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

TAUBMAN COLLEGE
ARCHITECTURE & URBAN PLANNING
UNIVERSITY OF MICHIGAN

peabiru

UNIÃO
DOS MOVIMENTOS
DE MORADIA
SÃO PAULO

UNIFICAÇÃO DAS LUTAS DE CORTIÇO E MORADIA
ULCM

ANCHIETA

Alcaldía de
Bucaramanga

Universidad
Industrial de
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Introduction: People & Funding

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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
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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
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Pai Ale Padilha, community leader, Estrela de Davi.
Martinha Araujo, coordinator of ULCM

BRAZIL - SÃO PAULO -PEABIRU TRABALHOS COMUNITÁRIOS E AMBIENTAIS
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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
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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 ~20× 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 mostly on outdoor temperatures.

- Indoor heat remains largely unmeasured, unregulated, and overlooked, despite being where people spend most of their time during heat waves.

HOUSES CAN BECOME HEAT TRAPS!

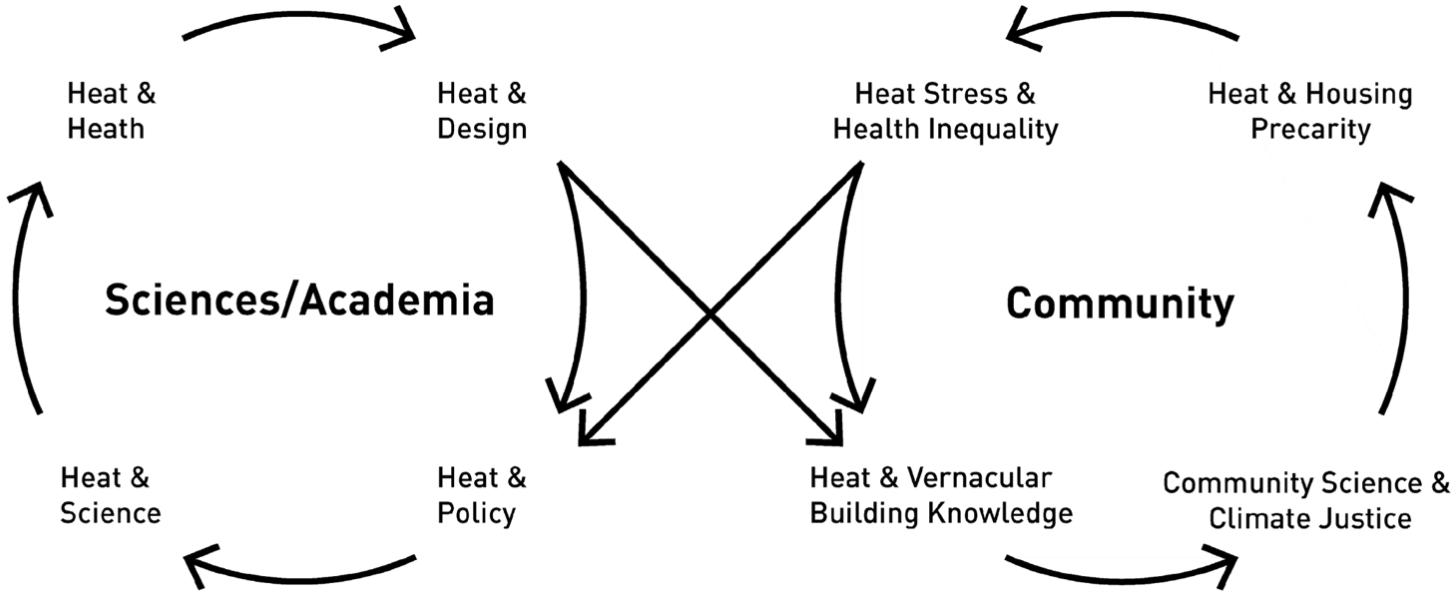
Introduction: Research Objective

This project advances research on **housing modifications that enhance 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, 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

Some Local Movements Affiliated with UMM – SP

UNIFICAÇÃO DAS LUTAS DE CORTIÇO E MORADIA
ULCM

LESTE 1
MOVIMENTO DOS TRABALHADORES

UMM Union of Housing Movements
(state level)

UNIÃO
DOS MOVIMENTOS
DE MORADIA
SÃO PAULO

UNMP National Union for Popular Housing
(national level)

UNIÃO
NACIONAL POR
MORADIA
POPULAR

Some National & International Coalitions

Secretaría Latinoamericana de la Vivienda y el Hábitat Popular

CENTRAL DE MOVIMENTOS POPULARES
CMP
BRASIL

Introduction: Research Partners

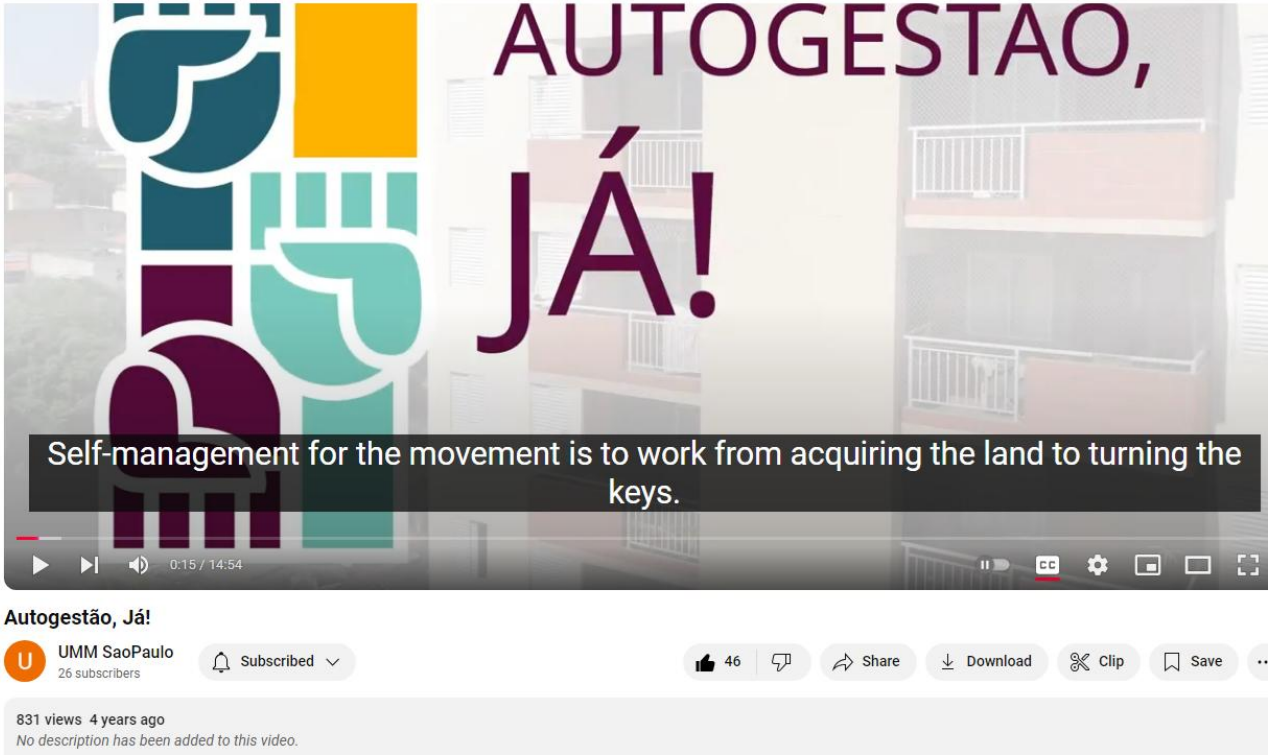
Favela Secretariat:
Tenure security
Land regularization
Grassroots upgrading plans

UNIÃO
DOS MOVIMENTOS
DE MORADIA
SÃO PAULO

Social Services
Legal Aid
Policy Advocacy
Technical Assistance
Popular Education
Organizing

Collectively managed, "autogestão" via mutual aid/joint effort "mutirão"

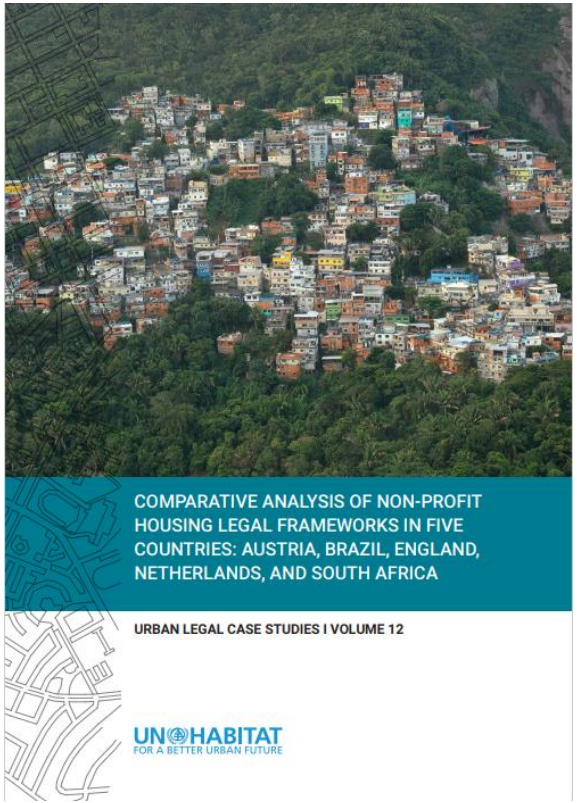
Introduction: Research Partners: Activist PAR



Policy Analysis & Advocacy Campaign

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

Introduction: Research Partners: Activist 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, Brazi by Diegograndi. source: envato elements.

Introduction: Research Partners: Activist PAR

TREE SPECIES

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

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

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

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

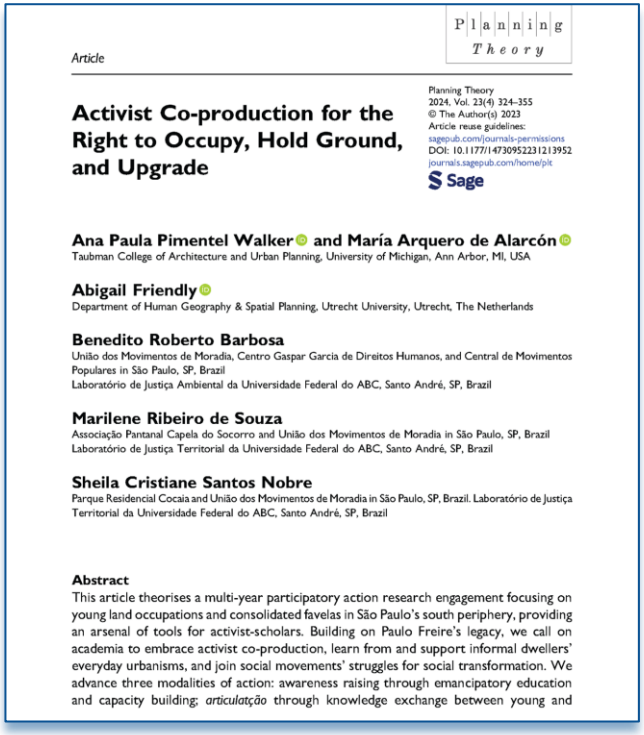
Viveiro de mudas é inaugurado na Zona Leste de SP para recuperar área de preservação

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: Research Partners: Activist PAR



Planning Theory

Article

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

Planning Theory
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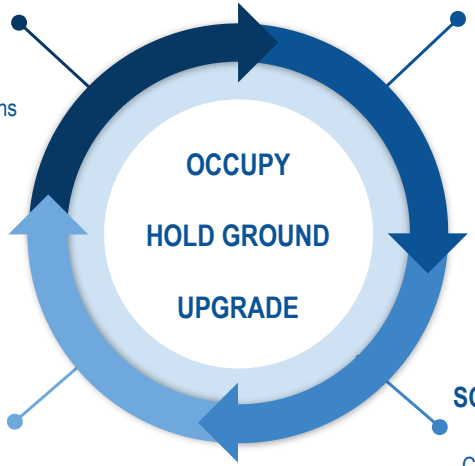
Abstract
This article theorises a multi-year participatory action research engagement focusing on young land occupations and consolidated favelas in São Paulo's south periphery, providing an arsenal of tools for activist-scholars. Building on Paulo Freire's legacy, we call on academia to embrace activist 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; *articulatção* 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

Introduction: Research Partners: Activist PAR

Ocupação Anchieta: History of Collaboration

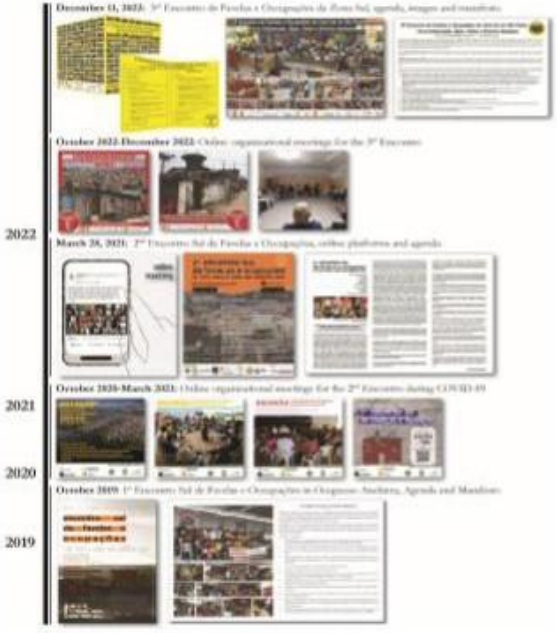
Anchieta Association Headquarters, UM capstone-studio collaboration, Dow 2017

Peabiru Technical Advisory Firm, mutual aid housing project

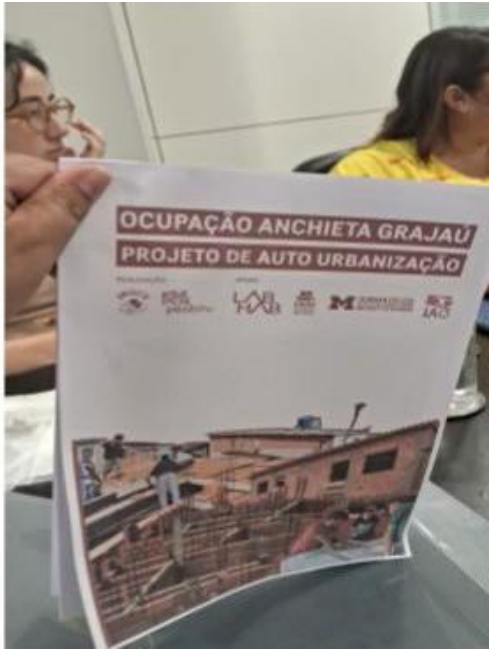
Introduction: Research Partners: Activist PAR

