15 Decision 15/12

CBD Urban Biodiversity

Mandates integration of biodiversity into urban planning and policy across all Parties.

Climate Agendas

EbA & Nature-based Solutions

Ecosystem-based adaptation now central to NDCs, National Adaptation Plans and the Nature for Cooling Challenge (GEF-UNEP).

Countries are converging on cities as delivery platforms for biodiversity, climate and development goals.

Zimbabwe

Urban Greening & Biodiversity

Integrating biodiversity-positive green infrastructure into national urban planning. Urban ecosystem services — cooling, flood regulation — recognized as essential infrastructure.

Mexico

Nature-Climate Synergies

Advancing urban NbS that address heat resilience, water security and biodiversity in a single investment approach. Directly aligned with COP30 momentum and Beat the Heat.

Thailand

Integrated Biodiversity-Climate Planning

Linking NBSAP implementation with NDC adaptation pathways through urban ecosystem approaches — a model for shared biodiversity-climate delivery.

No single institution can deliver cooler, more resilient cities, alone.



From Ambition to Action at Scale



01

INTEGRATE



Embed urban cooling into biodiversity implementation frameworks — not treated as a separate agenda.

02

INVEST



Finance biodiversity-positive green and blue infrastructure in cities — domestic budgets, development finance, BIOFIN, GEF.

03

PARTNER



Deepen connections between cities, governments and finance providers. The institutions exist. The connections need to be activated.

Nature-based solutions allow cities to address heat, biodiversity loss and resilience challenges simultaneously.

Thank You.



*The most effective cooling
infrastructure already
exists in nature!*

COP30
BRASIL
AMAZÔNIA
BELÉM 2025

UN
environment
programme

C Cool
Coalition
a UNEP-convened initiative

**BEAT
THE
HEAT**
Mutirão contra
o Calor Extremo

**BEAT
THE
HEAT**

**MUTIRÃO
CONTRA O
CALOR
EXTREMO**

June 2026

Why Extreme Heat, Why Now ?

🌡️ The deadliest climate hazard → half a million deaths per year

👤 Huge impacts on productivity → 2–3% productivity drop per degree above 20°C (ILO)

🔥 3.79 billion people exposed to extreme heat if warming passes 2°C 41% of global population in 2050*

🏙️ The majority of people affected will be living in cities in: India • Nigeria • Indonesia • Bangladesh • Pakistan • Philippines*

⚠️ But the most significant increase in dangerous temperatures will threaten: Central African Republic • Nigeria • South Sudan • Laos • Brazil*



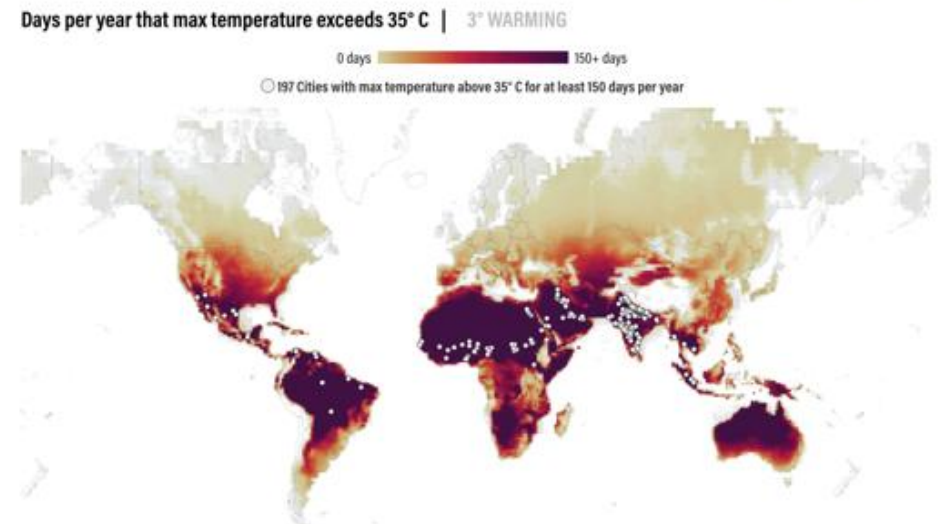
Belém, Brazil

222 days with extreme heat in 2050



Kolkata, India

188 days with extreme heat in 2050



*Source: Kommenda, N., Osaka, S., Ducroquet, S., & Penney, V. (2023). *Where dangerous heat is surging*. The Washington Post. Data analysis by CarbonPlan using NASA NEX-GDDP-CMIP6 climate projections.

