



# We will be starting soon!

*Thanks for joining us*



# Thriving with Hemp – Green Building Speaker Series

*Matt Marino – Homeland Hempcrete*

*Rohan Sutherland – Regenerative Systems*

*Roger Gorke – U.S. Environmental Protection Agency*

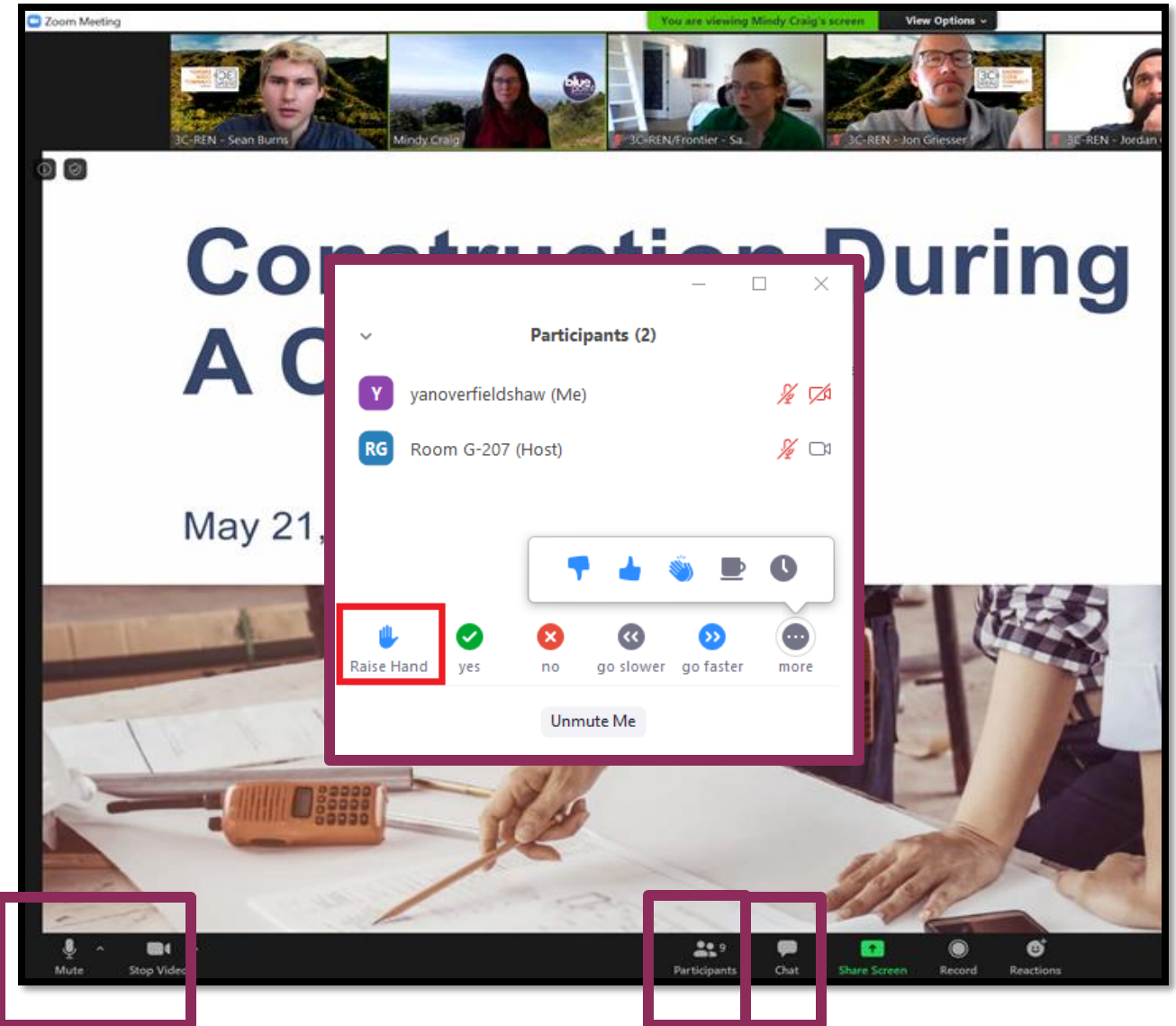
May 14, 2024





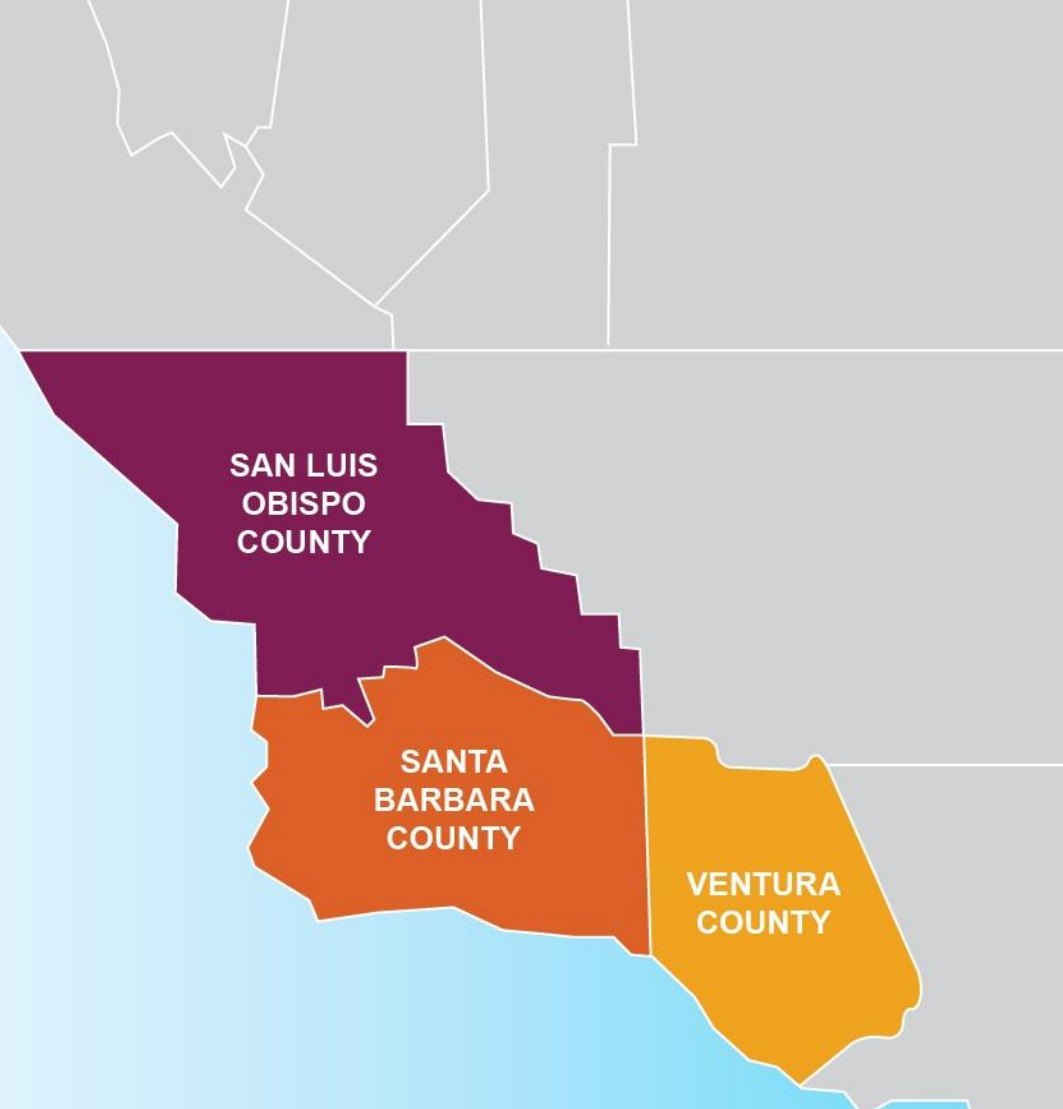
# Zoom Orientation

- Please be sure your full name is displayed
- Please **mute** upon joining
- Use "Chat" box to share questions or comments
- Under "Participant" select "Raise Hand" to share a question or comment verbally
- The session may be **recorded** and posted to 3C-REN's on-demand page. Feel free to ask questions via the chat and keep video off if you want to remain anonymous in the recording.



# 3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region





# 3C-REN Programs

- **Energy Code Connect (ECC)**
  - Industry Trainings and Regional Forums
  - Energy Code Coach: Title 24 Compliance Support Hotline (805) 781-1201
- **Building Performance Training (BPT)**
  - Industry Trainings & Certification for current and perspective building professionals
  - Helps workers thrive in an evolving industry
- **Home Energy Savings (HES)**
  - Flexible Home Energy Upgrades
  - Multifamily (5+ units) & Single Family (up to 4 units)



# Resources

- Continuing Education Units Available
  - Contact [ian.logan@ventura.org](mailto:ian.logan@ventura.org) for AIA & ICC LUs
- Coming to Your Inbox Soon!
  - Slides & Survey – Please Take It and Help Us Out!
- Upcoming Courses
  - [5/16 Tiny Homes & ADUs for Architects and Installers](#)
  - [5/23 HPF 6: Home Assessments for Decarbonization](#)
  - [5/30 When Title 24 Modeling and HVAC Design Meet](#)
  - [5/31 Practical Ways to Address Embodied Carbon](#)
  - [5/31 High Performance Residential Remodels](#)
  - [6/5 Panel Detectives – Electrical Panel Assessments for Heat Pump Installers](#)
- For more information about upcoming events please visit: <https://www.3c-ren.org/events>







**Thank you!**

For more info:  
[3c-ren.org](https://3c-ren.org)

For questions:  
[info@3c-ren.org](mailto:info@3c-ren.org)



TRI-COUNTY REGIONAL ENERGY NETWORK  
SAN LUIS OBISPO • SANTA BARBARA • VENTURA





**Homeland  
Hempcrete**  
Homes Built Better.

# GREEN BUILDING TECHNIQUES

**INFLUENCE FROM  
CODE, &  
COMMUNITY  
BENEFITS**



# WHY THIS MATTERS

One Traditional Home = 50 tons of carbon produced / 8,000lbs of waste added to landfill

One Hempcrete Home = 15 tons of carbon Sequestered/ 9,000lbs of natural waste utilized



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## WHAT CAN YOU USE HEMP STALKS FOR?

- ▶ Depends on the hemp variety grown
- ▶ For industrial hemp, two main parts of the stalk
  - ▶ Hurd & Fiber





# WHAT IS HEMPCRETE?

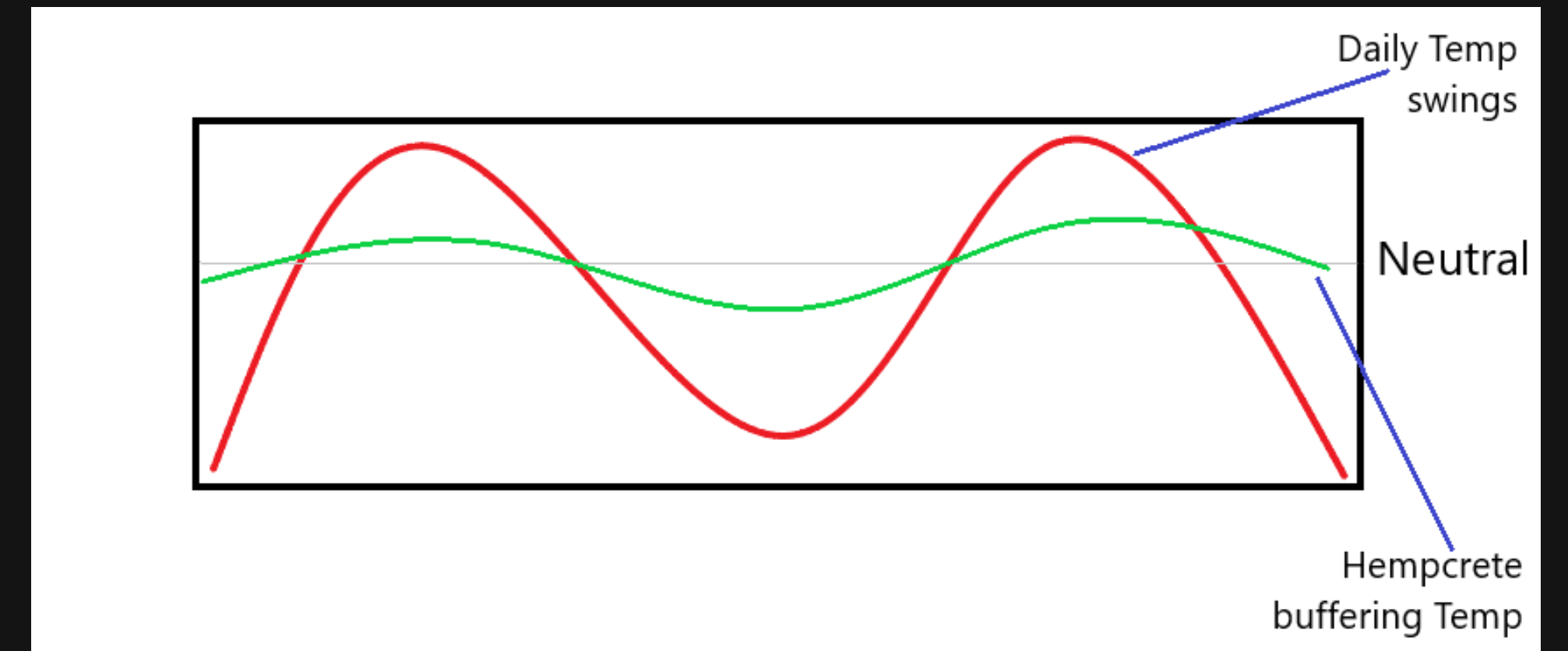
- ▶ Its Simple.
  - ▶ Made of 3 natural & sustainable ingredients: Water, Limestone, Hemp Hurd
- ▶ Performs better than a conventional structure