Ocupação Anchieta: History of Collaboration

Water Access during Covid-19



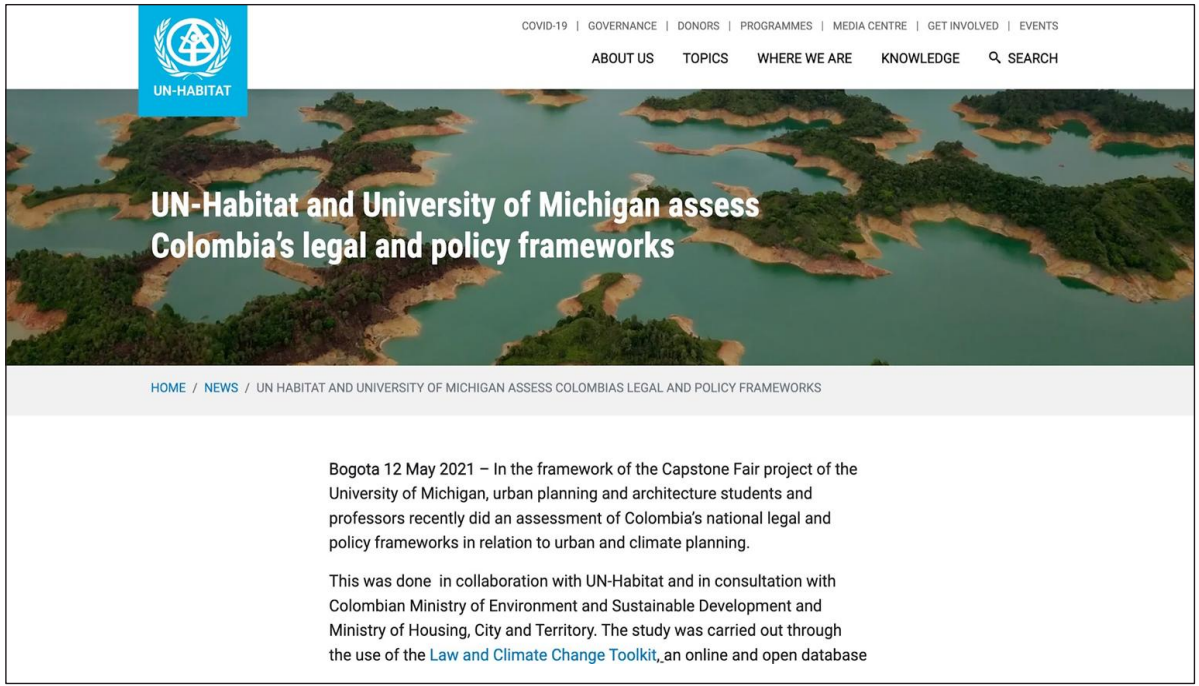
Meetings of favelas and occupations from the southern periphery of São Paulo and Urban Policy Manifestos

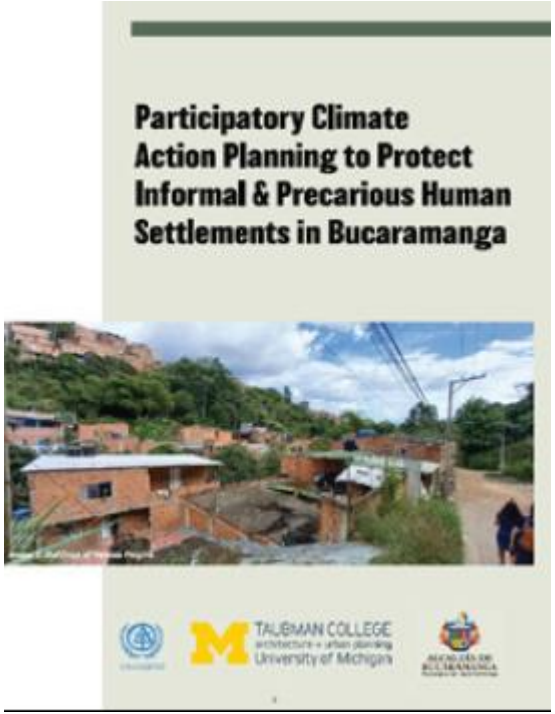


Anchieta Occupation Collevilly Managed, Resident-Led Upgrading Project with Peabiru

Introduction: Research Partners: CBPAR in Colombia

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





Introduction: Research Partner: Community Action Board

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, and UM team, August 2022

Introduction: Research Partner: Community Action Board

2022 Climate Action Workshops in Luz de Salvación II Transect Walk

Introduction: Research Partner: Community Action Board

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 provisoria 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: Research Partner: Community Action Board

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

Community Center

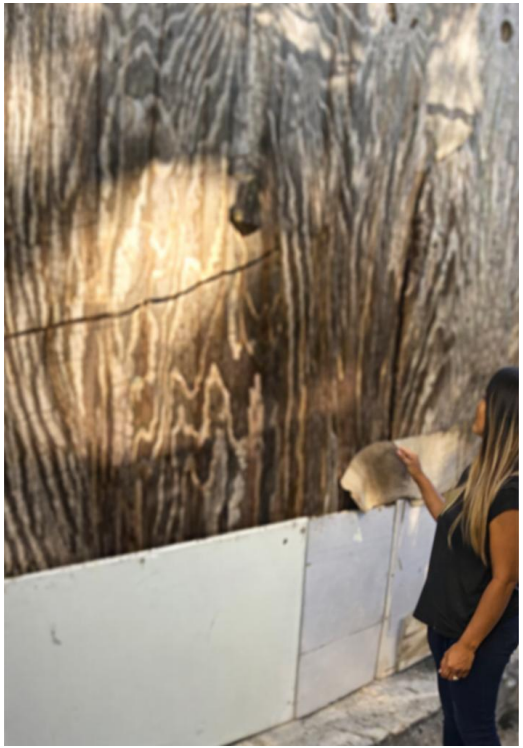
Theory of Change: Scaling Societal Impact: Level #1

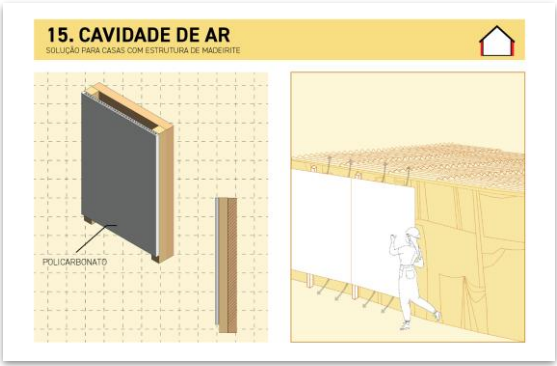
Learning and doing with what you have

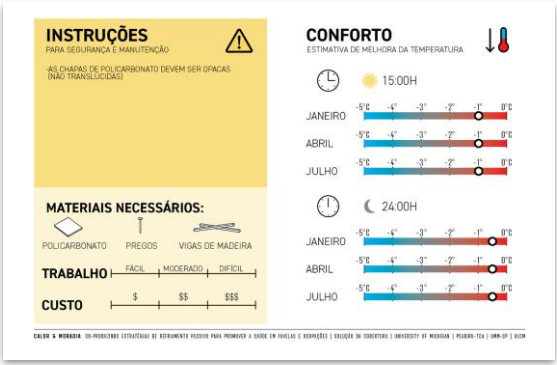
Zero-investment, self-built practices strengthened through *popular architectural education, thermal comfort literacy,* and *health-focused capacity building.*

Pursuing immediate action

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







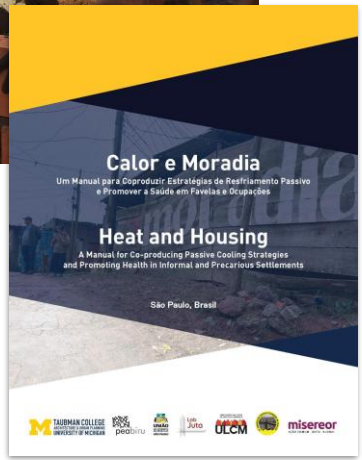
Theory of Change: Scaling Societal Impact: Level #2

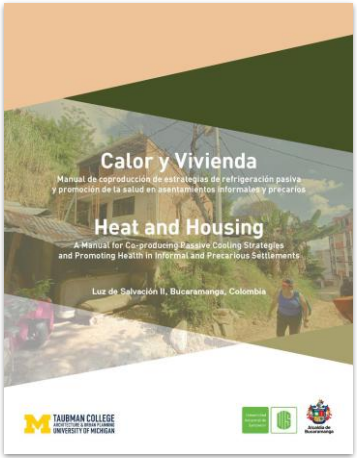
Accelerating mutual aid

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

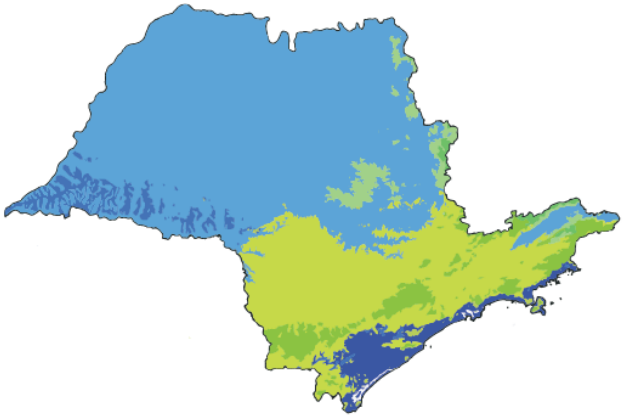
BRAZIL
SÃO PAULO
OCUPAÇÃO ANCHIETA

COLOMBIA
BUCARAMANGA
LUZ DE SALVACIÓN II

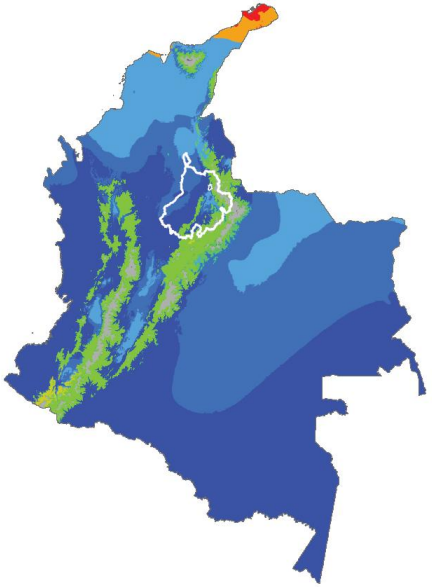
BURKINA FASO
NOUNA

Introduction: Climate Matters

BRAZIL
SÃO PAULO STATE



COLOMBIA
BUCARAMANGA (WHITE BOUNDARY)



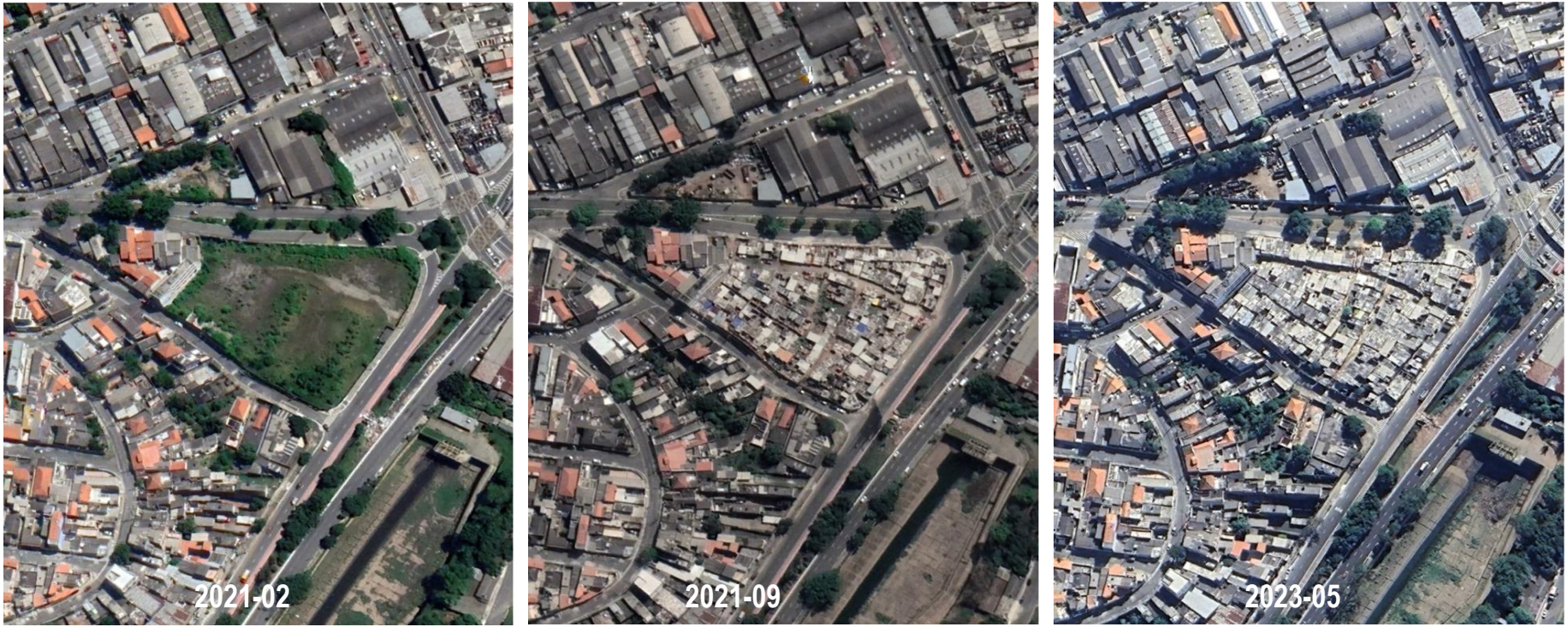
- Af, Ecuatorial o tropical húmedo — Tropical rainforest
- Am, Tropical monzónico — Tropical monsoon
- Aw, Tropical de sabana — Tropical savanna
- BSh, Semiárido cálido — Hot semi-arid
- Csb, Mediterráneo oceánico — Warm-summer Mediterranean
- Csc, Mediterráneo subalpino — Cold-summer Mediterranean
- 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

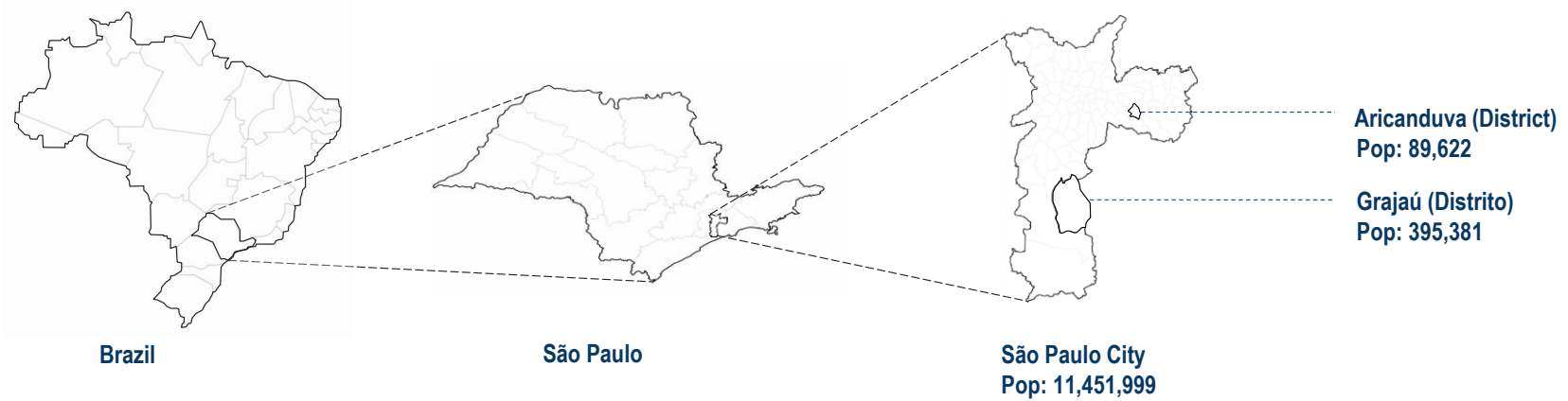
Introduction: São Paulo's Communities

Ocupação Estrela de Davi, East Zone

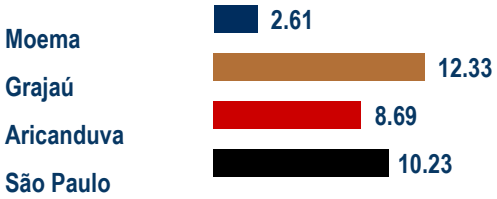


Introduction: São Paulo's Health Disparities

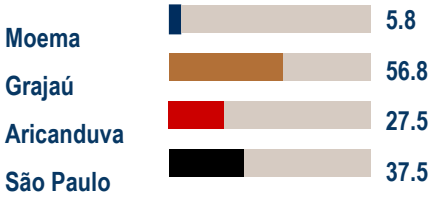
A City of Contrasts: Life Chances Across São Paulo's Districts



Infant Mortality (per 1,000 births)



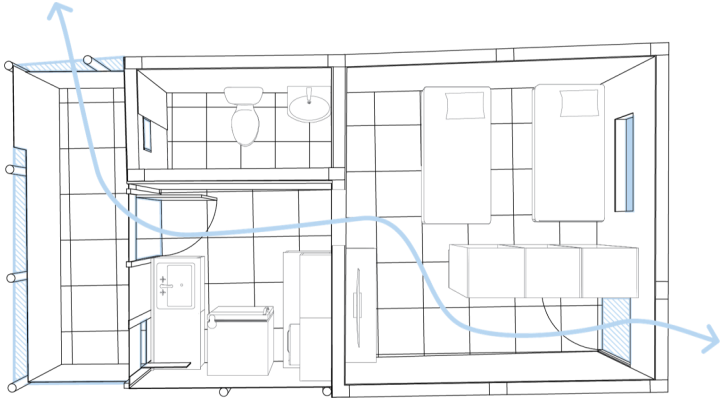
% Black and Brown Population



Life Expectancy (years)

Fonte: Nossa São Paulo, 2023.