Delivery mechanism for the Global Cooling Pledge

74 Countries | 250 Cities



- **Global Cooling Pledge launched (19 commitments)**
- **Political mandate established at COP**



- **Focal Point activation**
25–30 countries
- **Ministerial 2024**
convened
- Initial country coordination underway



- **First focal point meeting**
- **Ministerial 2025**
 - Extreme Heat Communiqué adopted
 - Intergovernmental Committee on Cooling (IGCC) established
- **Beat The Heat launched**
 - 220+ cities
 - 100+ partners



NOW MOVING INTO DELIVERY

Moving political commitment into implementation

- **IGCC convenes** to set delivery priorities
- **EPIC solutions** scaled through structured request cycles
- **Implementation underway** in priority countries

PHASE 1
PLEDGE
ESTABLISHMENT

2023

PHASE 2
ACTIVATION

2024

PHASE 3
INSTITUTIONALISATION
IMPLEMENTATION PHASE

2025

PHASE 4
PLEDGE DELIVERY

2026+

240+ Cities joining forces to **Beat the Heat**



100+ Partners

driving the mutirão



ARUP



COUNT US IN



URBAN SH/FT



100+ Partners

Driving the Mutirão

A CIDADE
PRECISA
DE VOÇÊ

AGC



AMBIATOR



CECOS
UNIVERSITY



DAIKIN



FORTYGUARD



geres
LA SOLIDARITÉ
CLIMATIQUE
EN ACTION



GSMA



SPACE COOL

BOERI
STEFANO
BOERI
INTERIORS



VISÃO
COOP

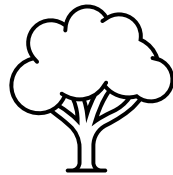


Implementation Pathway



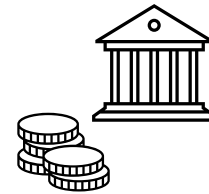
Commitment 1

Heat Action Planning



Commitment 2

NbS and Passive Cooling



Commitment 3

Public Procurement

Is extreme heat a priority?

Cities already recognize extreme heat as a major risk, but most still lack the basic planning and data foundations needed to respond.

High Urgency, Low Readiness

Percentage of surveyed cities reporting heat as a priority risk versus lack of foundational action.

64.2%



Extreme heat as a top 3 priority risk

45.0%



Have not yet started heat mapping or planning

40.4%



Have not yet started nature-based solutions and passive cooling

Planning lays the ground for scaled action

Cities with heat mapping and planning are significantly more likely to move toward implementing cooling solutions.

Planning is the Catalyst for Action

Percentage of cities actively designing, strategizing, or implementing physical cooling solutions.

Over 8.5x more likely to be advancing
NbS strategies, passive designs, or pilot projects

8.2%

Cities with NO formal
heat mapping or plans

70.0%

Cities with heat mapping
and/or planning

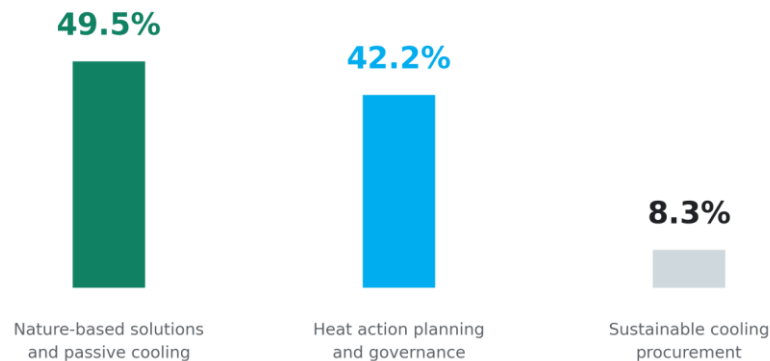
Establish robust governance structure is key

Over 90% of cities are asking for foundational heat planning and nature-based solutions.