# HEMPCRETE BENEFITS

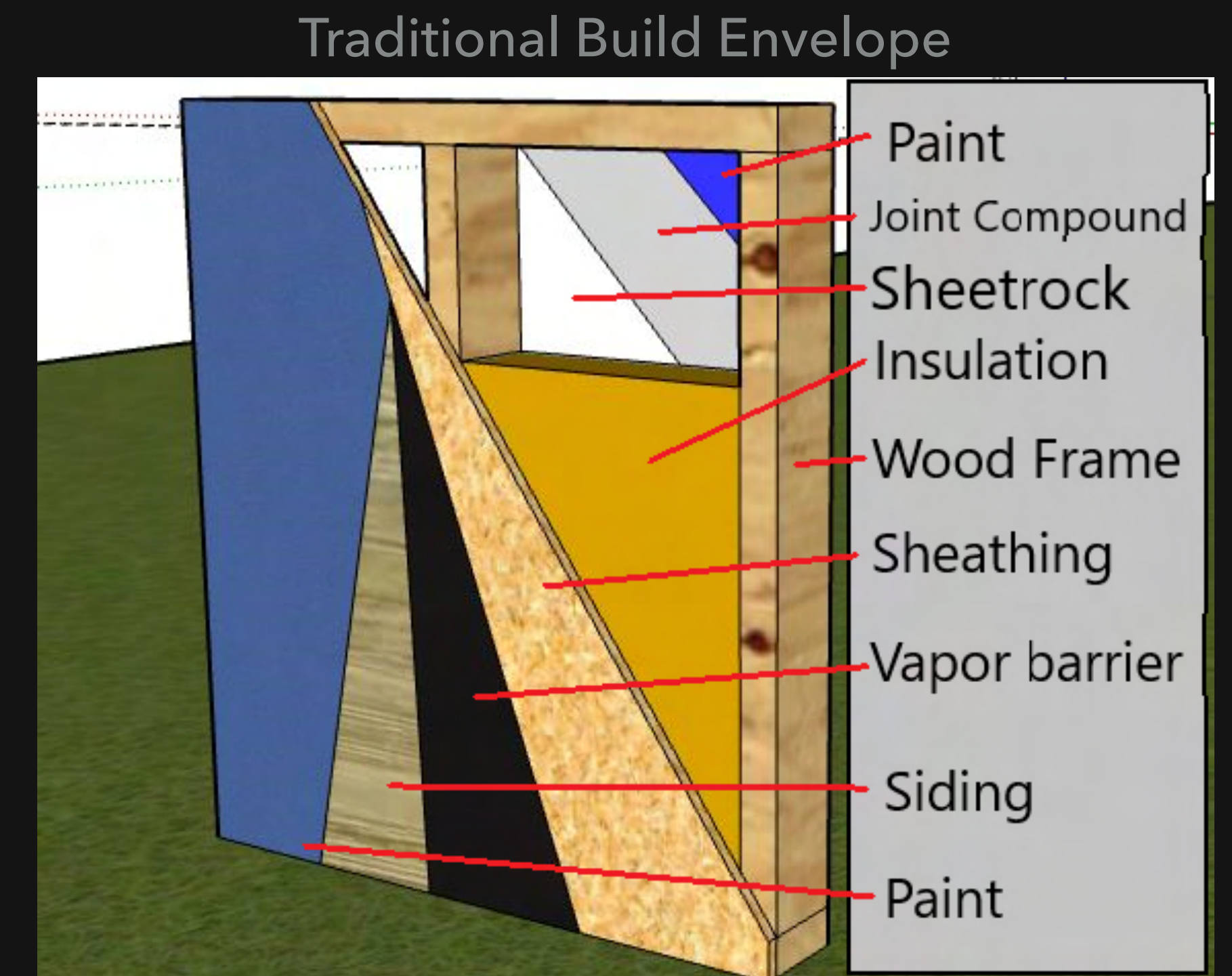
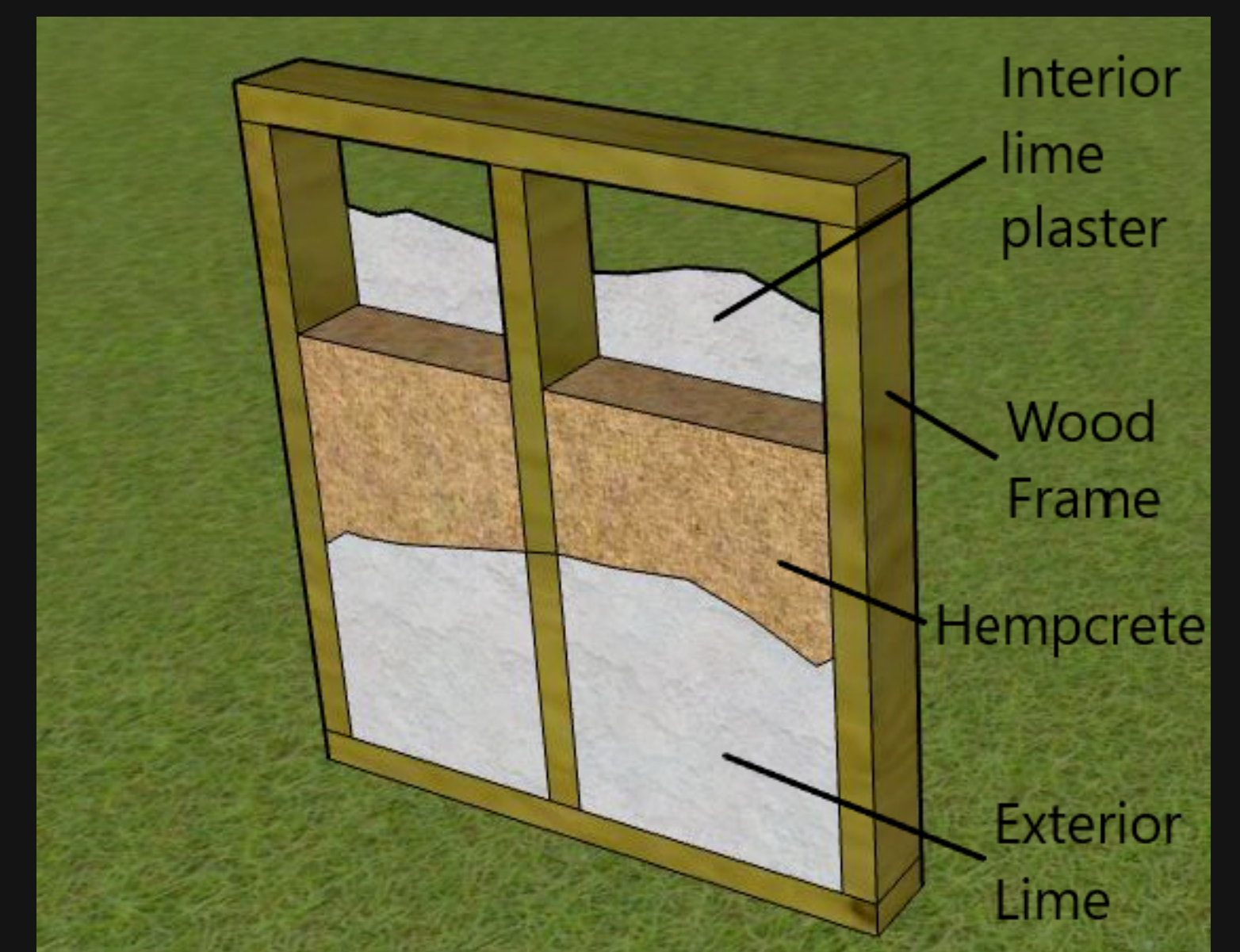
- ▶ Fire resistant
- ▶ Thermal performance
  - ▶ Lower utility bills
- ▶ Acoustic properties
- ▶ Superior IAQ (indoor air quality) / VOC free
- ▶ Mold resistant
- ▶ Can be primarily a byproduct
- ▶ Carbon Neutral/Negative





# WHY HEMPCRETE?

- ▶ Compared to conventional homes
- ▶ Things have gotten complicated in modern construction.
- ▶ Hempcrete brings us back to basics, without sacrifice
- ▶ Simplifies an overcomplicated building envelope





## When People Think of Natural Building

# WHY ITS NOT YET MAINSTREAM

- ▶ Public Perception - Natural Building Constraints
  - ▶ Aesthetics
  - ▶ Labor intensive
  - ▶ Cost prohibitive
  - ▶ Only Takes place in Cottage Industry



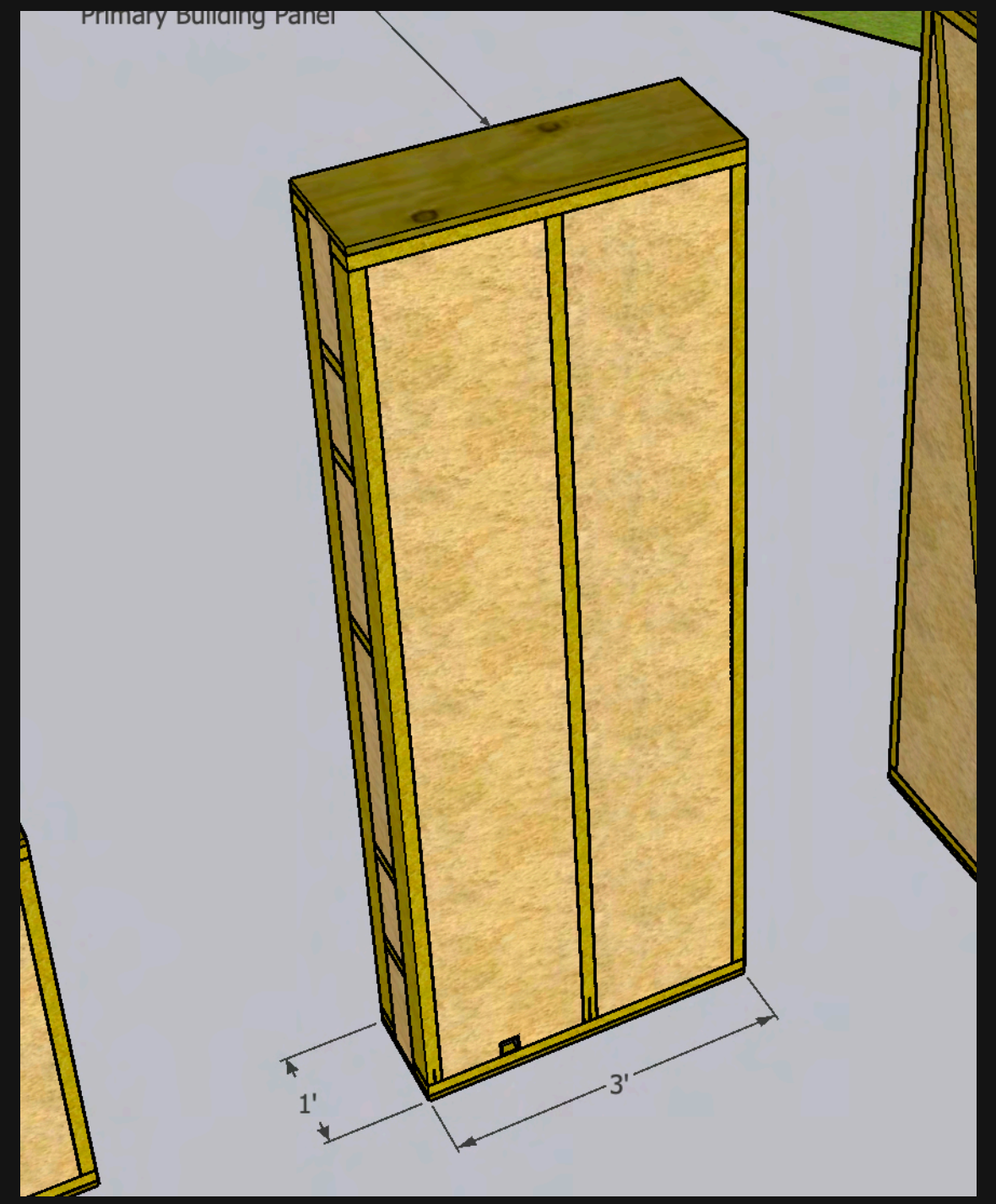
Courtesy of naturalhomes.org - Cobwood house w/ living roof





# HOW TO BUILD W/ HEMPCRETE - 4 METHODS

- ▶ Cast in-place
  - ▶ +Lowest barrier to entry, most common
  - ▶ -Extremely labor intensive, highly variable quality
- ▶ Spray applied
  - ▶ +Precise output, faster install times
  - ▶ -Limited suppliers, requires specialist, equipment \$
- ▶ Blocks
  - ▶ +Fast onsite assembly, pre-cured
  - ▶ -Expensive end-product, hybrid build approach
- ▶ Pre-fab
  - ▶ +Economical, fastest build method,
  - ▶ -No US suppliers, requires forklift to install, laborious





# WHAT WE DO

- ▶ Prefabricated hempcrete wall panel system
  - ▶ Built & cured in controlled environment
  - ▶ Delivered to build-site ready for assembly, then finishes can be applied immediately.