Introduction: Research Process



1. **Engaging with ethnographies of construction 2023**
2. **Conducting modeling & simulation of self-built homes 2023-2024**
3. **Analyzing potential passive cooling interventions 2024**
4. **Co-designing options with dwellers' associations and partners 2024-2025**
5. **Implementing passive cooling Interventions in 100 households July 2026**
6. **Housing, Heat, and Health Survey Validation, May and July 2026**

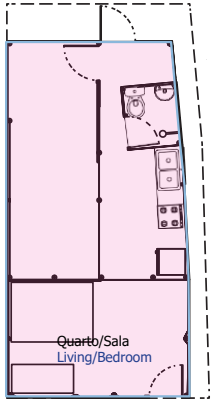
STEP 1. Engaging with ethnographies of construction

Jenny's House

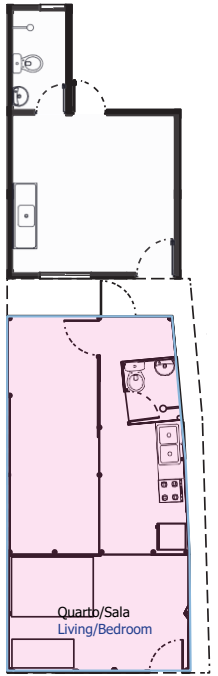
Shack made of plywood and recycled materials
17 types of material on the walls, ranging from plywood to closet boards, plastic, and fabric

Passive cooling retrofits align with incremental housing practices

Original Shack



Current House with Extension



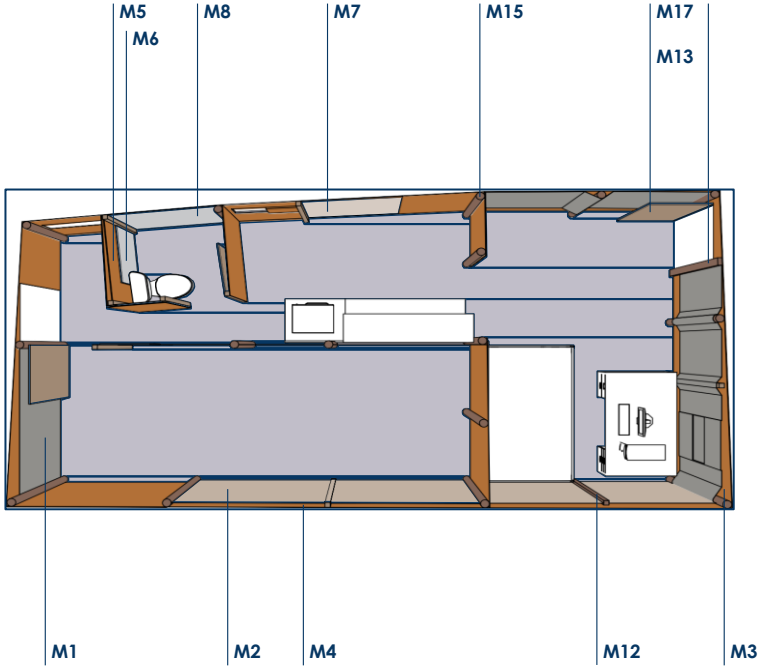
Planned Extensions

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

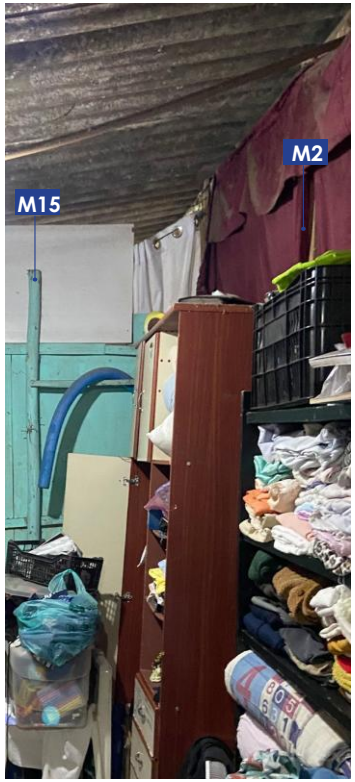
MXX	NAME	COMPOSITION	THICKNESS
M1	BANNER	PLASTIC	0.5mm
M2	CURTAIN	SYNTHETIC FABRIC	0.5mm
M3	PLYWOOD	PLYWOOD	10mm
M4	PLYWOOD	PLYWOOD	5mm
M5	WARDROBE WOOD	MEDIUM DENSITY PARTICLEBOARD (MDP)	20mm
M6	POLYCARBONATE SHEET	PLASTIC	20mm
M7	WARDROBE CEILING	MEDIUM DENSITY FIBERBOARD (MDF)	3mm
M8	PLASTIC SHEET	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

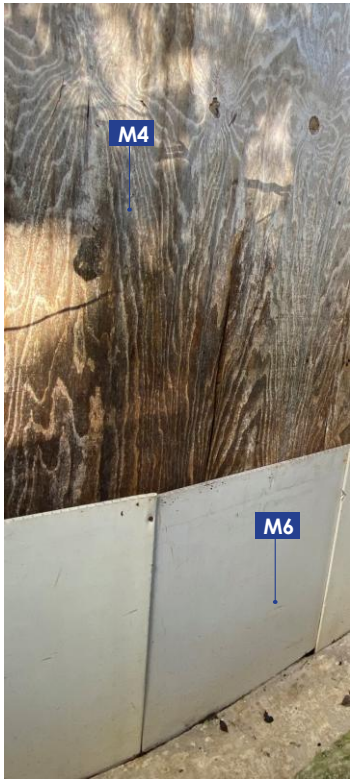
Quarto/Armário

Bedroom/Closet



Fachada Norte

North Facade



Quarto/Sala de Estar

Bedroom/Living Room

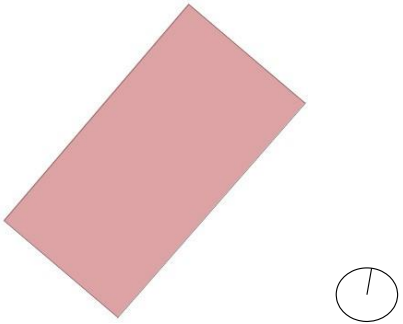
Detalhes da Cozinha

Kitchen Details

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.



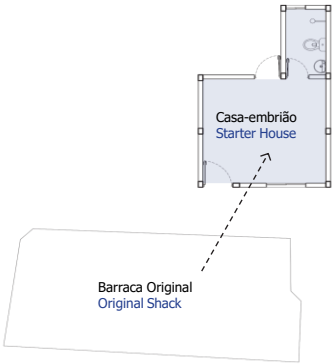
Solar orientation

Exterior

STEP 1. Engaging with ethnographies of construction

Claudiane's House

Incremental, self-built housing



Original Shack

Recommended Extensions (Peabiru)

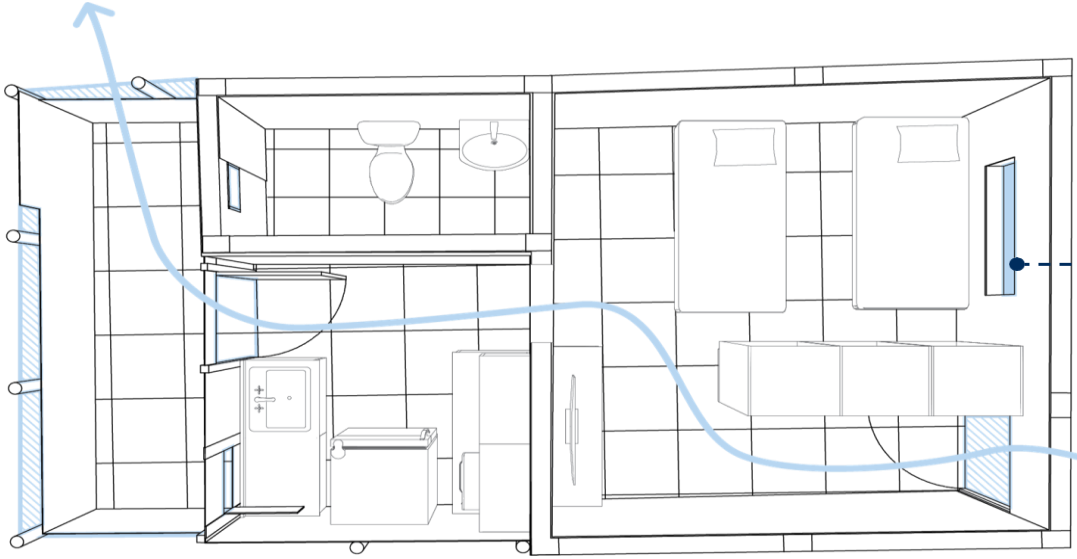
Current House with Extension

Claudiane's Planned Extensions

STEP 1. Engaging with ethnographies of construction

Claudiane's Core starter house with extension

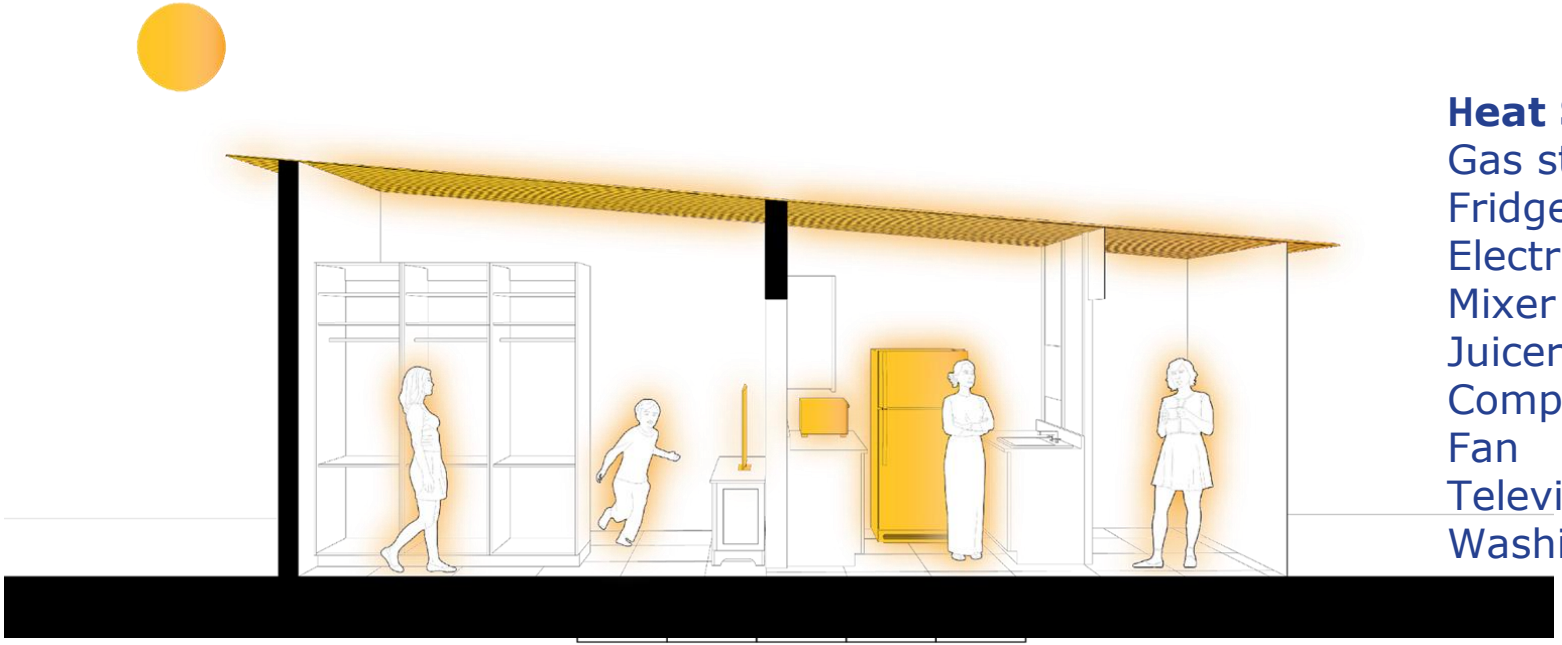
Ventilation and Humidity analysis



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

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DFG Deutsche Forschungsgemeinschaft
German Research Foundation

REFLECT

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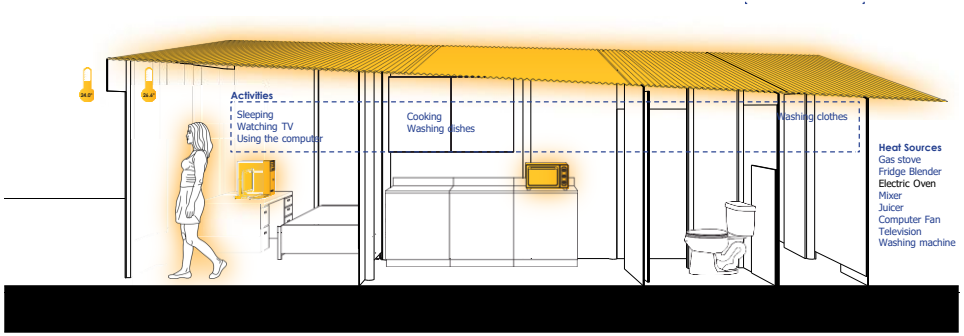
INSTITUTE FOR SOCIAL RESEARCH SURVEY RESEARCH CENTER UNIVERSITY OF MICHIGAN