Cities recognize that to survive extreme heat, they must first establish core governance (Heat Action Plans) and deploy nature-based & passive cooling solutions.

High Demand for Infrastructure and Planning

Percentage of cities prioritizing each commitment if they could only receive support for one.



How does Beat the Heat support countries and cities?



Countries prioritized:
policy, financial and
technical support

- Brazil (87)
- Cambodia (3)
- Ethiopia (5)
- Grenada (2)
- India (55)
- Kenya (14)
- Nigeria (17)

Cities

Local action /
Implementation

Community
Buy-in

Stakeholder
mobilization

Capacity
building

**UNEP Cool
Coalition**

Matchmaking needs to
expertise

Help Pipelines Creation

Multilevel Governance
and Partner Convening
and Coordination

Global Advocacy

Partners

Development of Knowledge
and Tools: diagnostic, action
plans, capacity building

Implementation Support:
technical assistance and
pipeline development

Financial Support and Planning

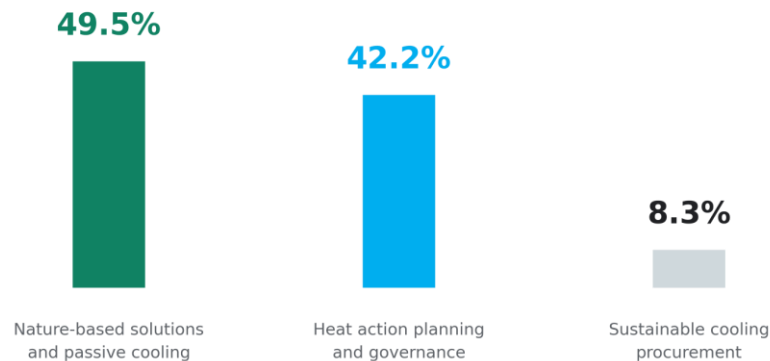
Cities need implementation support now

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pipeline development

Financial Support and Planning

Early delivery already underway



ARUP



Digital Tool

Cool
Cities Lab