# APPLICATION METHODS





# APPLICATION METHODS





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# INTRO TO BUILD CODE – HEMP-LIME

- ▶ Writing began in 2021
- ▶ Submitted and review first half of 2022
- ▶ Hemp-lime IRC Appendix, available for adoption 2024

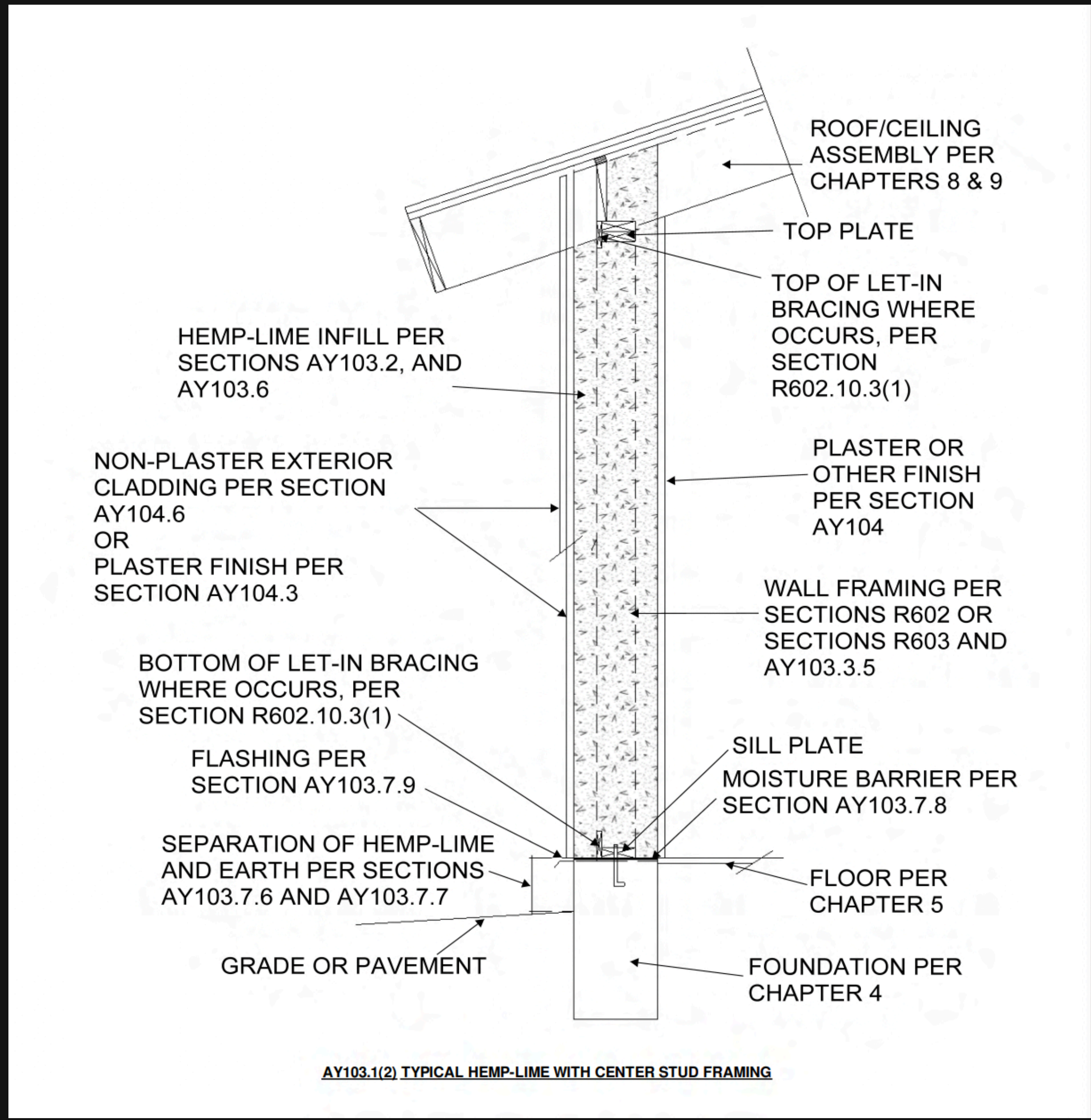


- ▶ Search Name: APPENDIX BL HEMP-LIME (HEMPCRETE) CONSTRUCTION



# HOW THE APPENDIX HELPS

- ▶ Increased legitimacy for build method
- ▶ Establishes common ground
- ▶ Sets build standards, input gathered from around the world





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# COMMUNITY BENEFITS

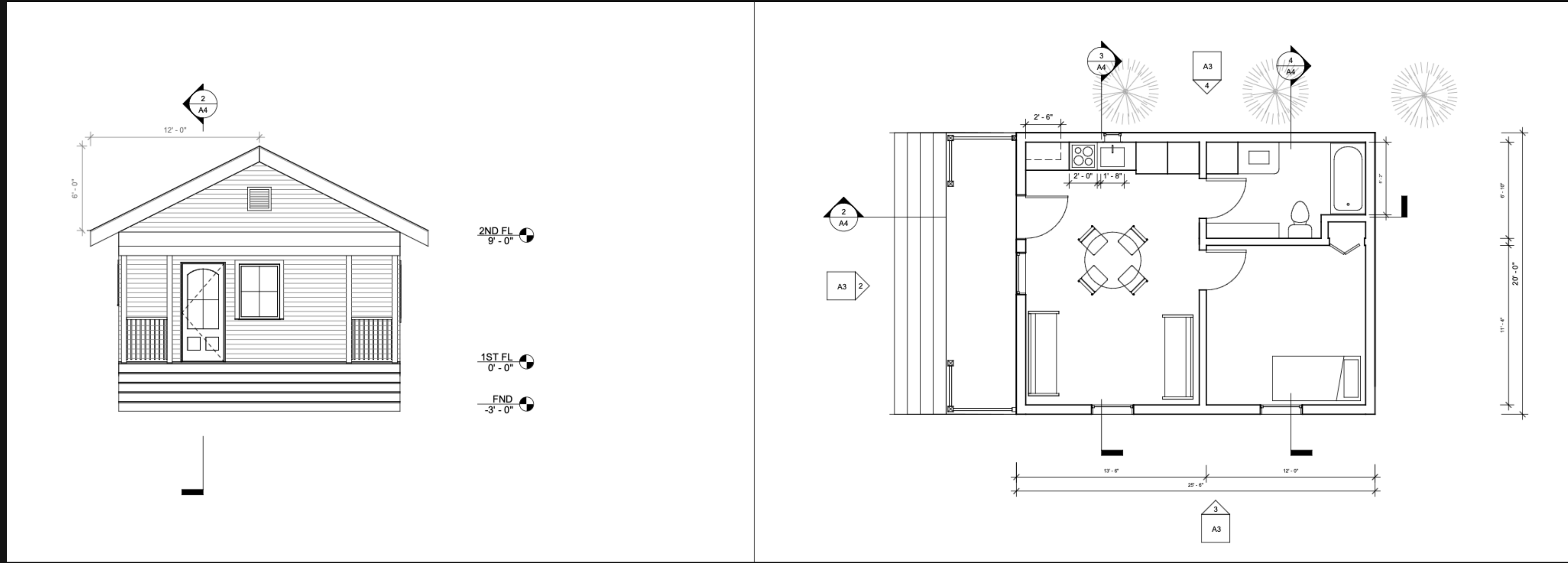
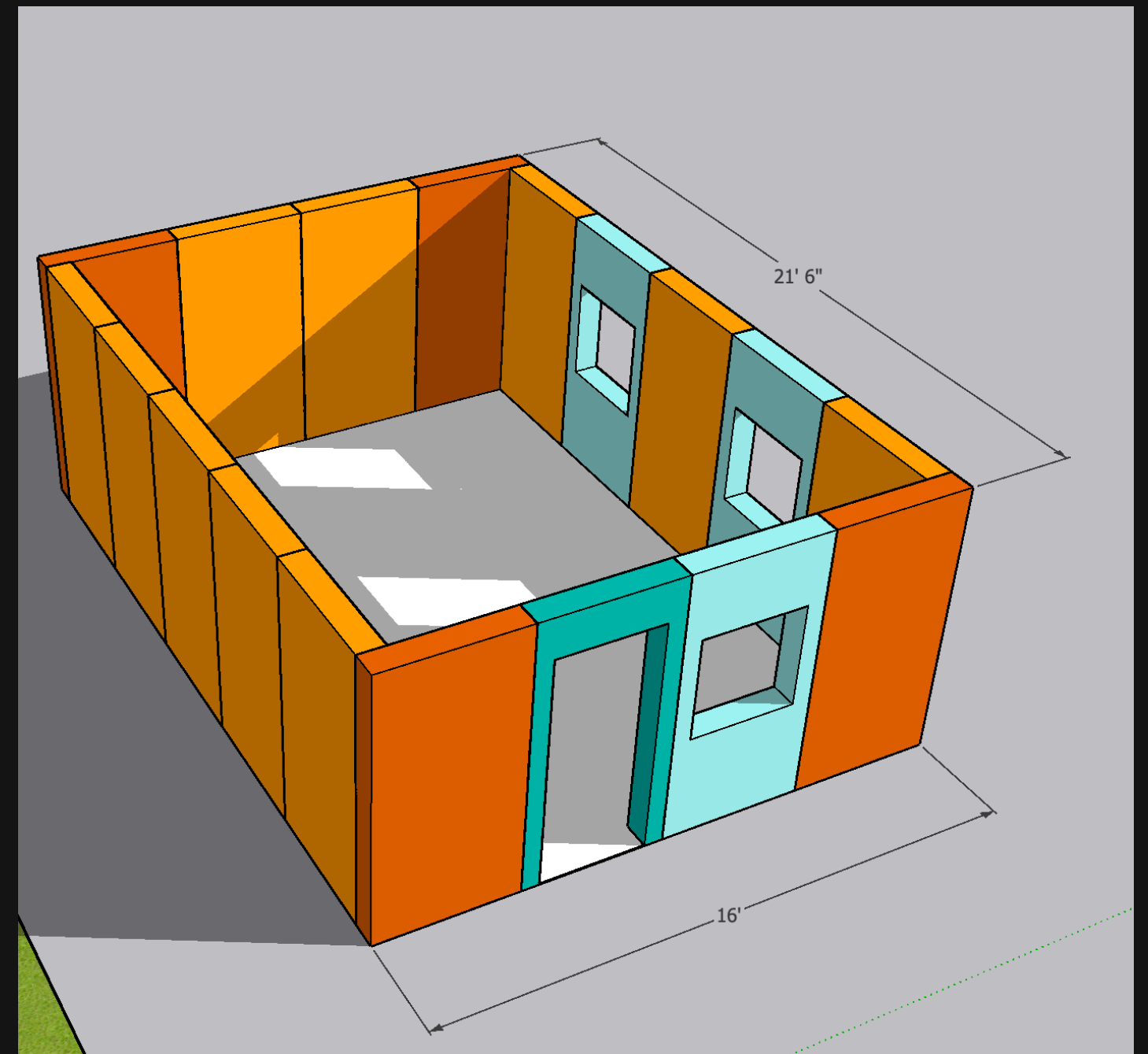
- ▶ Community Projects
- ▶ Circular Economy Development
- ▶ Affordable Housing