CENTER FOR GLOBAL HEALTH EQUITY UNIVERSITY OF MICHIGAN

STEP 2. Modeling & simulation

Heat and comfort analysis



Hot
Warm
Slightly warm
Neutral
Slightly cool
Cool
Cold

Computer simulations and <u>comparisons</u> of passive cooling interventions across seasons, house types, and climate zones

Baseline (No Intervention)

Day in year	111	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
	112	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	2.9
	113	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
	114	2.9	2.8	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	3.2
	115	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	3.3	3.2	3.2	3.1	3.0	3.0	3.2
Hour in day		1	2	3	4	5	6	7	8	9	0	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	2.7	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	2.8	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	2.4	2.5	2.6	2.6	2.7	2.8	2.8	2.8	2.8	2.7	2.7	2.6	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	2.5	2.6	2.7	2.8	2.8	2.9	2.9	2.9	2.9	2.9	2.8	2.8	2.8	2.7	2.9
	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	2.8	2.9
Hour in day		1	2	3	4	5	6	7	8	9	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24

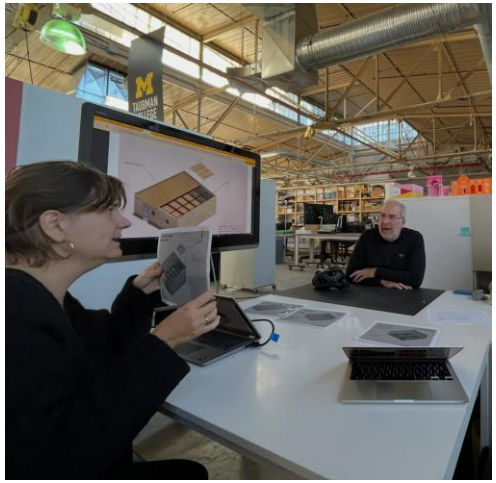
Intervention Combination: White Roof, Fabric Insulation, and Cavity Wall

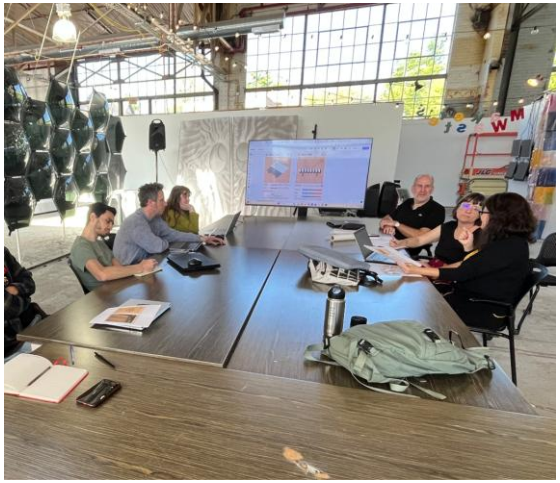
Day in year	111	2.6	2.6	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.5	2.5
	112	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.4	2.4	2.4	2.4
	113	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	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	2.6	2.6	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	2.6	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	0	11	12	13	14	15	16	17	18	19	20	21	22	23	24

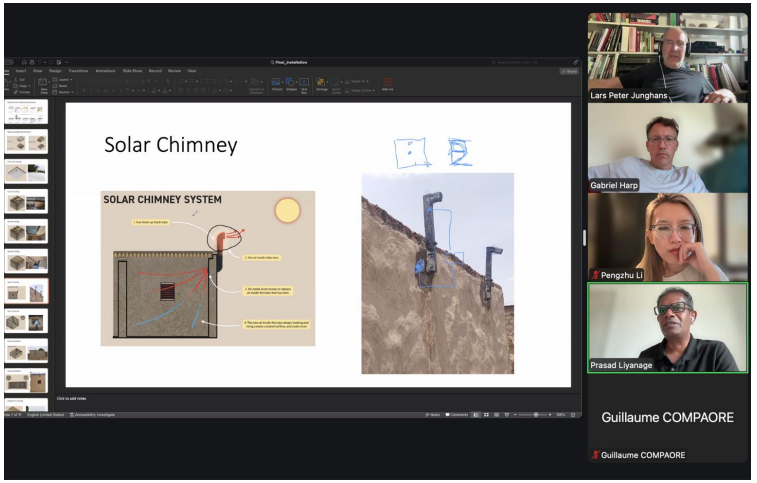
STEP 3. Analyzing & Visualizing passive cooling options

Designed visual and communication materials create shared understanding in Participatory Action Research

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

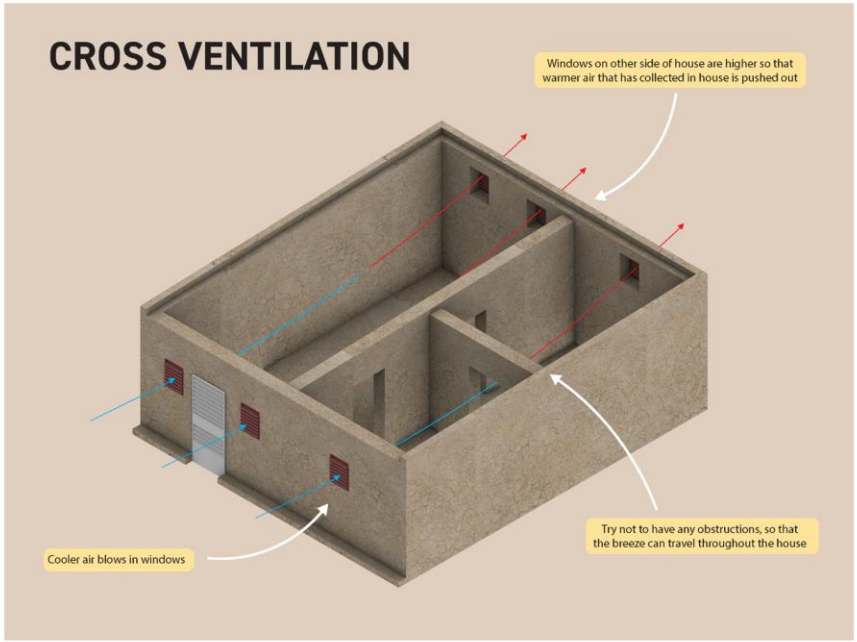


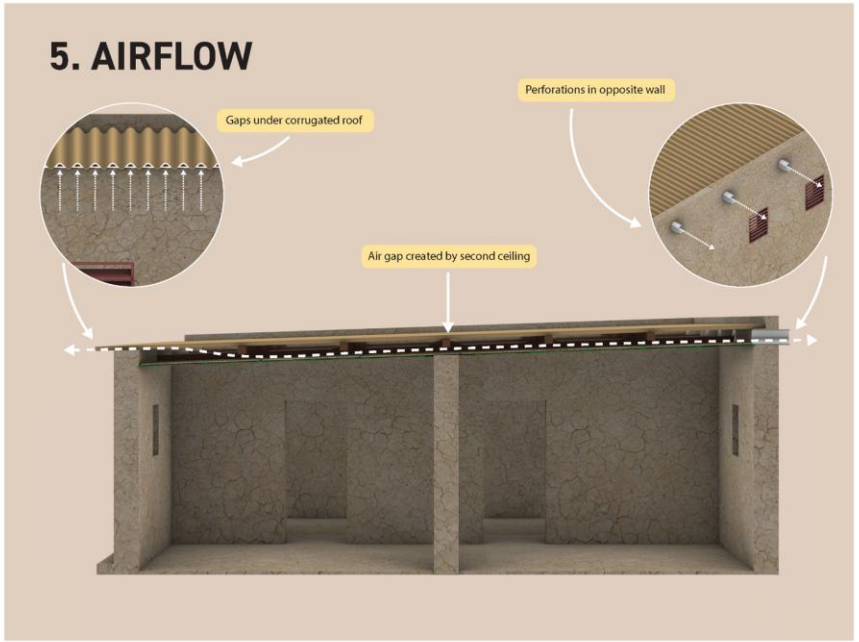




STEP 3. Analyzing & Visualizing passive cooling options

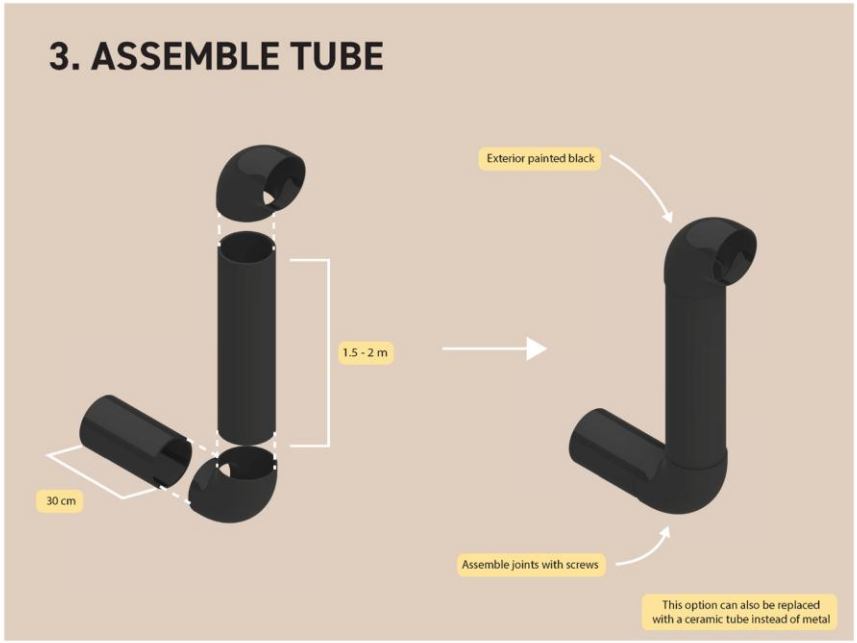
Cross ventilation and air flow

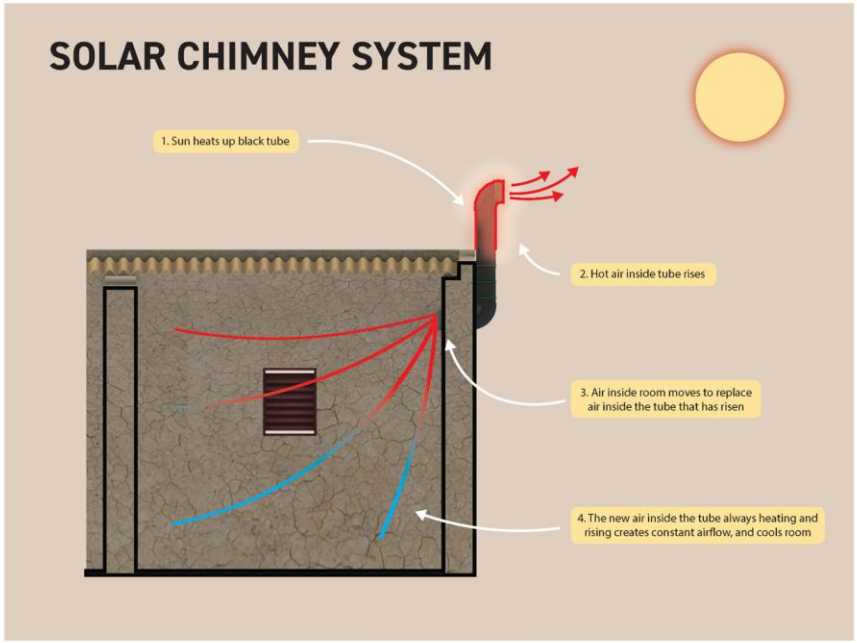




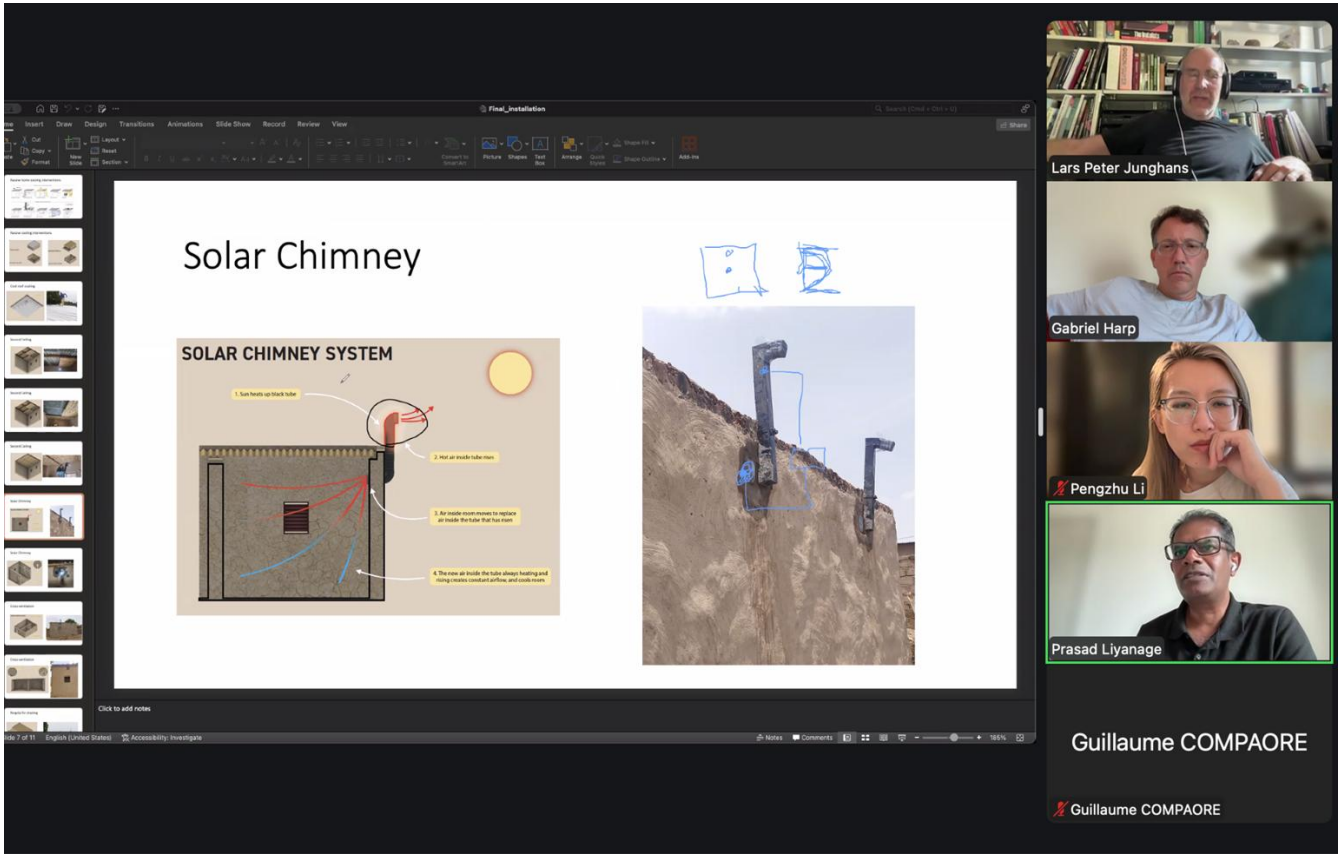
STEP 3. Analyzing & Visualizing passive cooling options