Data Access

Roof albedo
and green
canopy data

Training

Heat action
planning
framework

Public Activation

50 cities at
50 degree
Celsius

Geospatial Analysis

Keep Cool
Hub &
Lagos
Training

Early delivery already underway



BeCool Programme

Ongoing:
India
Upcoming:
Africa

Country Support

GEF-8
Nature for
Cooling
Challenge

EPIC Facility

50 technical
assistance
requests
from 25
countries

NCAP with Heat

Brazil
Nigeria
Kenya
Ethiopia

Core countries ready for impact

Targeting these 6 countries
unlocks impact for 74% of
the BTH network

Brazil

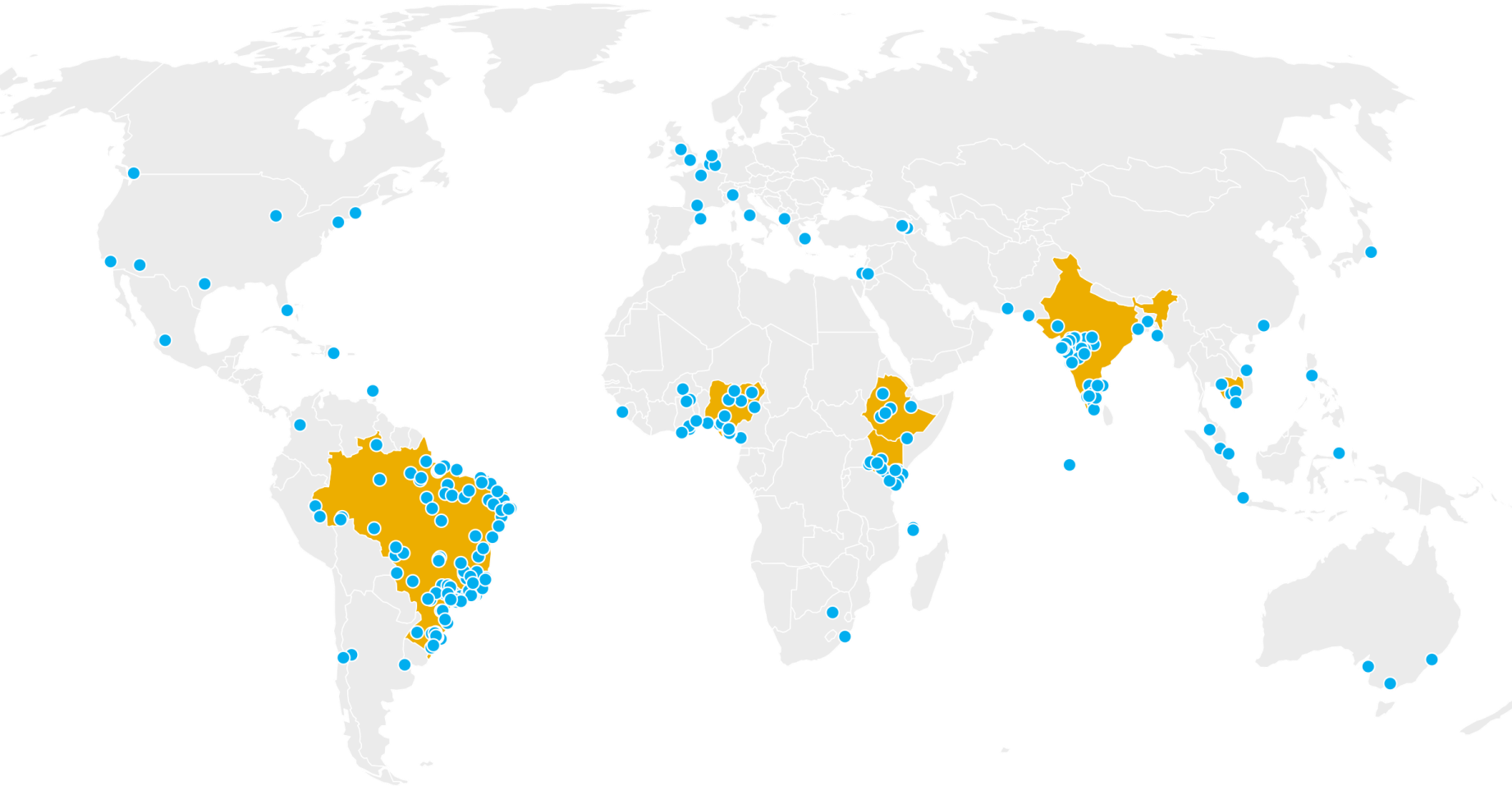
Cambodia

Ethiopia

India

Kenya

Nigeria



Cities need implementation support now

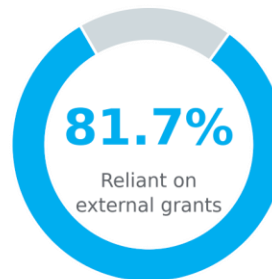
Reliance on external funding is widespread, but technical capacity remains the most commonly cited challenge.

Relatively small amounts of technical assistance can unlock substantially larger implementation opportunities.

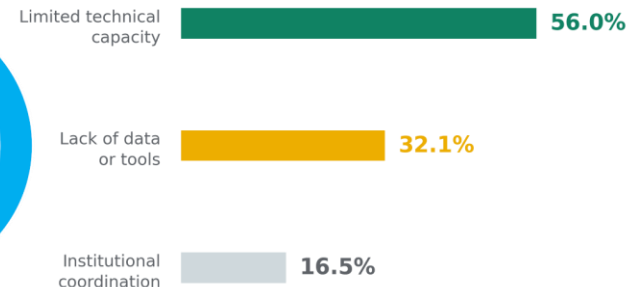
Funding and Capacity Block Action

Cities are financially stranded. Even if funded, a lack of technical capacity remains the core barrier.

The Financial Reality



The Operational Bottlenecks



*Respondents could select multiple operational barriers.