# COMMUNITY BENEFITS

- ▶ Affordable Housing Opportunities
  - ▶ Pathway for adoption and use



Credit: Gro Enterprises & Sexsmith Architects









**Homeland  
Hempcrete**  
Homes Built Better.

**THANK YOU**

**[HOMELANDHEMPCRETE.COM](http://HOMELANDHEMPCRETE.COM)**





REGENERATIVE  

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SYSTEMS



# FROM SUSTAINABILITY TO REGENERATION

## Sustainable Development



UNDP - Morocco

## Climate Change



COP 15 - Denmark

## Self-sufficient buildings



Earthship - Argentina

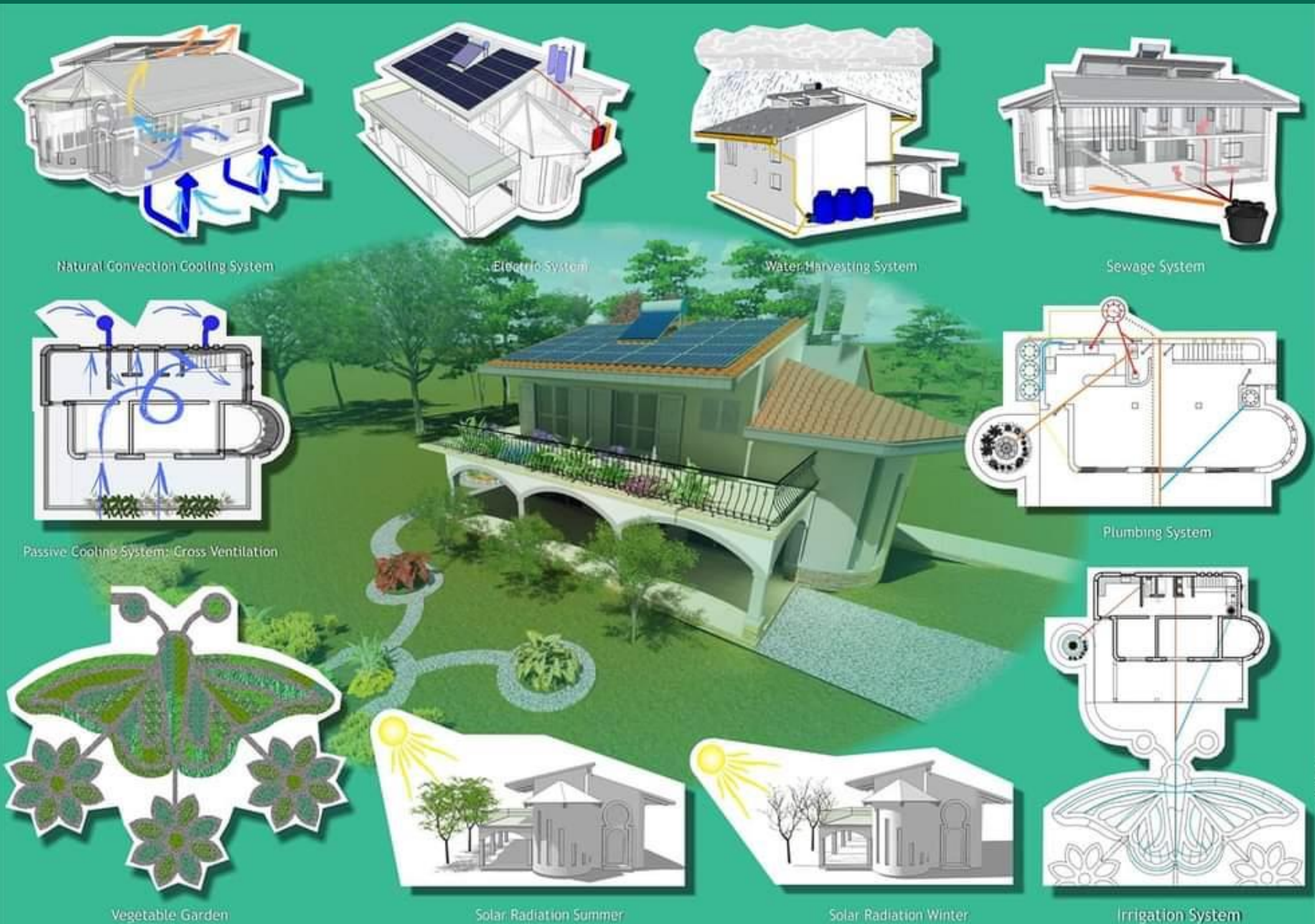
## Food Sovereignty



Urban Homestead - USA



# Net-Positive Housing



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ATLAS







# REFUGEE CAMPS

## Short-term vs. Holistic vision

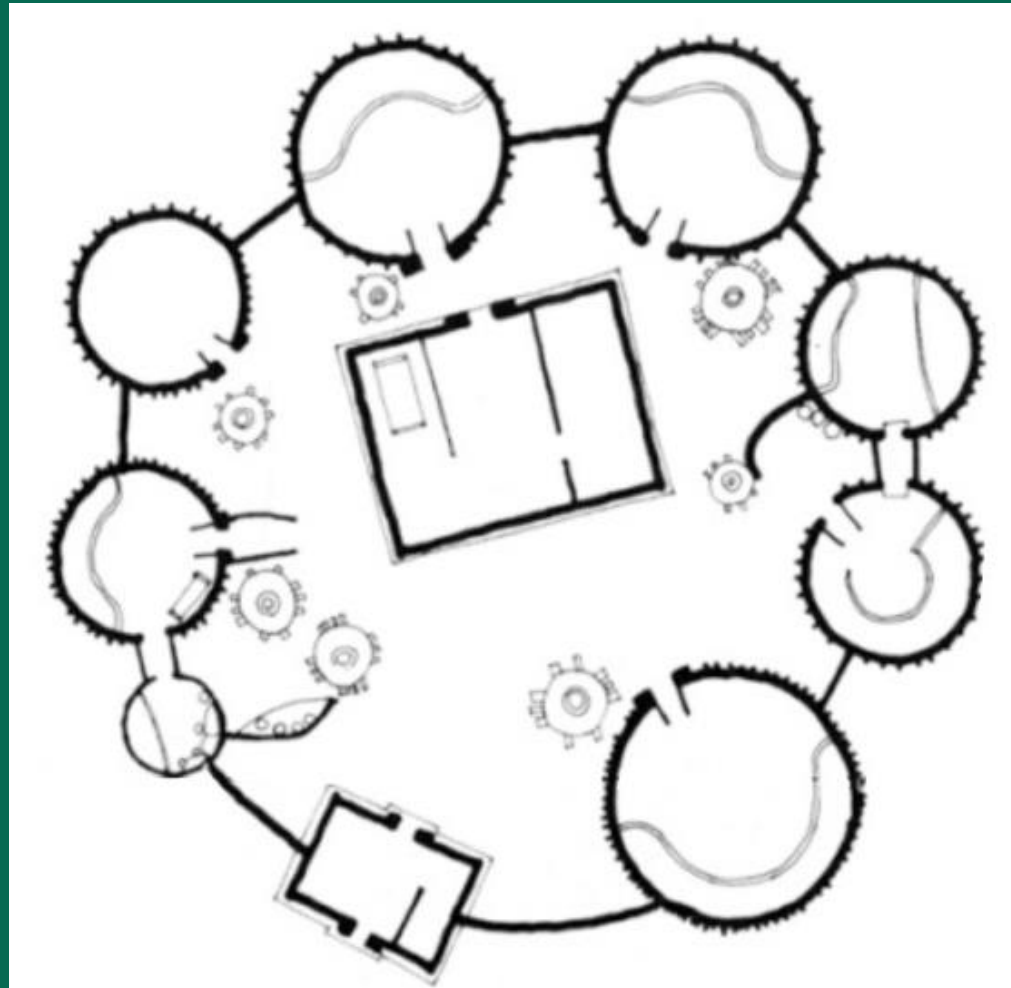


Mbororo refugees from the Central African Republic are empowered to thrive

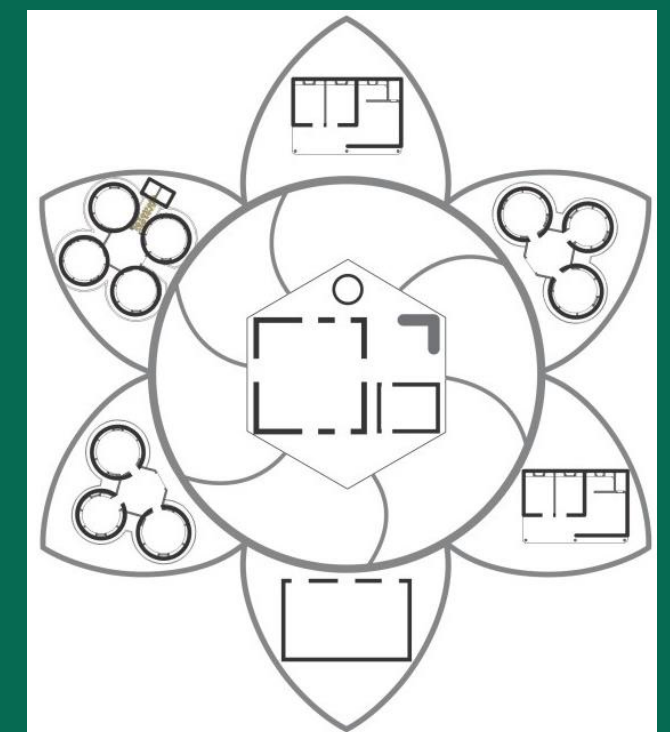
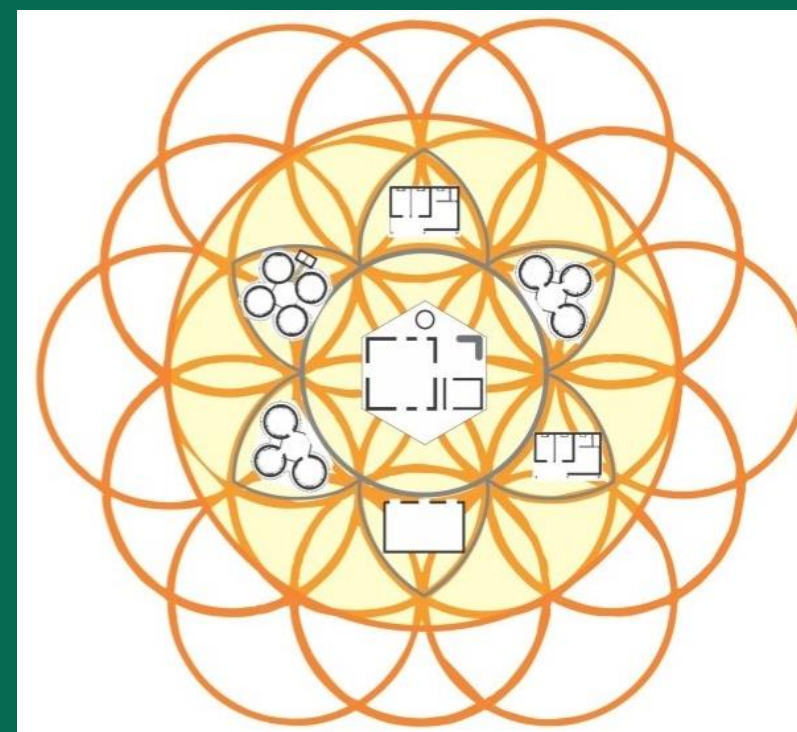




# Traditional architecture



# Eco-CASA complex for orphans and vulnerable elders in Edea, Cameroon





# Disaster Relief - The art of up-cycling





# Learning by doing – while helping!





# EVE - EARTHSHIP VILLAGE ECOLOGIES



Sustainable Testing Site









State of New Mexico  
**County of Otero**

**OTERO COUNTY  
ORDINANCE NO. 16-07**

**SUSTAINABLE DEVELOPMENT TESTING SITE ACT**  
**AMENDING INSTR#: 201607572**

AS, New Mexico enacted the *Sustainable Development Testing Site Act*, Sections 71-8-1 through 78-8-8;

AS, Otero County wishes to enact an ordinance modeled after the *Sustainable Development Testing Site Act*.

AS, the test sites would allow for experimental, sustainable building construction that does not meet the intent of current codes; but with the validation of construction authorities.

AS, the Act would limit test sites to no more than two (2) acres, with the potential for a five (5) year extension;

AS, Otero County wishes to allow for experimental alternative construction methods, provided that such alternative construction meets or exceeds the intent of New Mexico's building codes.





# Research and Development

Testing vernacular  
and innovative  
building systems  
and gathering  
evidence to  
ensure code  
compliance





# Natural Building Codes

- **Strawbale Construction** : Appendix AS in IRC ←
- **Light Straw-Clay** : Appendix AR in IRC ←
- **Cob (Monolithic Adobe)** : Appendix AU in IRC ←
- **Adobe** : Section 2109 in IBC, New Mexico, Pima County, AZ ←
- **Hemp-Lime (Hempcrete)** : Approved April 2, 2022 for IRC (!) ←
- **Rammed Earth** : New Mexico, Pima County, AZ
- **Compressed Earth Block** : Pima County, AZ
- **Earthbag/ Superadobe** : none (planned effort for IRC) ←
- **Earthen Floors** : new ASTM Standard in progress ←
- **Bamboo** : no domestic example
- **Crushed Stone/Rubble/Gravel Trench Footings** : IRC R403.4.1, with proposed expansion ←
- **Low-Carbon Concrete** : Marin County, CA ←
- **Tiny Houses** : Appendix AQ in IRC
- **General Earthen Walls**: ASTM E2392
- **International Examples**: New Zealand (Performance) many others (prescriptive)

[A] **104.11 Alternative materials, design and methods of construction and equipment.** The provisions of this code are not intended to prevent the installation of any material or to prohibit any design or method of construction not specifically prescribed by this code, provided that any such alternative has been *approved*. An alternative material, design or method of construction shall be *approved* where the *building*

*official* finds that the proposed design is satisfactory and complies with the intent of the provisions of this code, and that the material, method or work offered is, for the purpose intended, not less than the equivalent of that prescribed in this code in quality, strength, effectiveness, *fire resistance*, durability and safety. Where the alternative material, design or method of construction is not *approved*, the *building official* shall respond in writing, stating the reasons why the alternative was not *approved*.

[A] **104.11.1 Research reports.** Supporting data, where necessary to assist in the approval of materials or assemblies not specifically provided for in this code, shall consist of valid research reports from *approved* sources.

[A] **104.11.2 Tests.** Whenever there is insufficient evidence of compliance with the provisions of this code, or evidence that a material or method does not conform to the requirements of this code, or in order to substantiate claims for alternative materials or methods, the *building official* shall have the authority to require tests as evidence of compliance to be made without expense to the jurisdiction. Test methods shall be as specified in this code or by other recognized test standards. In the absence of recognized and accepted test methods, the *building official* shall approve the testing procedures. Tests shall be performed by an *approved agency*. Reports of such tests shall be retained by the *building official* for the period required for retention of public records.