Solar Chimney

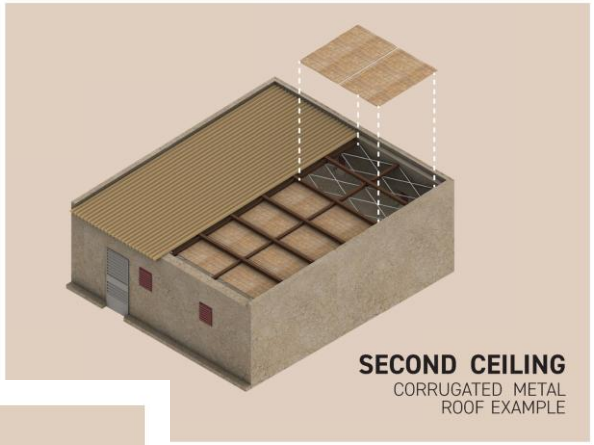




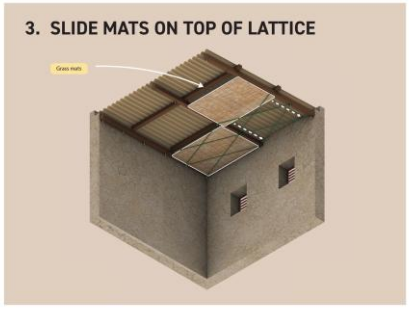
STEP 3. Analyzing & Visualizing passive cooling options

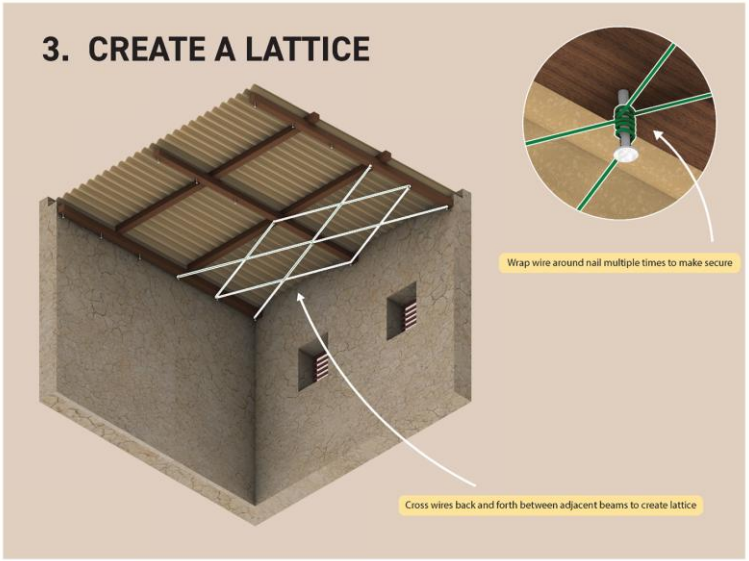


STEP 3. Analyzing & Visualizing passive cooling options

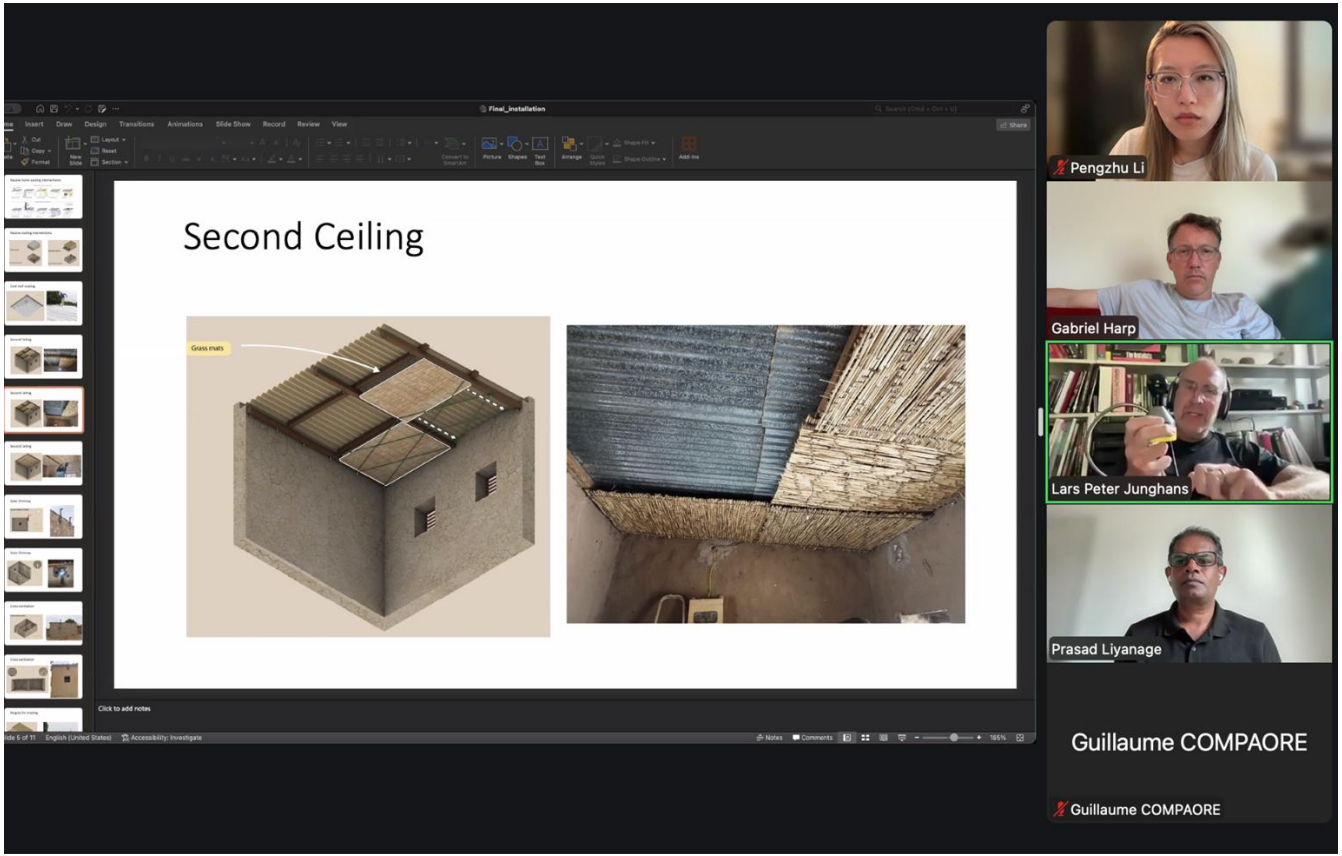


Second ceiling



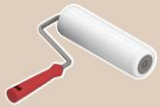


STEP 3. Analyzing & Visualizing passive cooling options



STEP 3. Analyzing & Visualizing passive cooling options

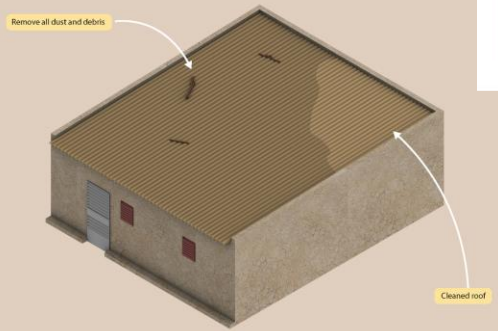
MATERIALS NEEDED:



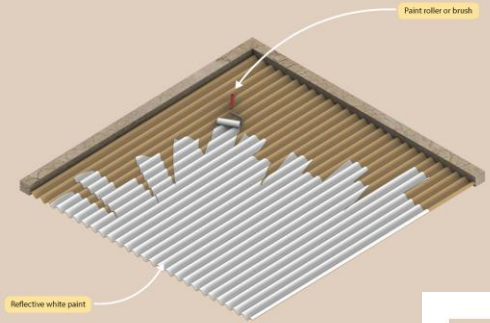
PAINT BRUSH/ROLLER

REFLECTIVE WHITE PAINT

1. CLEAN AND REPAIR ROOF SURFACE



2. APPLY PAINT



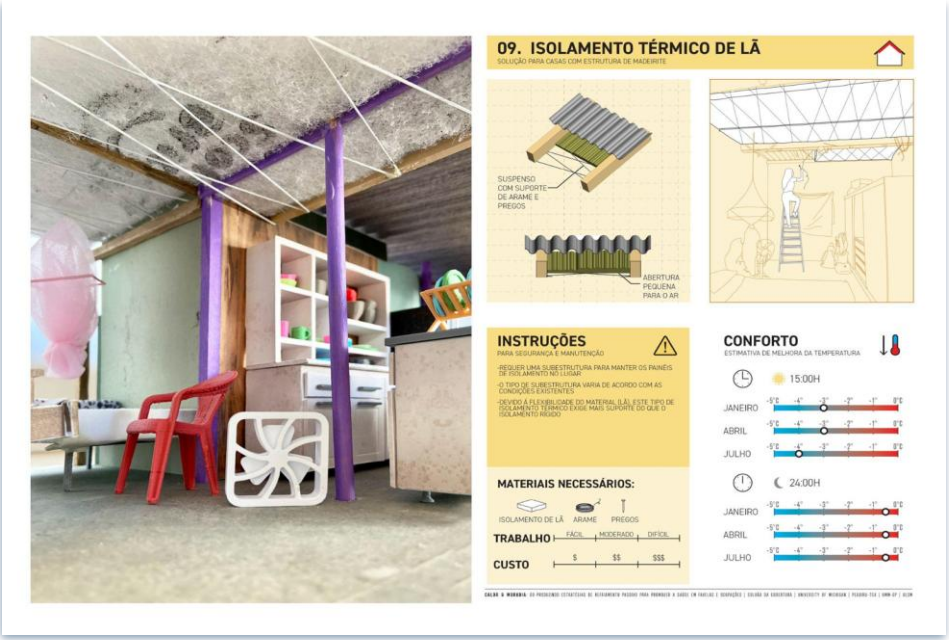
3. APPLY SECOND COAT OF PAINT

Reflective roof

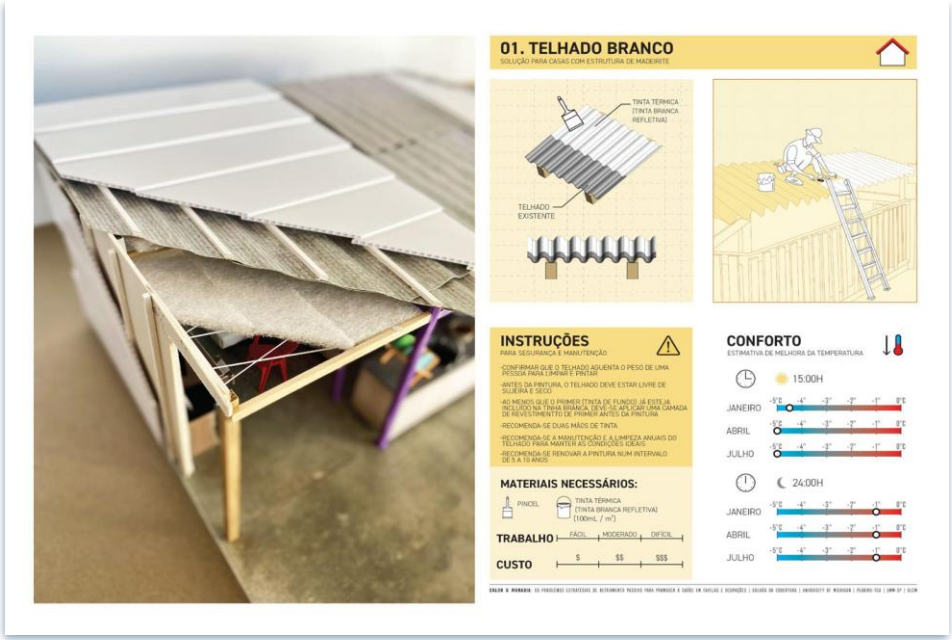
COMPLETED WHITE ROOF

STEP 3. Analyzing & Visualizing passive cooling options

Development of passive cooling intervention cards and physical model



Fabric Insulation

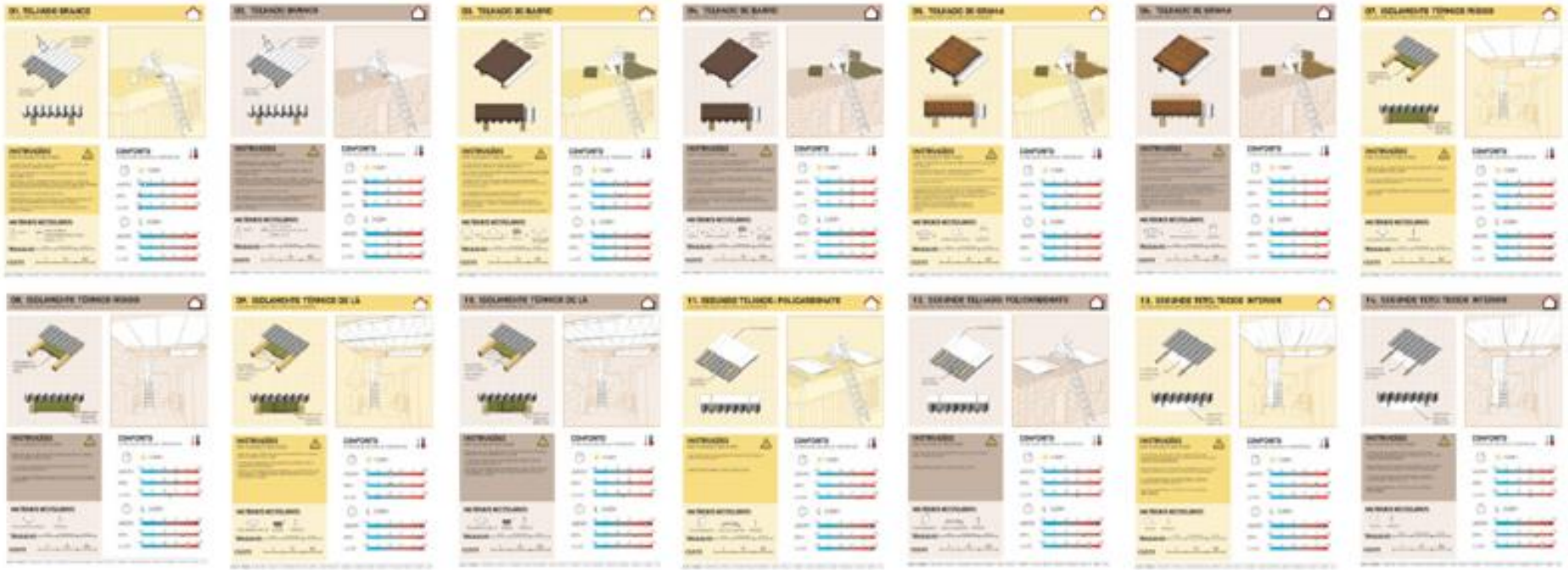


Roof cooling paint (white, reflective)

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

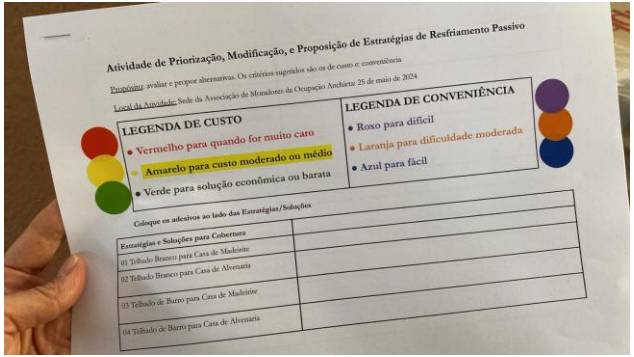
Workshop, Estrela de Davi, 2024

Dialogue Circle, MST Leste 1, 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
- Sheila Cristiane Santos Nobre, UMM-SP
- 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 Brazil