COP30
BRASIL
AMAZÔNIA
BELÉM 2025

UN 
environment
programme

 Cool
Coalition
a UNEP-convened initiative

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Mutirão contra
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Thank you

Critical Gap

Strong global commitments, **but fragmented & underfunded delivery** at city level

Lack of multilevel governance to scale up solutions

Weak links connecting heat and cooling agenda, adaptation and mitigation work

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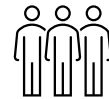
Survey Statistics

Respondents to Survey



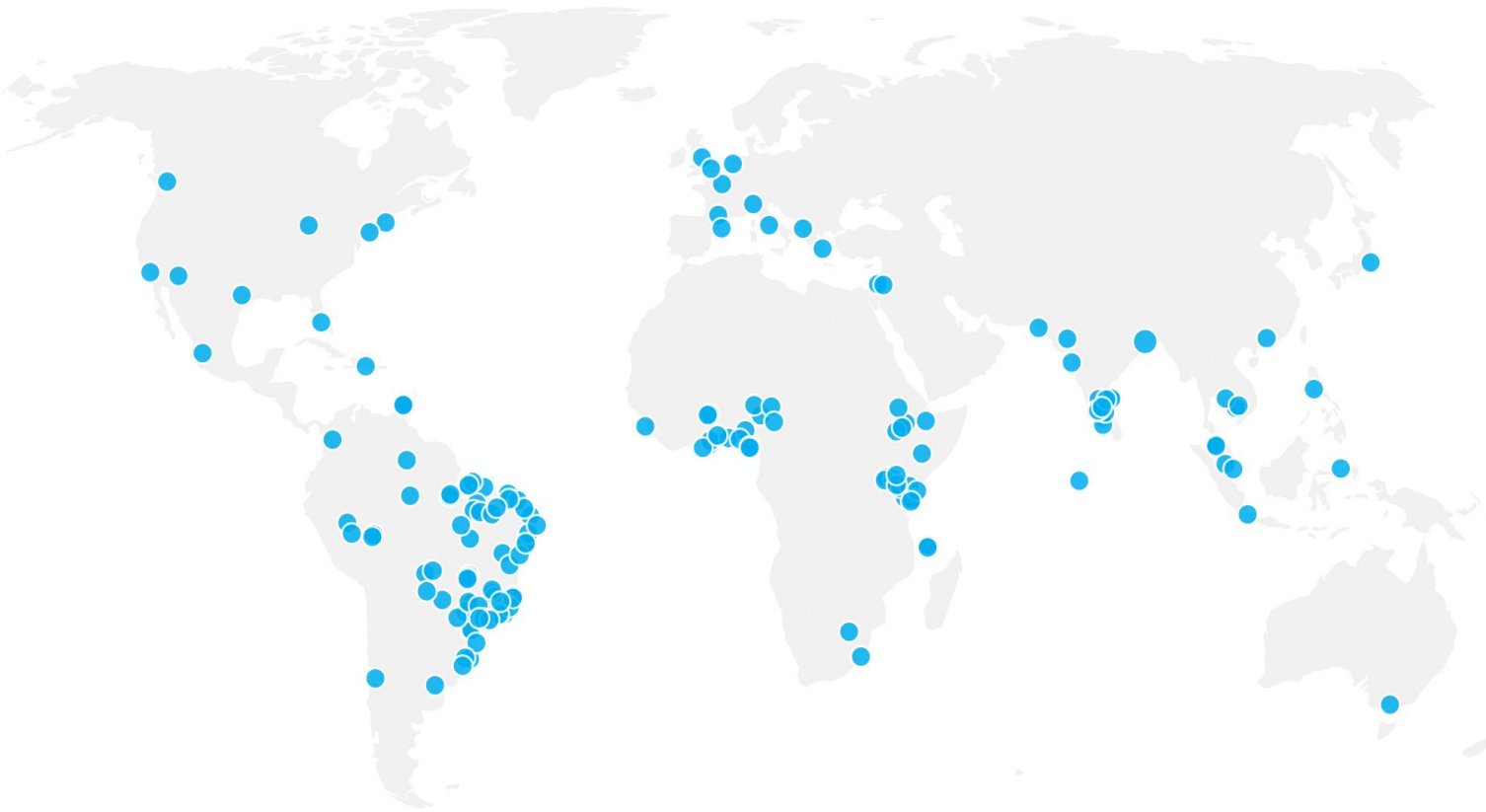
103 of 250
participating cities

Estimated total population
of all 250 participating cities



558 million

200+ Cities joining forces to **Beat the Heat**



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driving the mutirão



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