# Hemp-Lime Appendix in 2024 International Residential Code



2022 ICC Hearings in Rochester, NY

7-2 approval vote for IRC Appendix AY – Hemp-Lime (Hempcrete) Construction - Slide by Martin Hammer

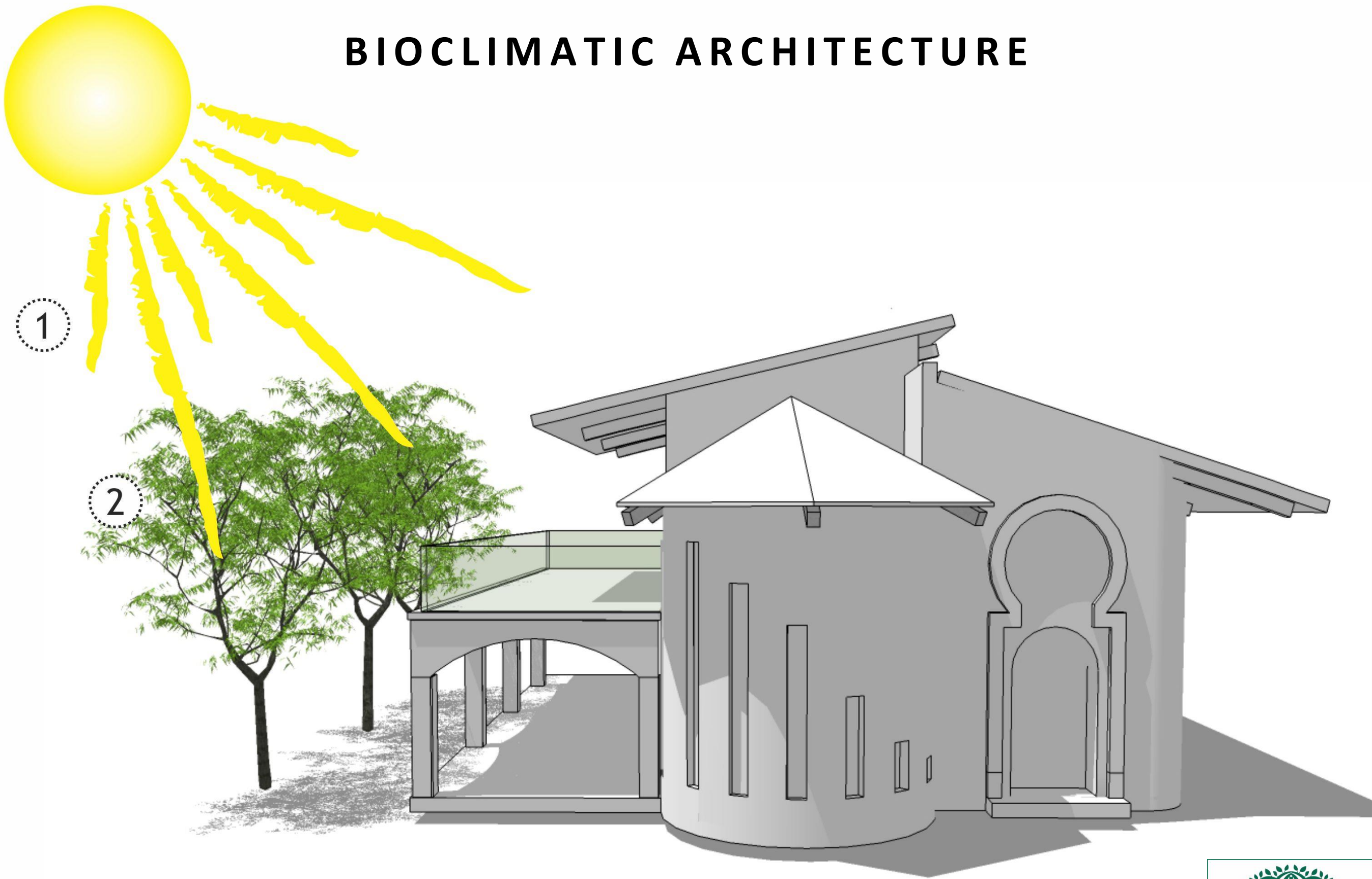


# Alternative Building Methods





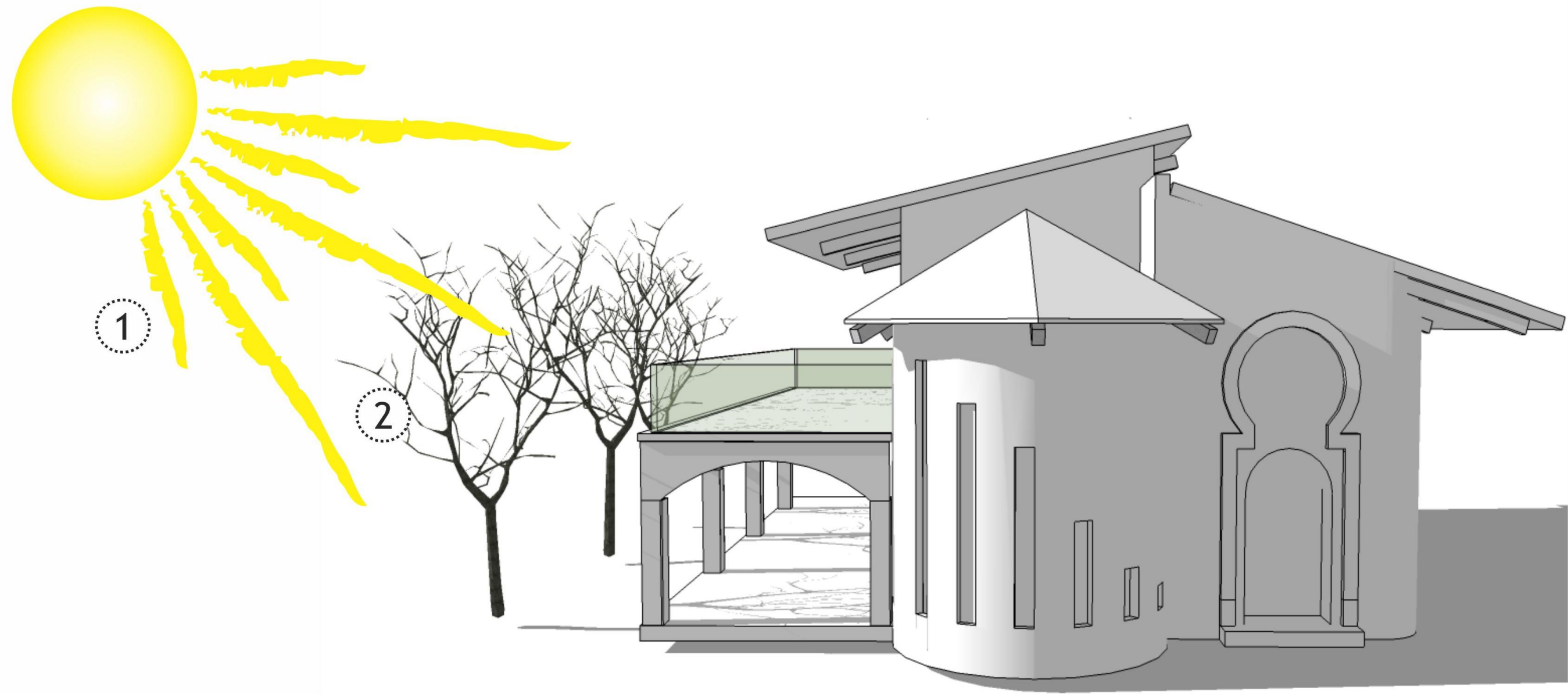
# BIOCLIMATIC ARCHITECTURE



1 Solar Radiation Summer Noon - 2 Deciduous Tree





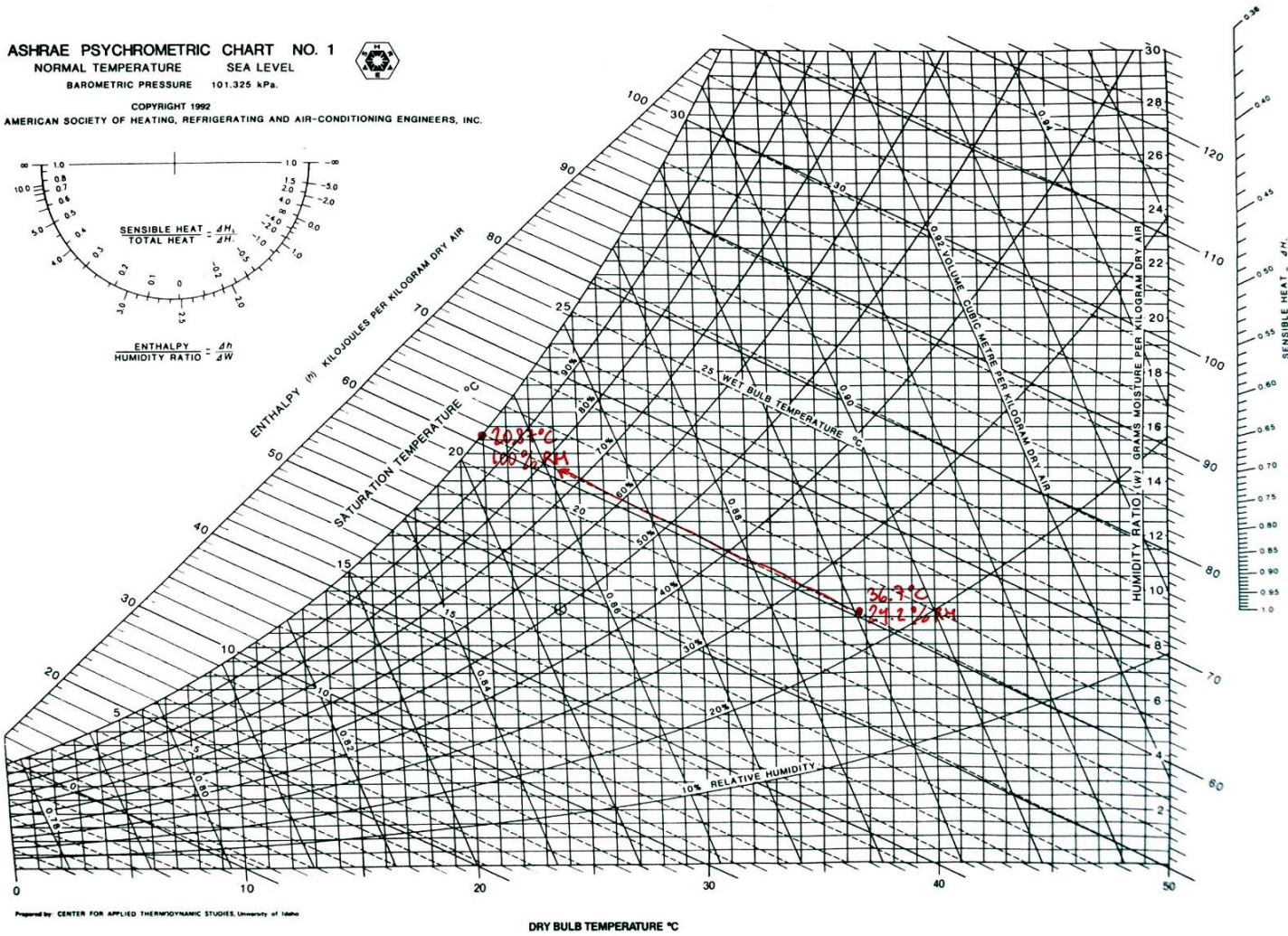


1 Solar Radiation Winter Noon - 2 Deciduous Tree





# Bioclimatic Design for the Tijuana Community Center from Calpoly Pomona

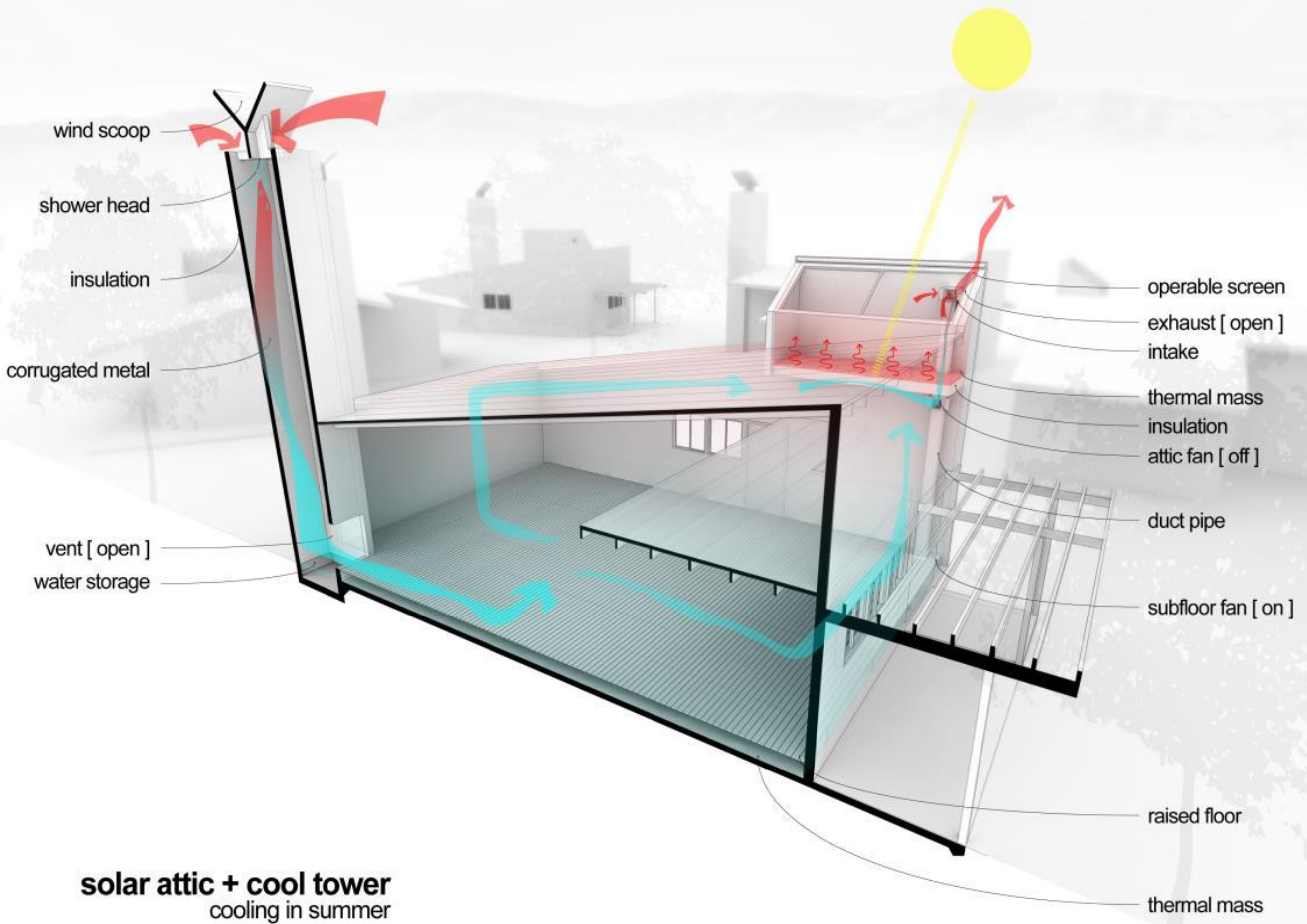


Cool Tower Performance  