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

STEP 5. Implementing passive cooling in Brazil

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

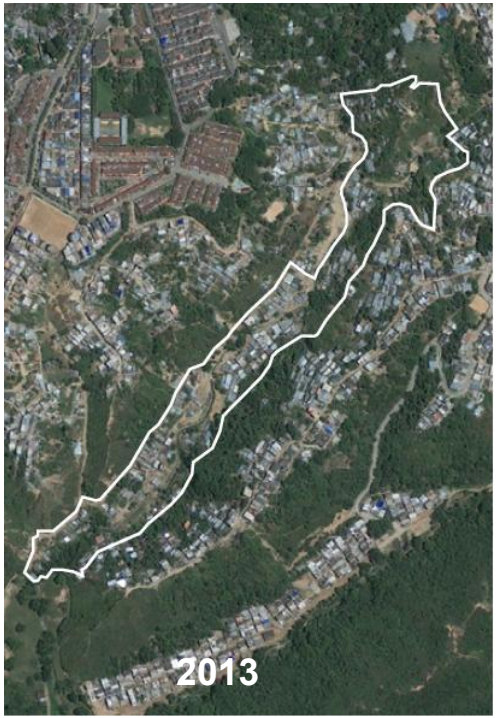
STEP 5. Implementing passive cooling in Colombia

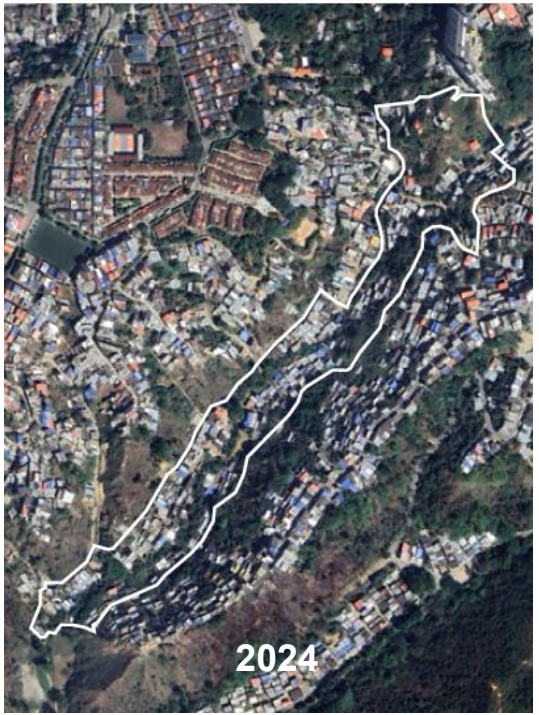
Luz de Salvación II

- 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.

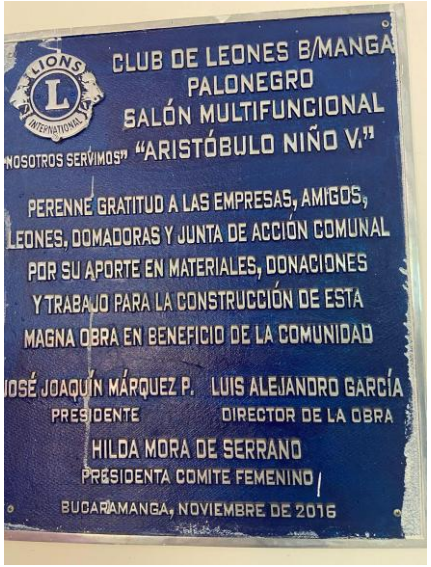
STEP 5. Implementing passive cooling in Colombia

Luz de Salvación II, Comunas 10 & 11





STEP 5. Implementing passive cooling in Colombia



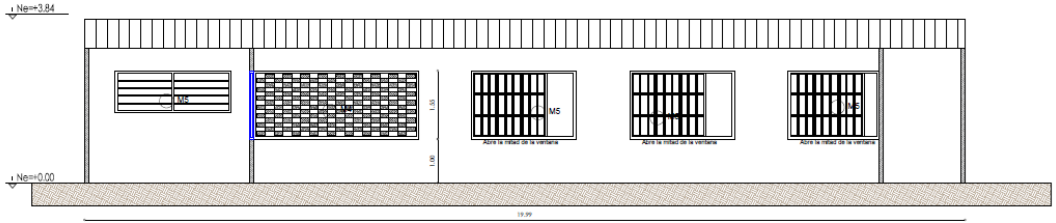
ACCION COMUNAL
COLOMBIA

MONTANI
LIBERI
SEMPER

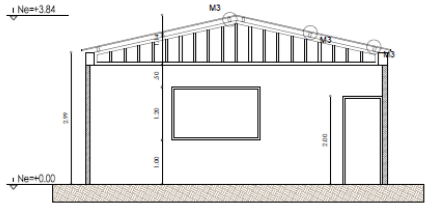
STEP 5. Implementing passive cooling in Colombia

STEP 5. Implementing passive cooling in Colombia

Levantamiento fisico de la vivienda CASA 3
SALON COMUNAL



3 CORTE A-A'
Escala: 1_100

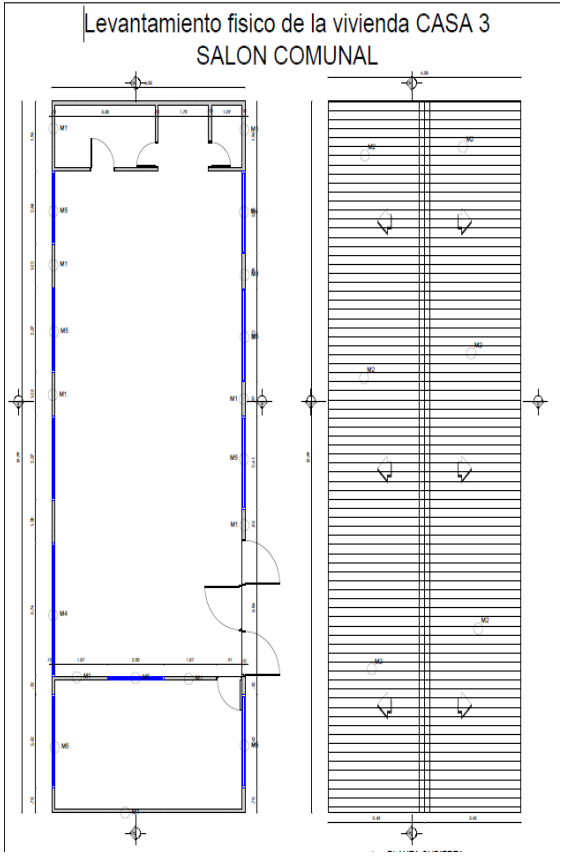


4 CORTE B-B'
Escala: 1_100

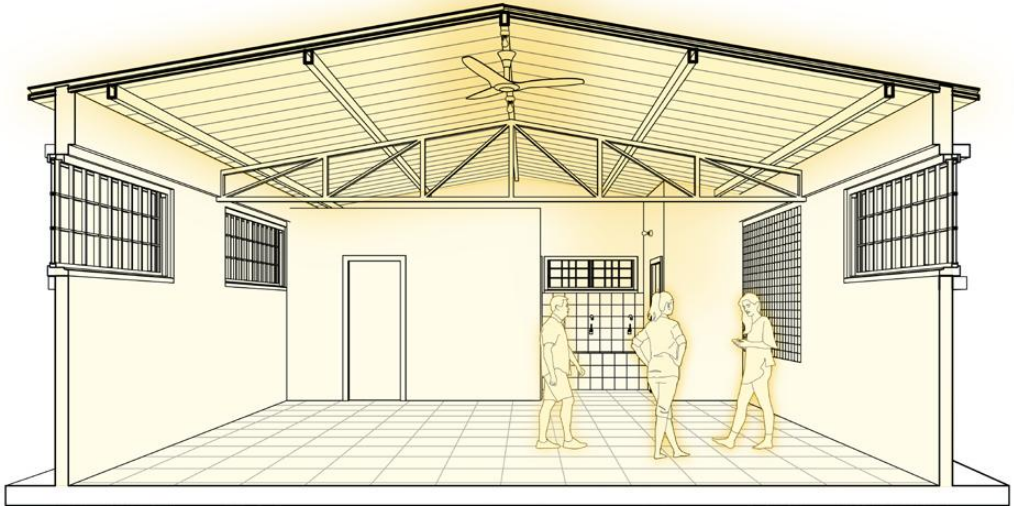
LEYENDA MATERIALES DE CONSTRUCCION(POSICION EXACTA EN LA CASA POR DIBUJO)				
Mxx	NOMBRE DEL MATERIAL-AÑO	COMPOSICION	ESPESSURA	HABITACION
M1	Ladrillo H-10	Arcilla	10 cm	
M2	Teja de zinc	Zinc		
M3	Correas - Cubierta	2" x 1" Pulg		
M4	Ventanas en ladrillo	Arcilla		
M5	Ventanas Metalicas	Hierro		

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 Colombia



STEP 5. Implementing passive cooling in Colombia

Combined Second Ceiling + Cool roof

STEP 6. Assessing housing, heath, and health outcomes

Household Housing, Heat & Health Survey

Household & Housing Characteristics

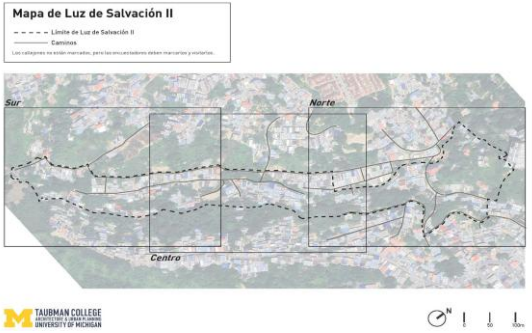
- Section 1 Demographic Information
- Section 2 Tenure Security and Incremental Housing
- Section 3 Housing Structural Characteristics
- Section 4 Home Heating and Cooling
- Section 5 Household Energy Use
- Section 6 Water Access and Reliability
- Section 7 Neighborhood and Environmental Conditions
-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

Colombia survey validation

(in progress)



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. Érinn 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

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Research Outcomes

- **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 in precarious housing.
- **Policy-ready evidence** with actionable recommendations for integrating passive cooling into housing and settlement planning.

Combining Scientific & Socioenvironmental Benefits

- Improved computational modeling for indoor thermal comfort that is suitable for people living in self-built homes in different climate zones.
- Tested passive cooling interventions that can improve thermal comfort, reduce thermal stress, and increase dwellers' health and well-being.
- Trained dweller-educators who are knowledgeable about passive cooling strategies to promote health.
- Reduced household costs (electricity) associated with active cooling (fans).
- Lowered greenhouse gas emissions in the future by avoiding the prospects of air conditioning solutions for self-built homes.
- Evidence-based recommendations for policy-makers to integrate passive cooling options into housing and human settlement planning.

THANK YOU!

TAUBMAN COLLEGE
ARCHITECTURE & URBAN PLANNING
UNIVERSITY OF MICHIGAN

peabiru

UNIÃO DOS MOVIMENTOS DE MORADIA SÃO PAULO

UNIFICAÇÃO DAS LUTAS DE CORTIÇO E MORADIA
ULCM

ANCHIETA

Alcaldía de Bucaramanga

Universidad Industrial de Santander

TAUBMAN COLLEGE
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UNIVERSITY OF MICHIGAN

INSTITUTE FOR SOCIAL RESEARCH
SURVEY RESEARCH CENTER
UNIVERSITY OF MICHIGAN

CENTER FOR GLOBAL HEALTH EQUITY
UNIVERSITY OF MICHIGAN

COOL TALKS · SESSION 13

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

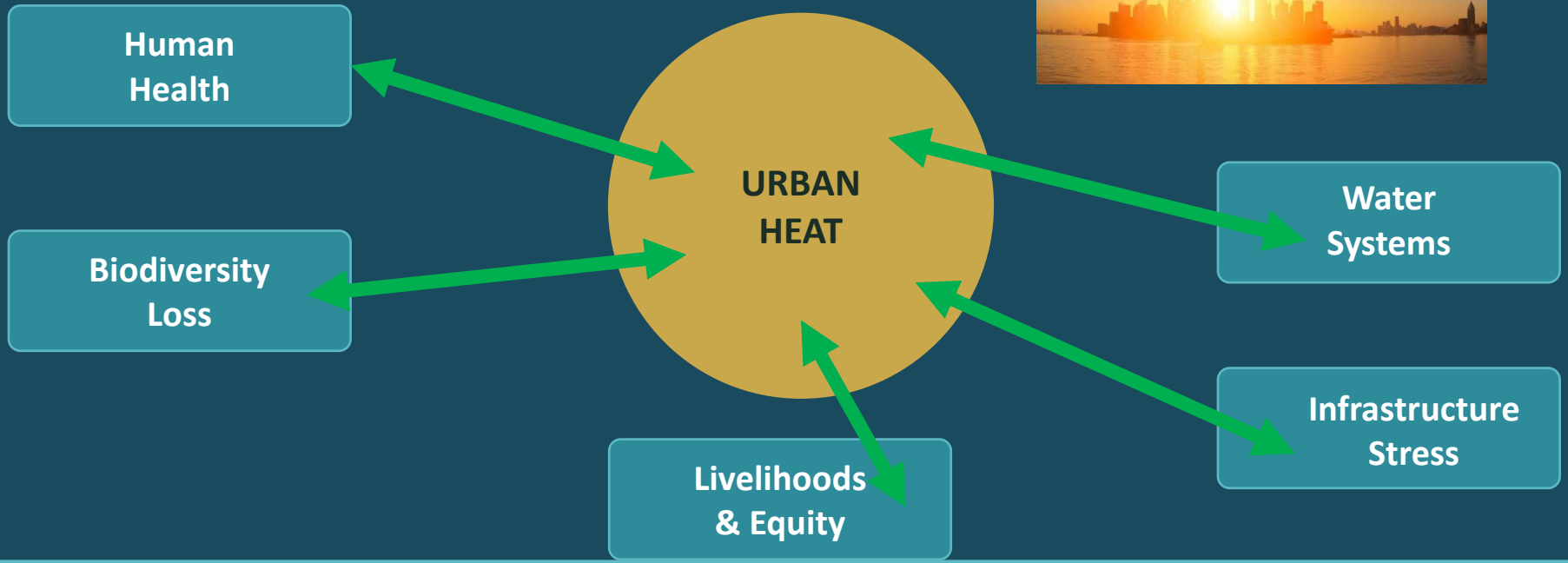
Cities are becoming critical implementation platforms for biodiversity action.

Global Biodiversity Framework → **National Biodiversity Strategies and Action Plans (NBSAPs)** → **Cities as Implementation Platforms** → **Action & Delivery**

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.

NBSAP accelerator partnership

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.

NBSAP accelerator partnership

NBSAP Accelerator Partnership

- Cities & Local Govts
- National Governments
- Non-State Actors
- Academia
- Multilateral Agencies
- Finance Institutions

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!