Temperature Outside:  
98.1 F (36.7 C) & 24.2 % RH

Temperature coming out of the Cool  
tower: 69.56 F (20.87 C) & 100%RH

Lowered the temperature by 28.5 F





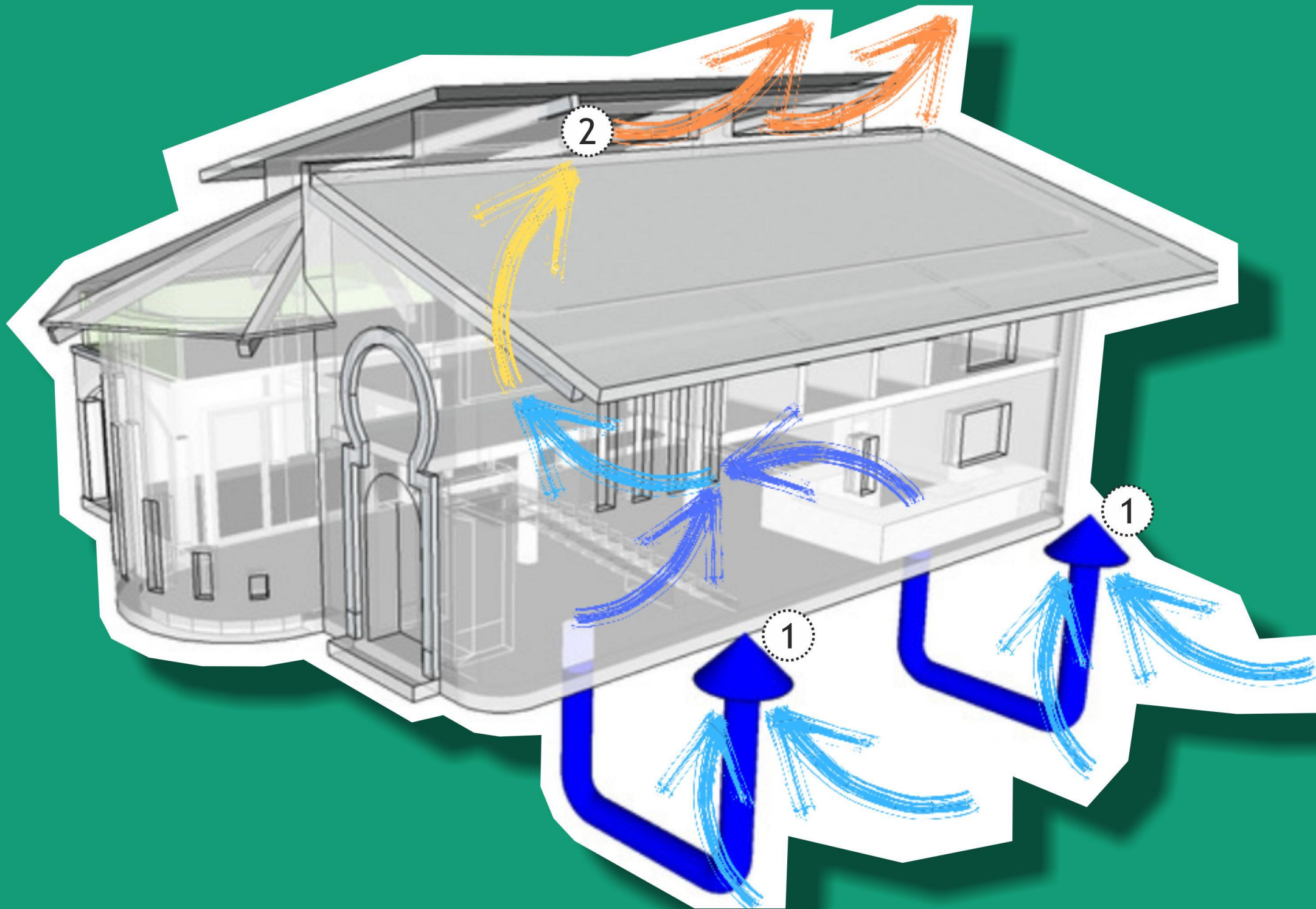
wind scoop  
 shower head  
 insulation  
 corrugated metal  
 vent [ open ]  
 water storage

operable screen  
 exhaust [ open ]  
 intake  
 thermal mass  
 insulation  
 attic fan [ off ]  
 duct pipe  
 subfloor fan [ on ]  
 raised floor  
 thermal mass

**solar attic + cool tower**  
 cooling in summer



# Natural Convection Cooling System



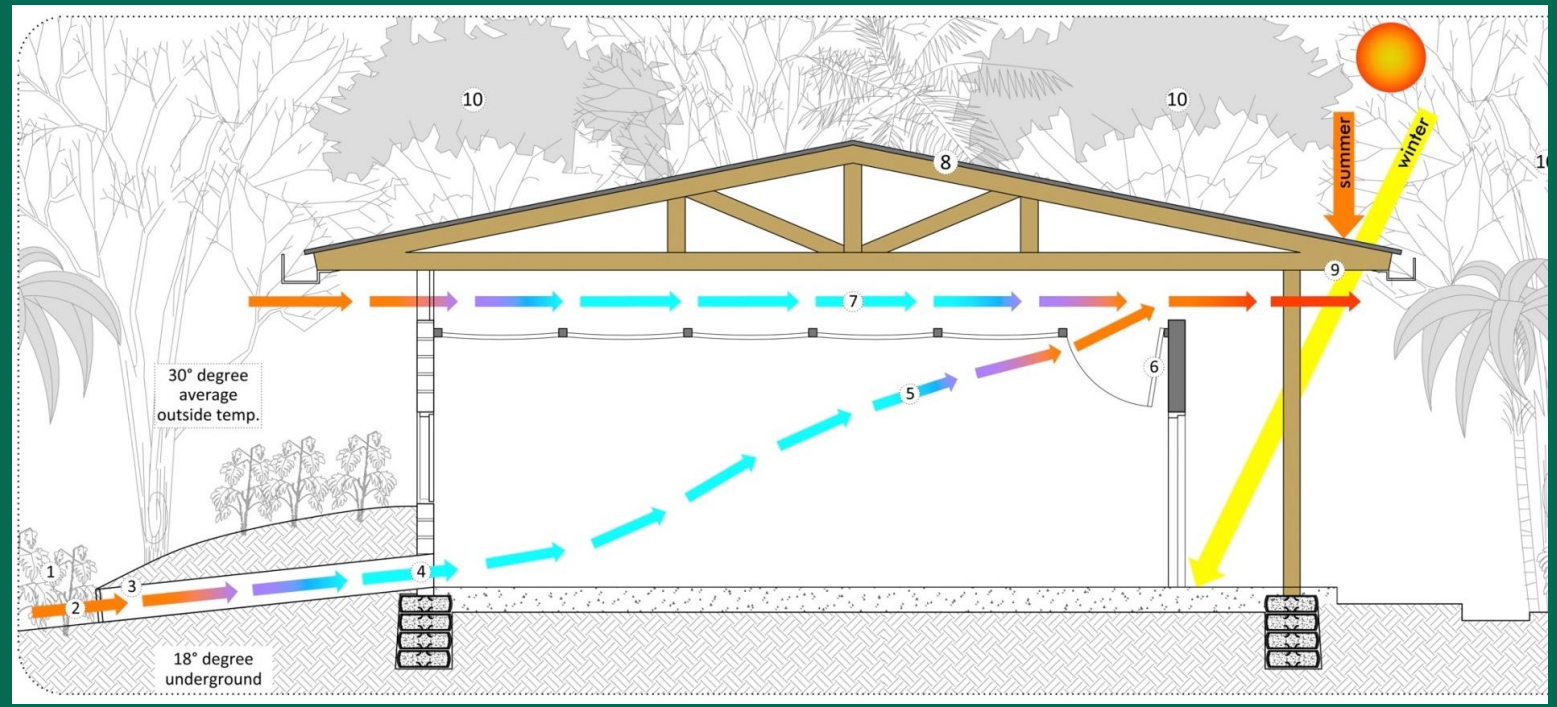
1 Ventilation Tube - 2 Air Output Window

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ATLAS



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SYSTEMS



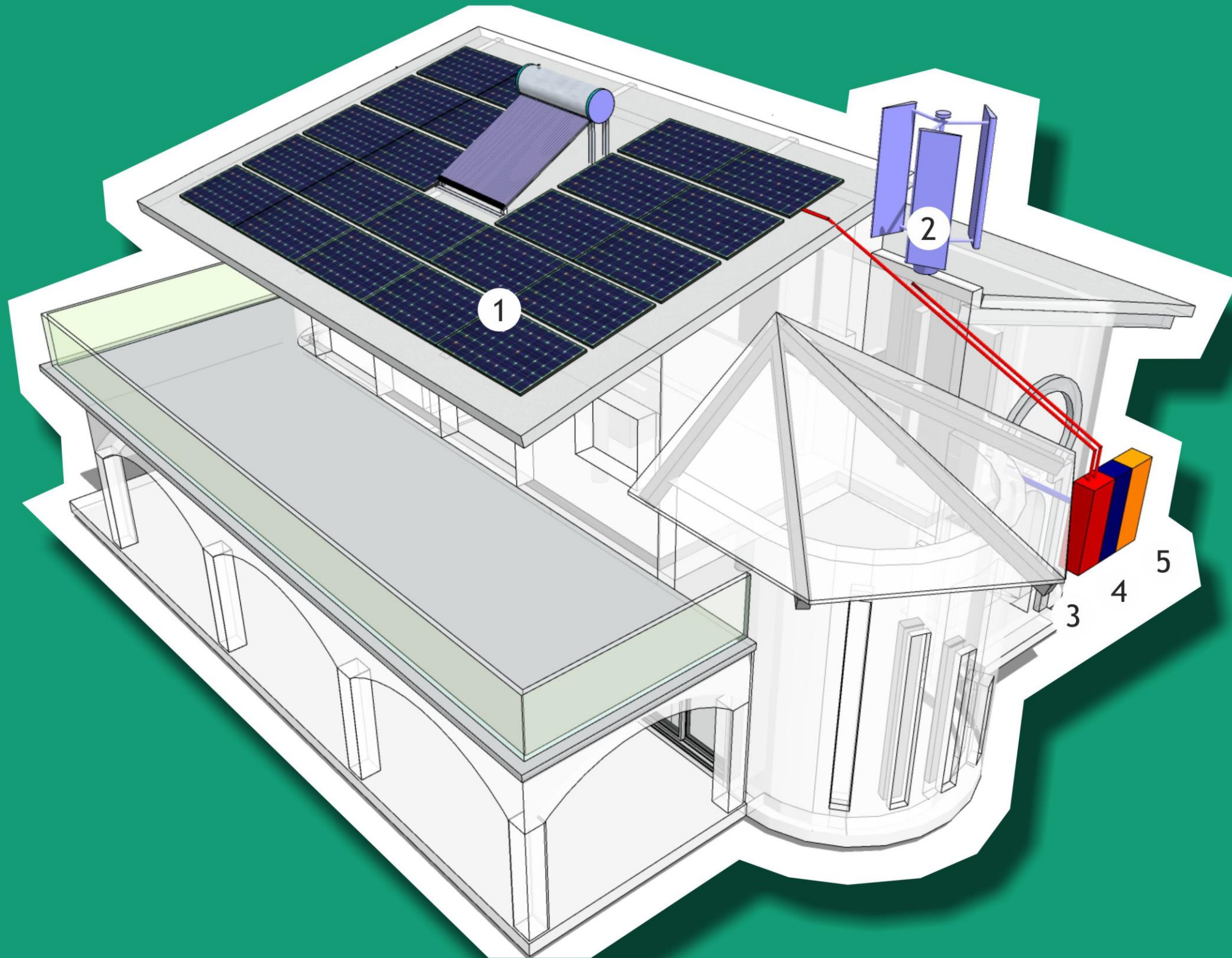


Edea, Cameroon





# Electric System



1 Photovoltaic Panels - 2 Wind Turbine - 3 Charge Controller - 4 Batteries - 5 Inverter

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ATLAS



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SYSTEMS



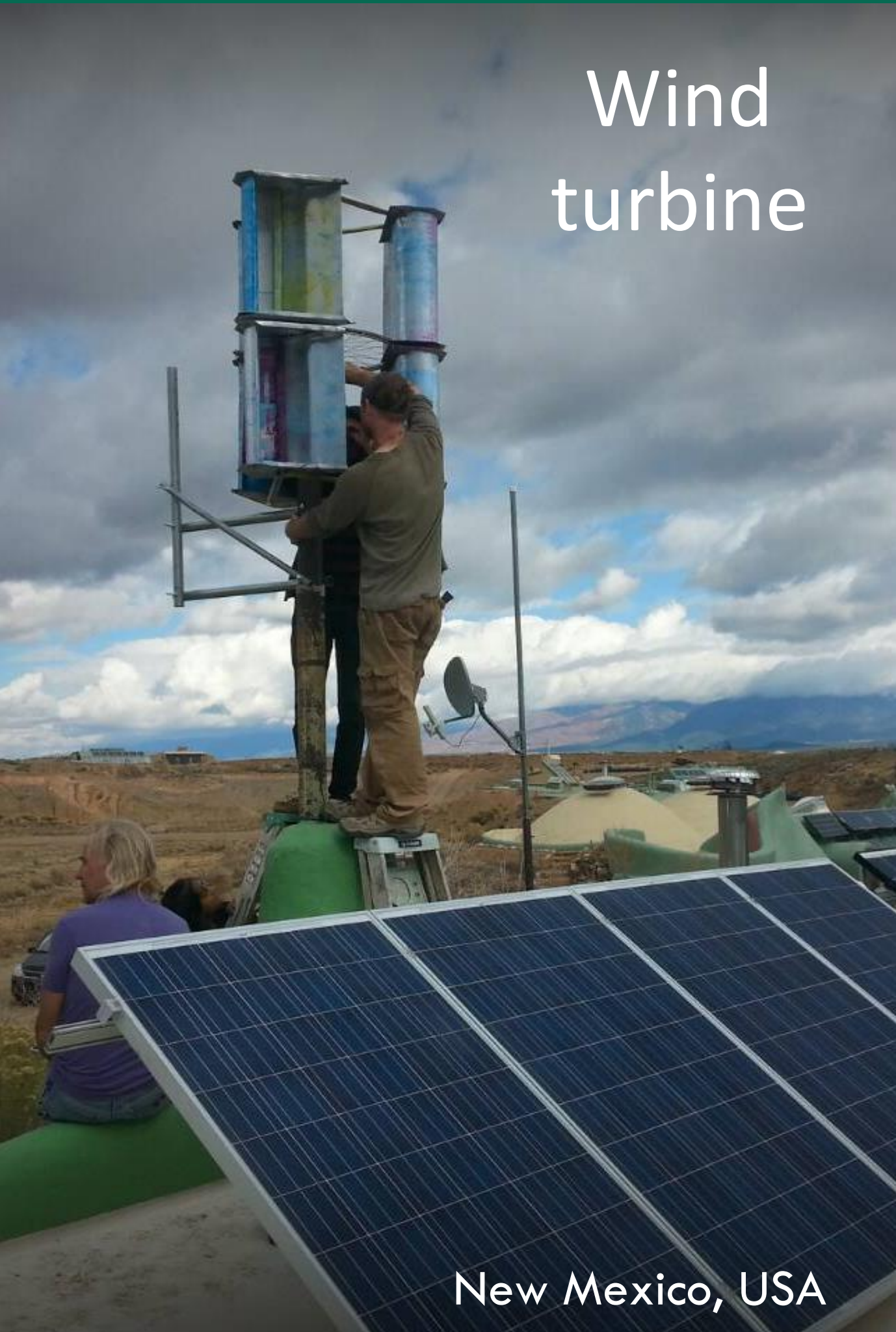
# Photovoltaic System



Northern California, USA



Wind turbine



New Mexico, USA

Micro Hydro



Northern California, USA

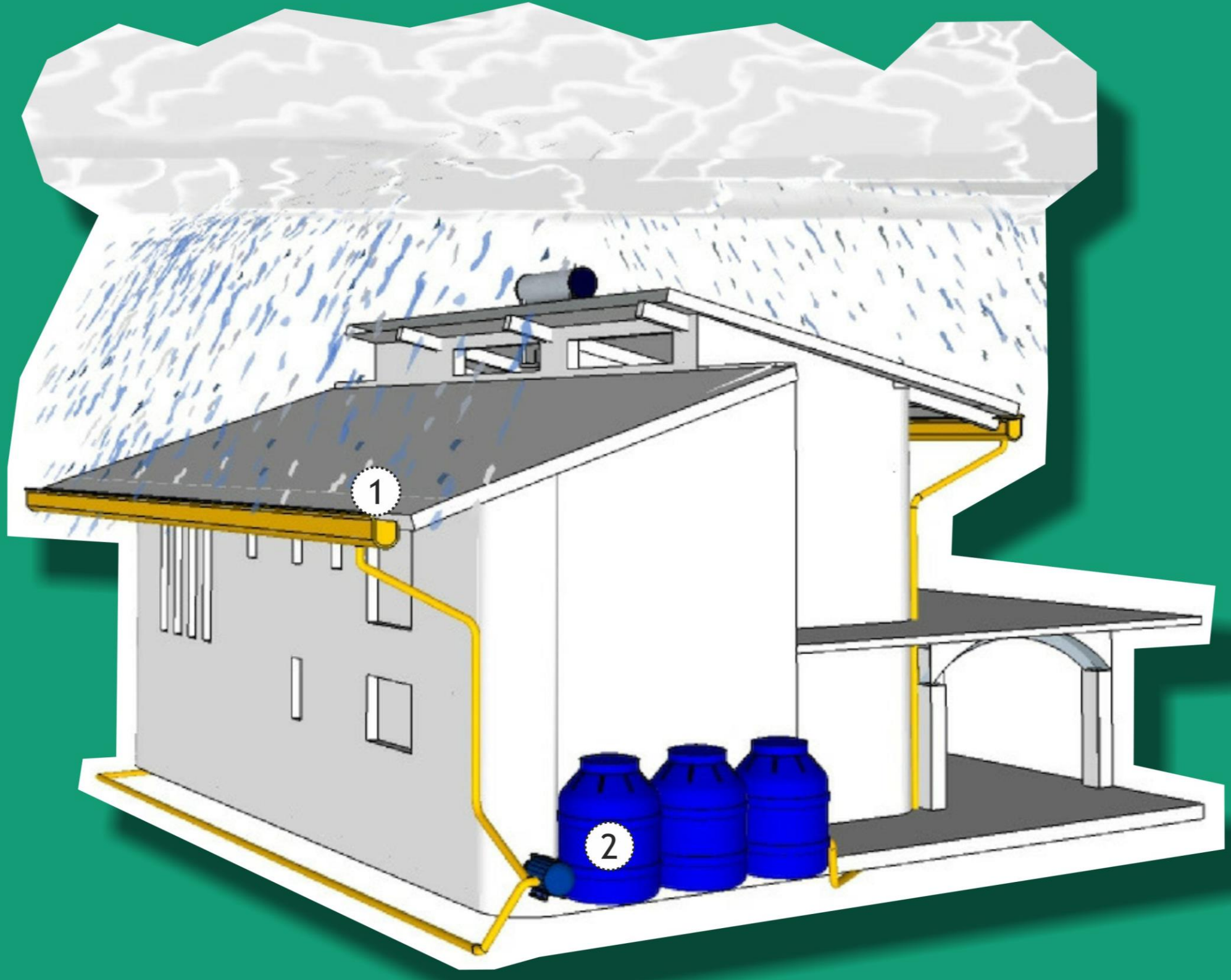


# Power Organizing Module (Powerwall)





# Water Harvesting System



1 Gutters - 2 Tanks

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SYSTEMS



# Dew Harvester

Valparaiso, Chile





# Water Storage



Socal, USA



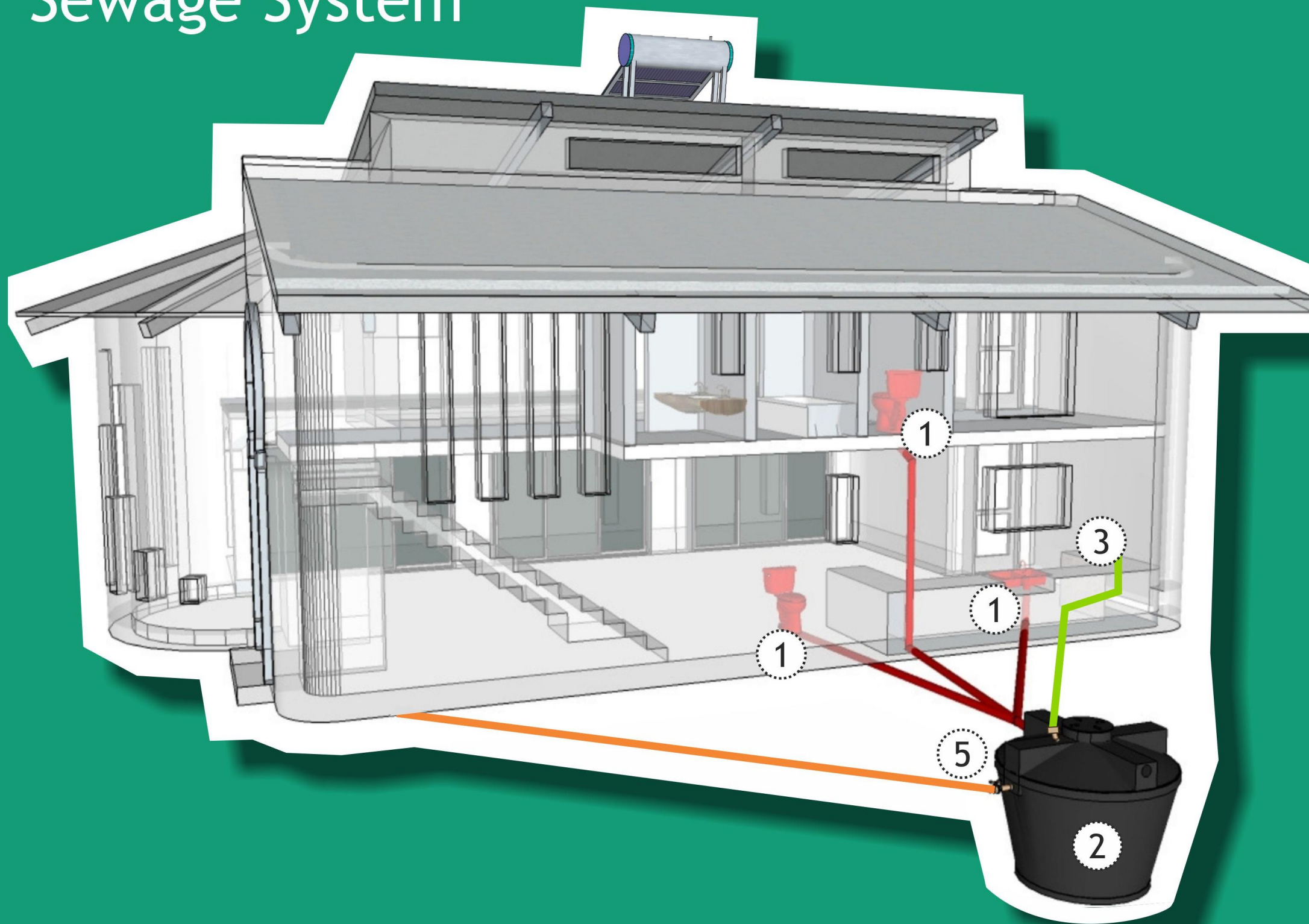
# Pump and Filters



Socal, USA



# Sewage System



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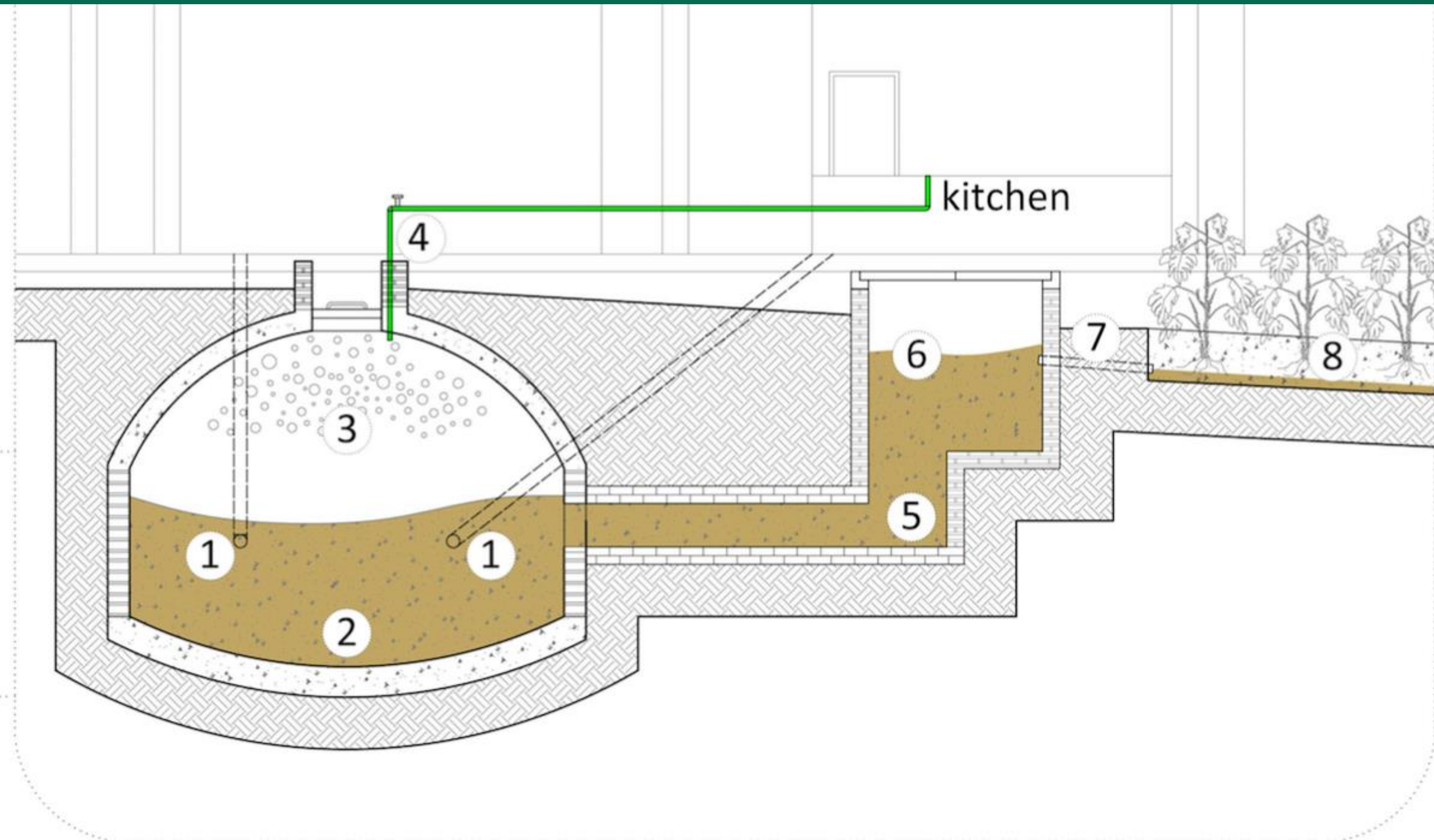