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)

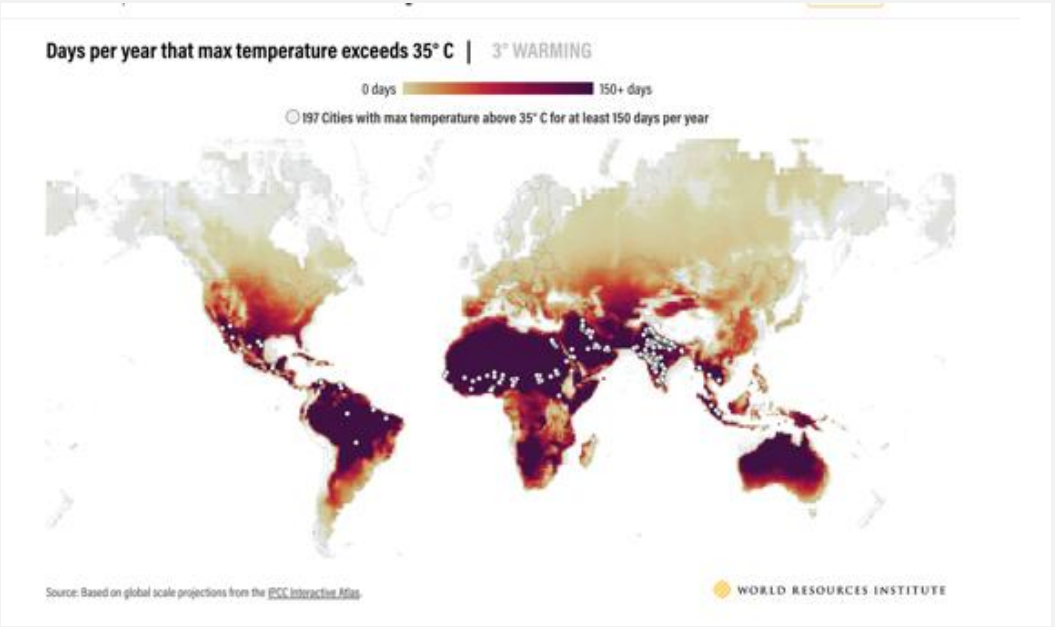
🔥 3.79 billion people exposed to extreme heat if warming passes 2°C 41% of global population in 2050*

🌆 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

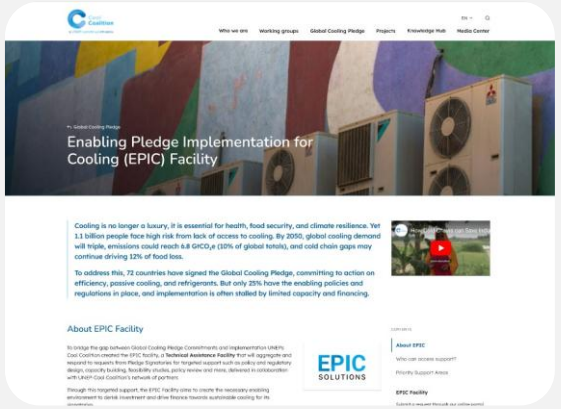
- **Global Cooling Pledge launched (19 commitments)**
- **Political mandate established** at COP

- **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

#BEAT THE HEAT

Beat the Heat operationalises the Global Cooling Pledge, turning commitments into scalable cooling action.



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

PHASE 2
ACTIVATION

PHASE 3
INSTITUTIONALISATION IMPLEMENTATION PHASE

PHASE 4
PLEDGE DELIVERY

2023 — **2024** — **2025** — **2026+**

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

100+ Partners

driving the mutirão

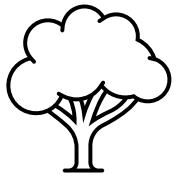
100+ Partners

Driving the Mutirão

Implementation Pathway

Commitment 1

Heat Action Planning



Commitment 2

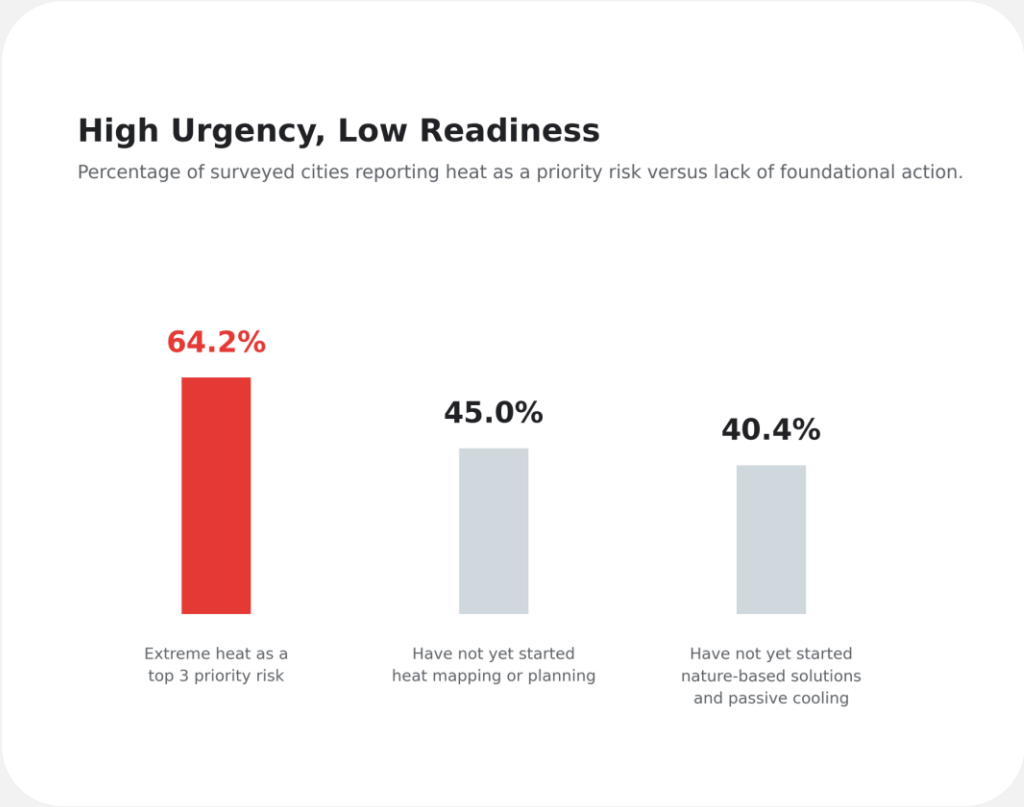
NbS and Passive Cooling

Commitment 3

Public Procurement

Is extreme heat a priority?

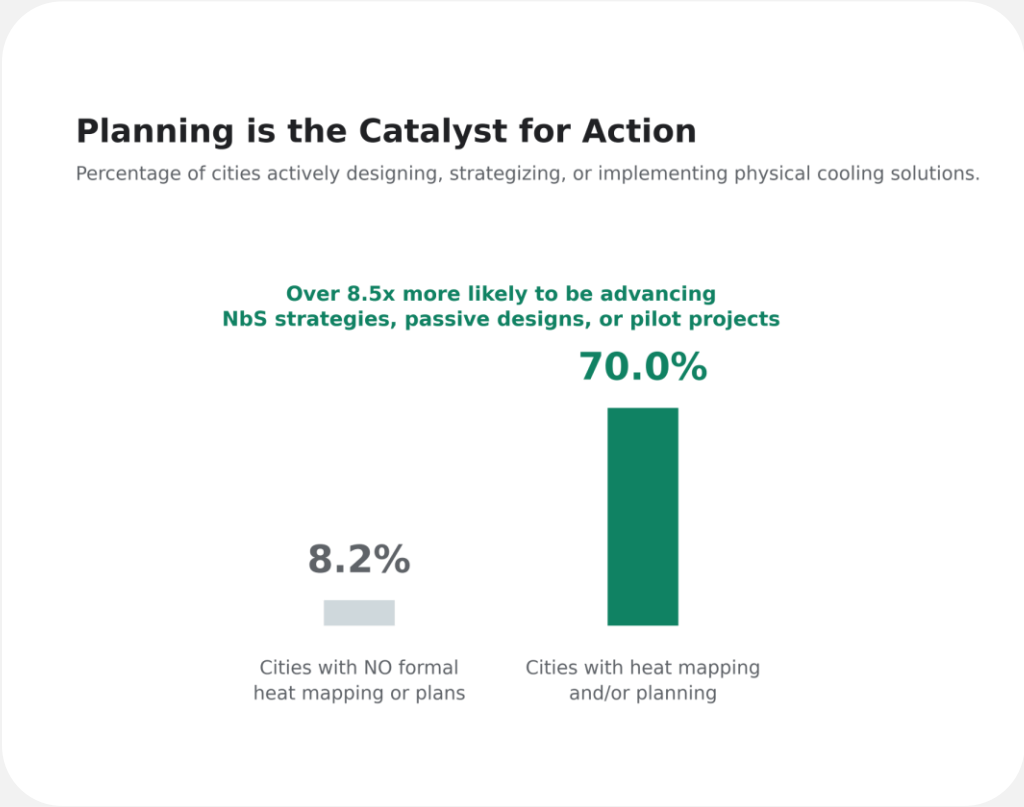
Cities already recognize extreme heat as a major risk, but most still lack the basic planning and data foundations needed to respond.



UN environment programme

Planning lays the ground for scaled action

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

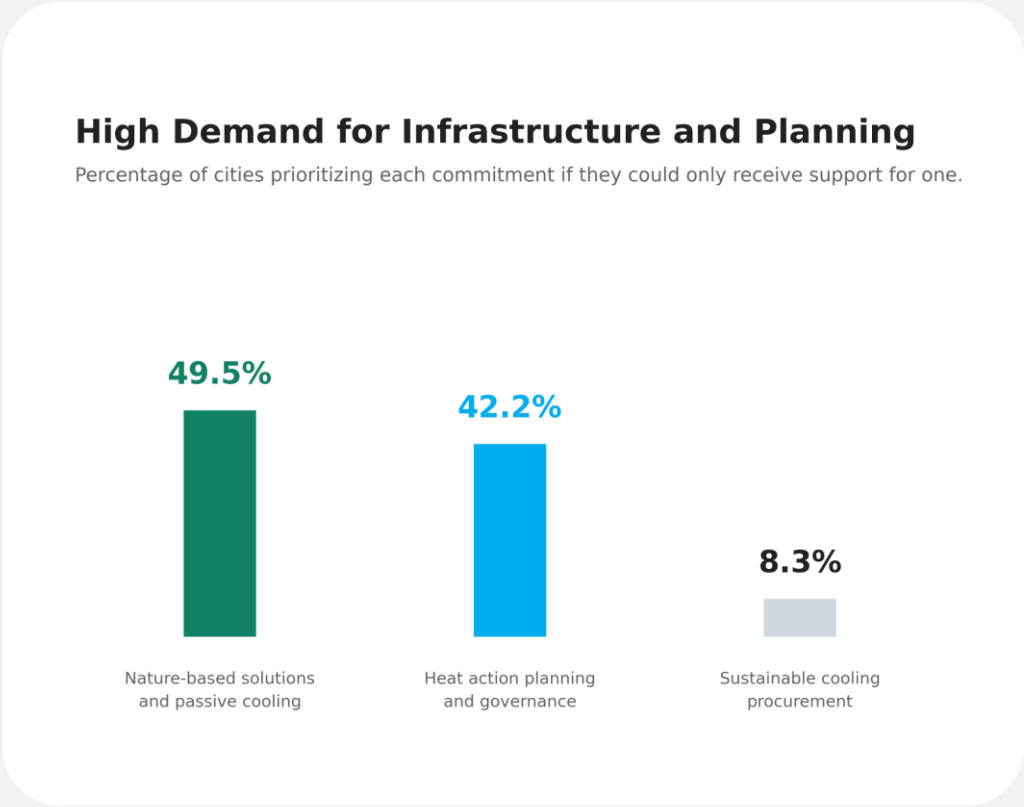


UN environment programme

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.



UN environment programme

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

UN environment programme

Cities need implementation support now

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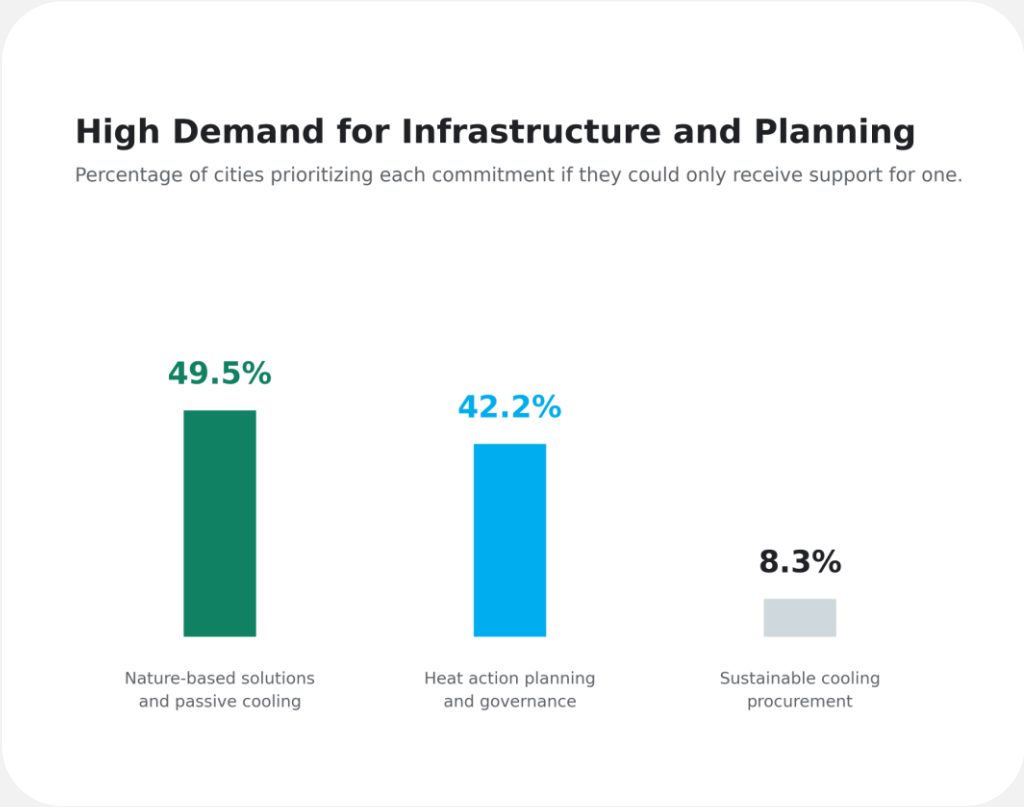

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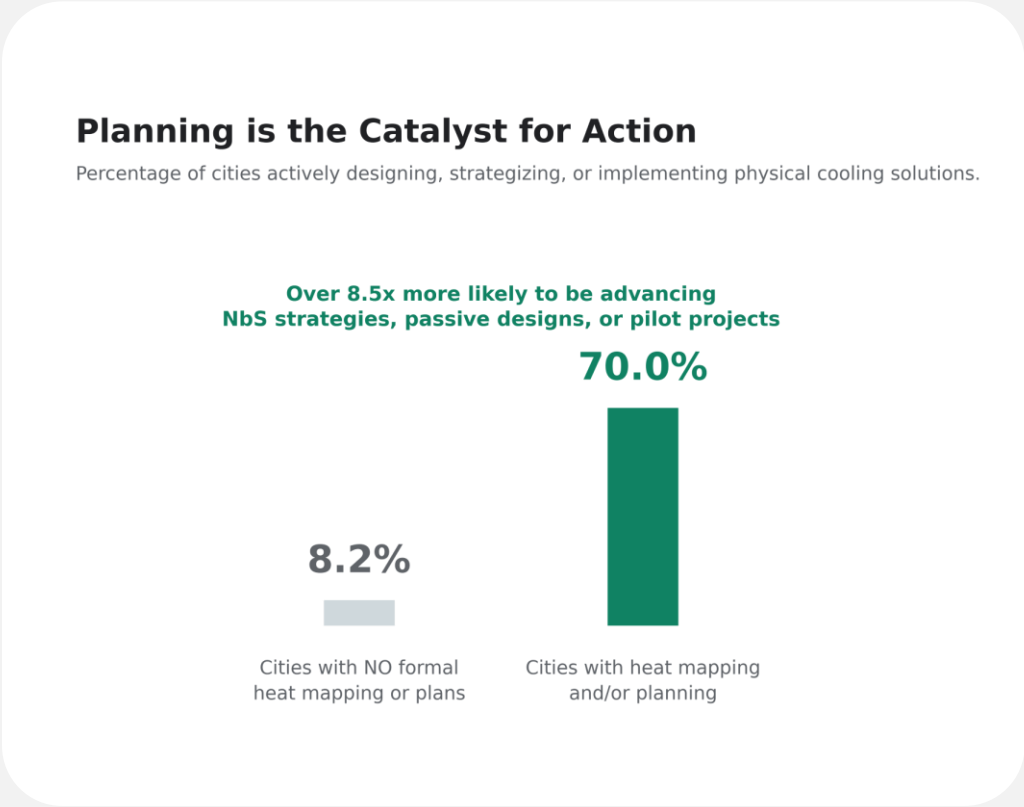

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Financial Support and Planning

UN environment programme

Early delivery already underway

Digital Tool	Data Access	Training	Public Activation	Geospatial Analysis
Cool Cities Lab	Roof albedo and green canopy data	Heat action planning framework	50 cities at 50 degree Celsius	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

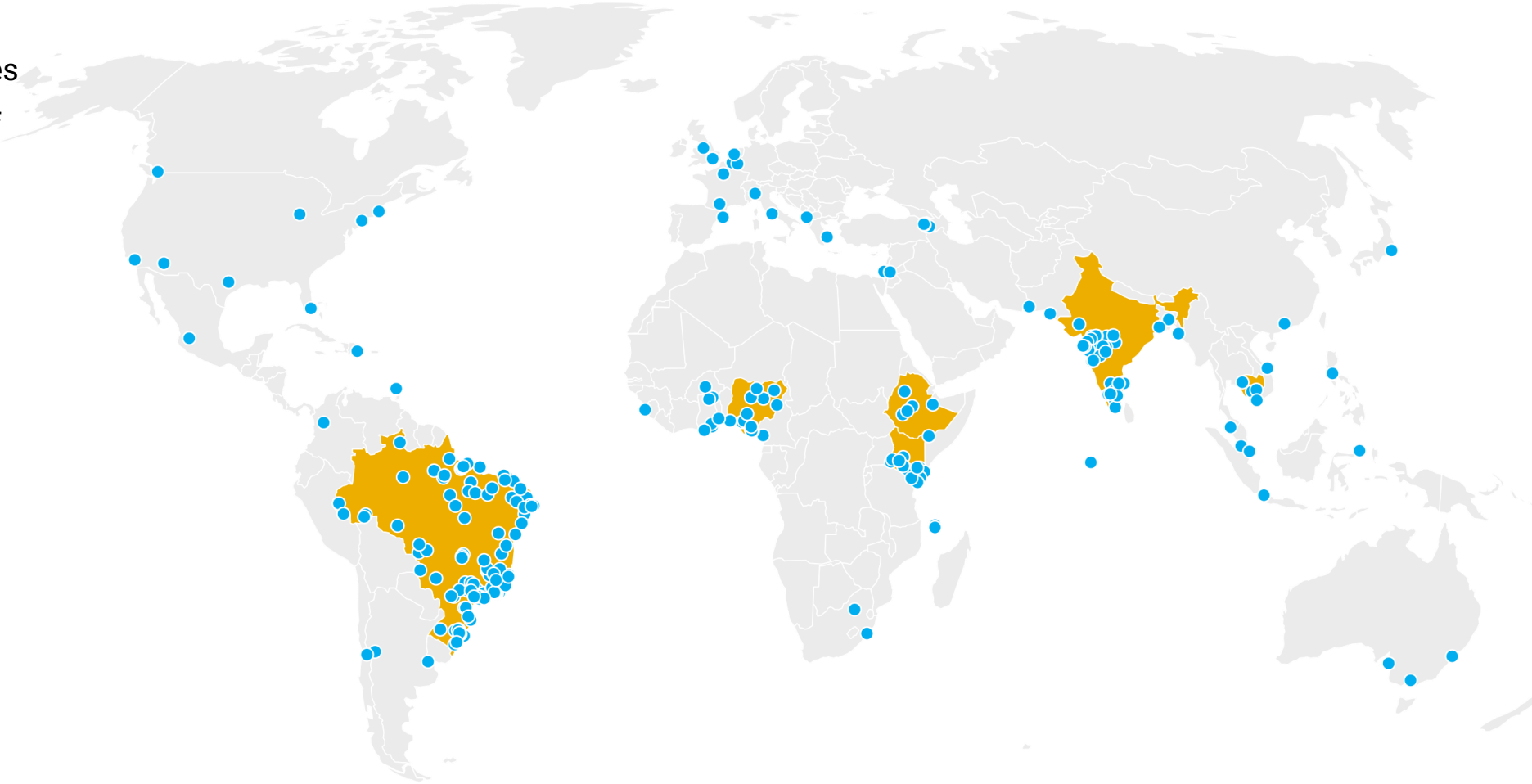
Cambodia

Ethiopia

India

Kenya

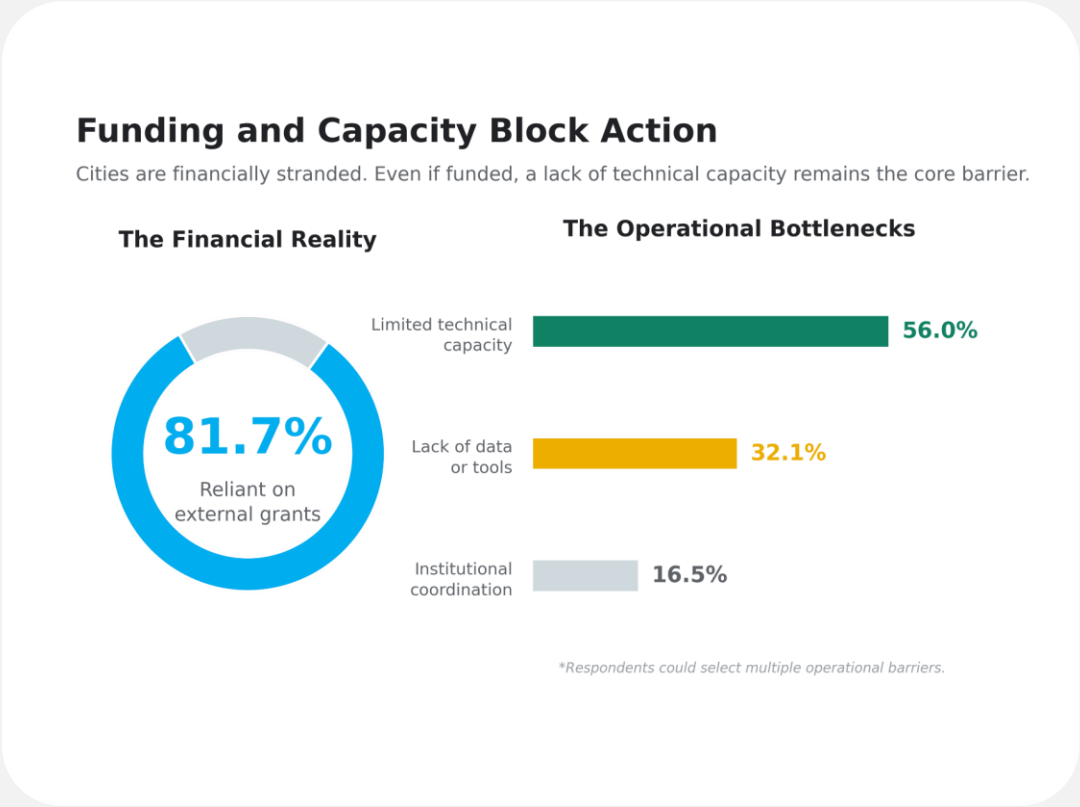
Nigeria



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.



UN environment programme

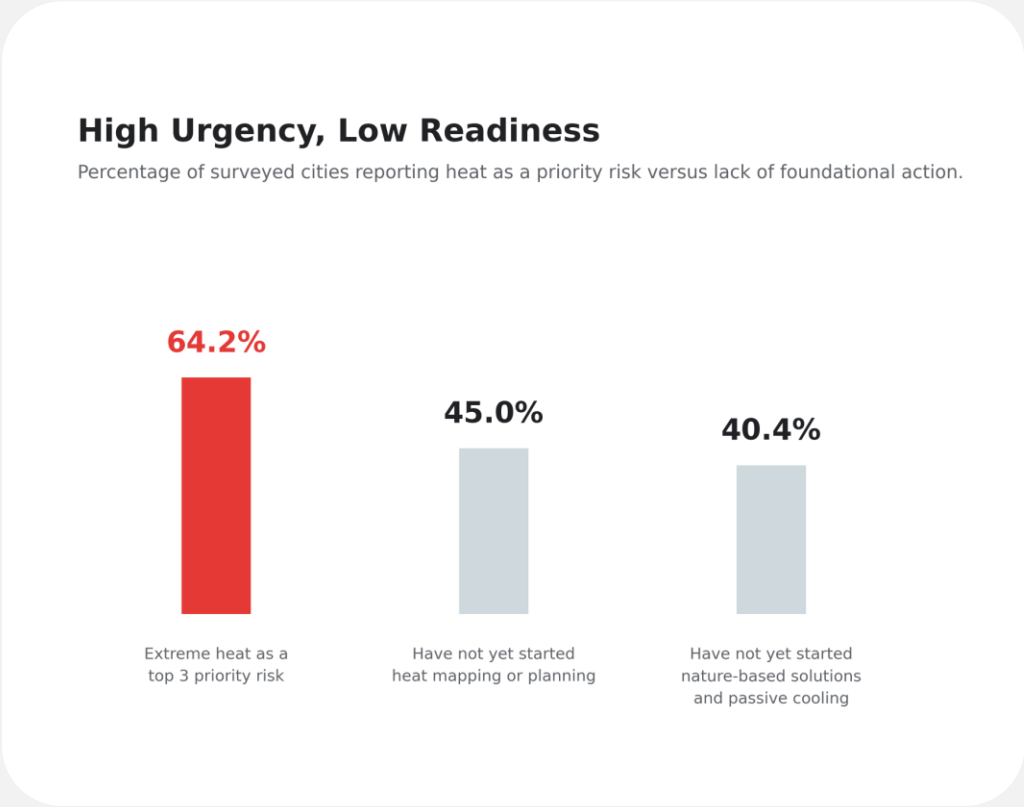

COP30
BRASIL
AMAZÔNIA
BELÉM 2025
UN
environment
programme
Cool
Coalition
a UNEP-convened initiative
BEAT
THE
HEAT
Mutirão contra
o Calor Extremo
BEAT
THE
HEAT
Thank you

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



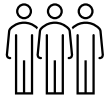
UN environment programme

Survey Statistics

Respondents to Survey

103 of 250
participating cities

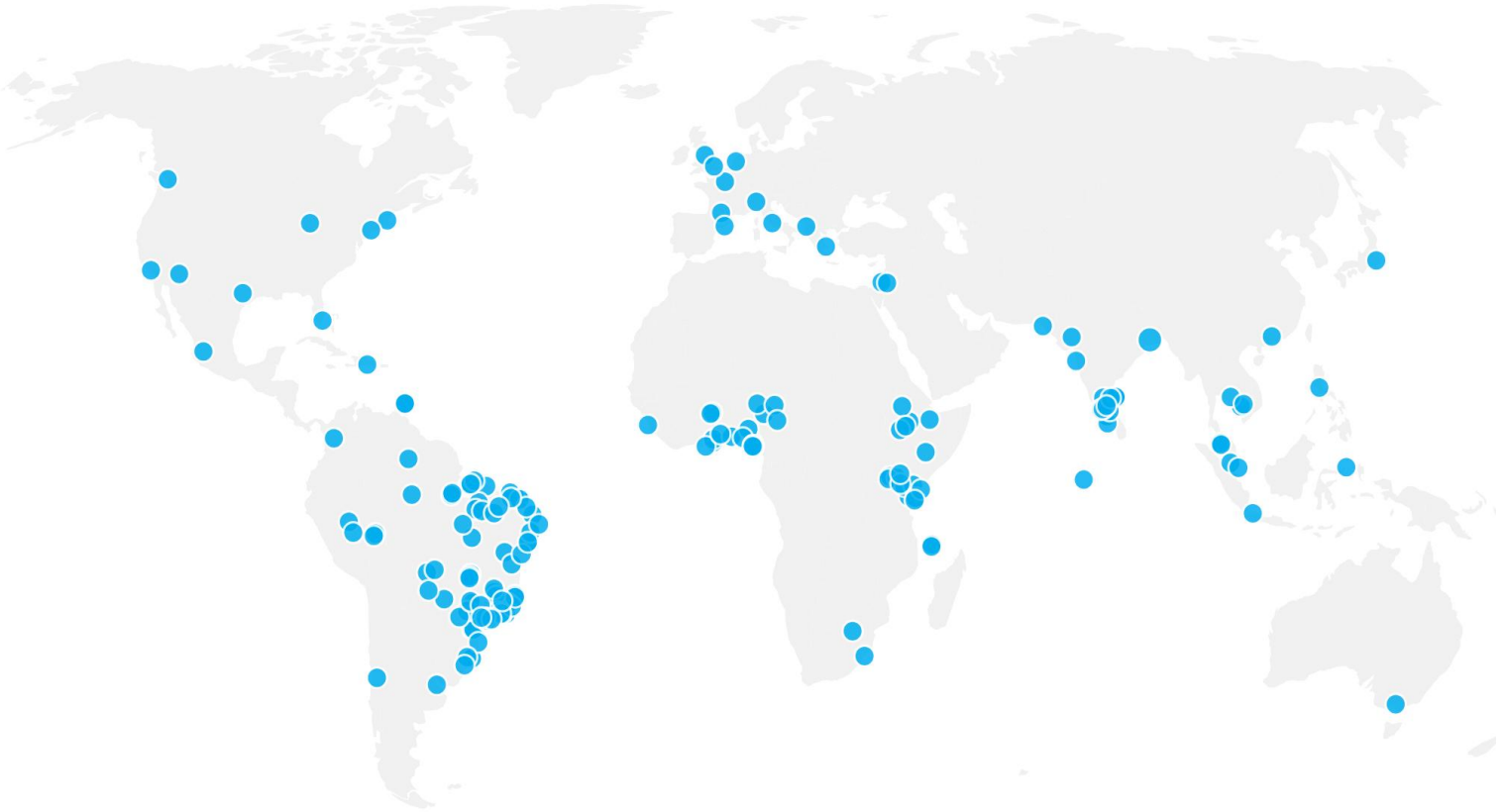
Estimated total population
of all 250 participating cities



558 million

UN environment programme

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



100+ Partners

driving the mutirão

100+ Partners

Driving the Mutirão