REGENERATIVE  
SYSTEMS

1 Black Water - 2 Biodigester - 3 Biogas outlet - 4 Natural Fertilizer outlet

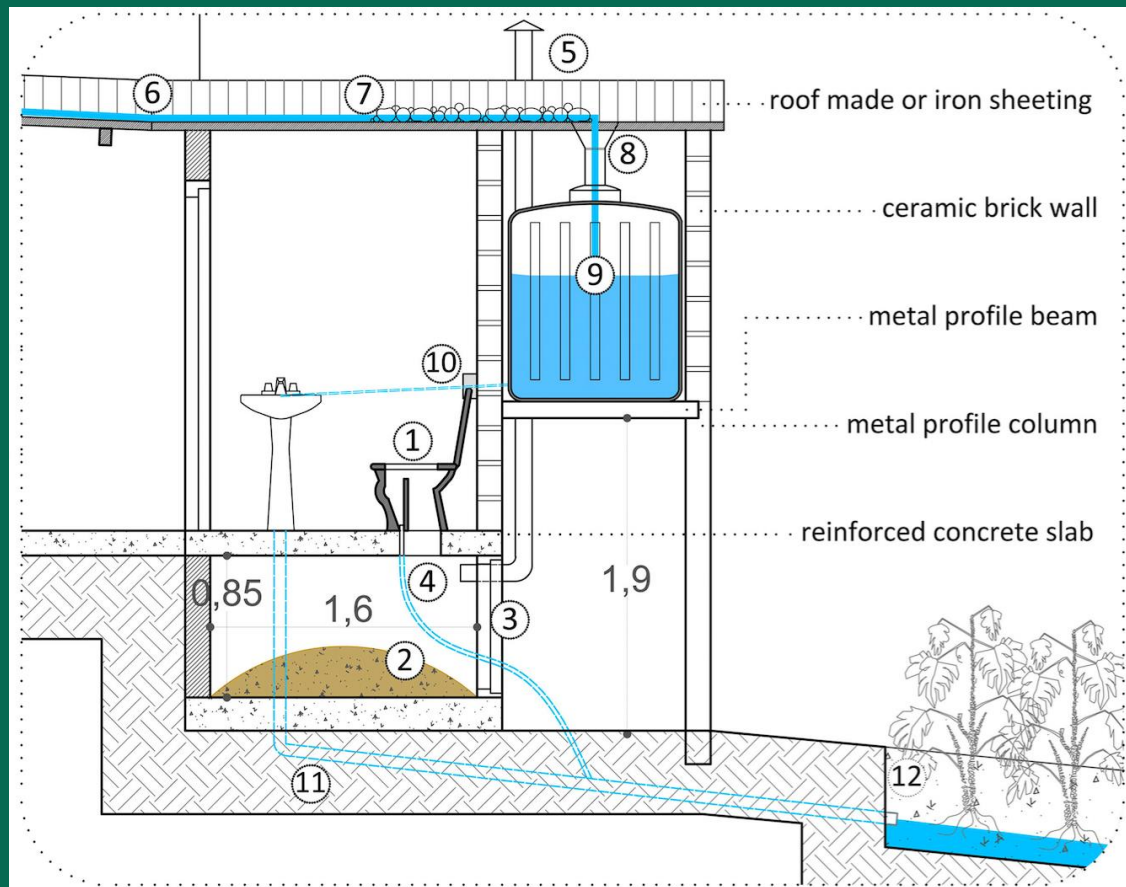


# Biodigester





# Alternatives to Blackwater

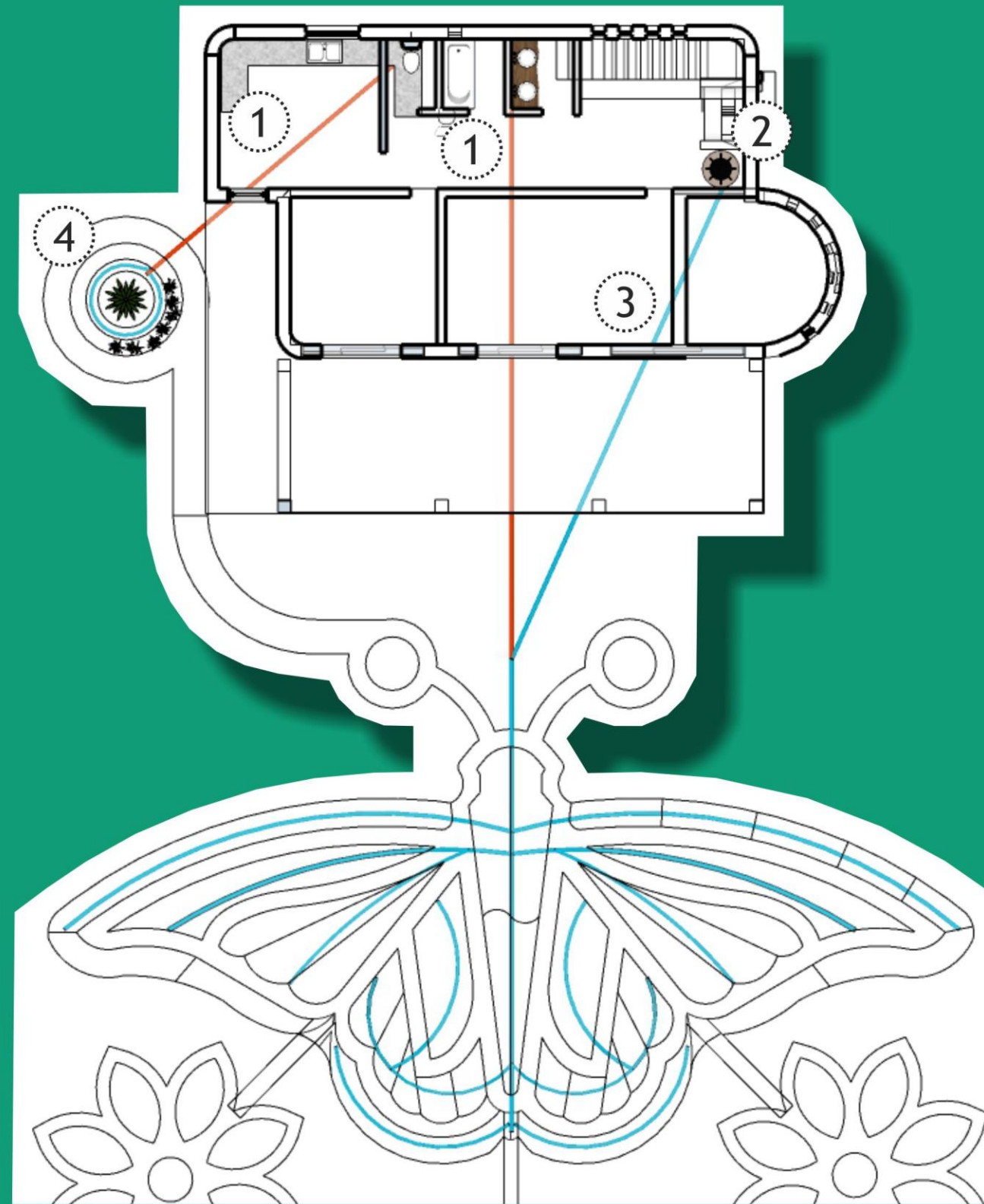


Atacama, Chile



# Irrigation System

USE OF GREY  
WATER AND  
RAINWATER  
TO IRRIGATE  
THE GARDEN



1 Gray Water - 2 Tank - 3 Clean Water - 4 Garden

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ATLAS



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SYSTEMS





Laundry to  
Landscape  
system



Deep root  
irrigation  
through  
mulch  
basins



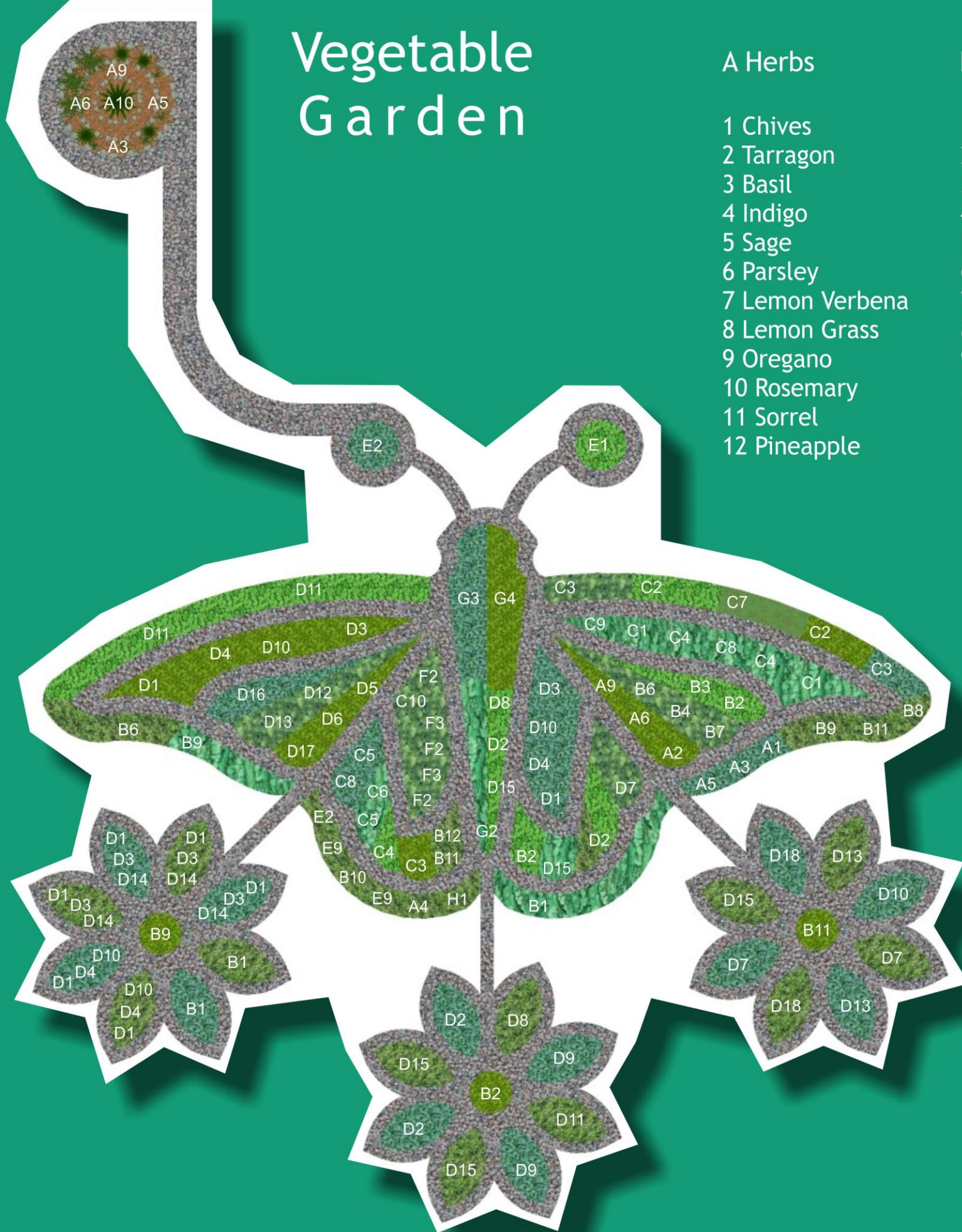


Greywater Systems





# Vegetable Garden



## A Herbs

- 1 Chives
- 2 Tarragon
- 3 Basil
- 4 Indigo
- 5 Sage
- 6 Parsley
- 7 Lemon Verbena
- 8 Lemon Grass
- 9 Oregano
- 10 Rosemary
- 11 Sorrel
- 12 Pineapple

## B Flowers

- 1 Sunflower
- 2 Marigold
- 3 Calendula
- 4 Roses
- 5 Lavender
- 6 Nasturtium
- 7 Borage
- 8 Hollyhocks
- 9 Zinnia
- 10 Wild Violets
- 11 Bee Balm
- 12 Tithonia

## C Wildy Native

- 1 CA Lilac
- 2 Whit Blue Sage
- 3 Poppy
- 4 Nettles
- 5 Miners Lettuce
- 6 Chickweed
- 7 CA Sagebrush
- 8 Elderberry
- 9 Mugwort
- 10 Mullein

## E Fruit + Bernes

- 1 Fig
- 2 Pomegranate
- 3 Guava
- 4 Blackberry
- 5 Apple
- 6 Peach
- 7 Plum
- 8 Citrus
- 9 Blueberry
- 10 Apricot

## D Veggies

- 1 Corn
- 2 Pepper
- 3 Squash
- 4 Kale
- 5 Broccoli
- 6 Radish
- 7 Cucumber
- 8 Garlic
- 9 Onion
- 10 Pumpkin
- 11 Amaranth
- 12 Chard
- 13 Arugula
- 14 Beans
- 15 Tomatoes
- 16 Mustard
- 17 Peas
- 18 Eggplant

## F Ground Cover

- 1 Yarrow
- 2 Mint
- 3 Thyme
- 4 Clover
- 5 NZ Spinach

## G Vines

- 1 Runners Beans
- 2 Lima Beans
- 3 Jasmine
- 4 Roses

## H Tubers

- 1 Sunchokes







Bioswale



Agro-forestry



Hugelkultur



Bio-intensive gardening



# Some of the food production at Eco-CASA





OUR AIM, ABOVE ALL ELSE, IS TO BUILD  
RESILIENT COMMUNITIES

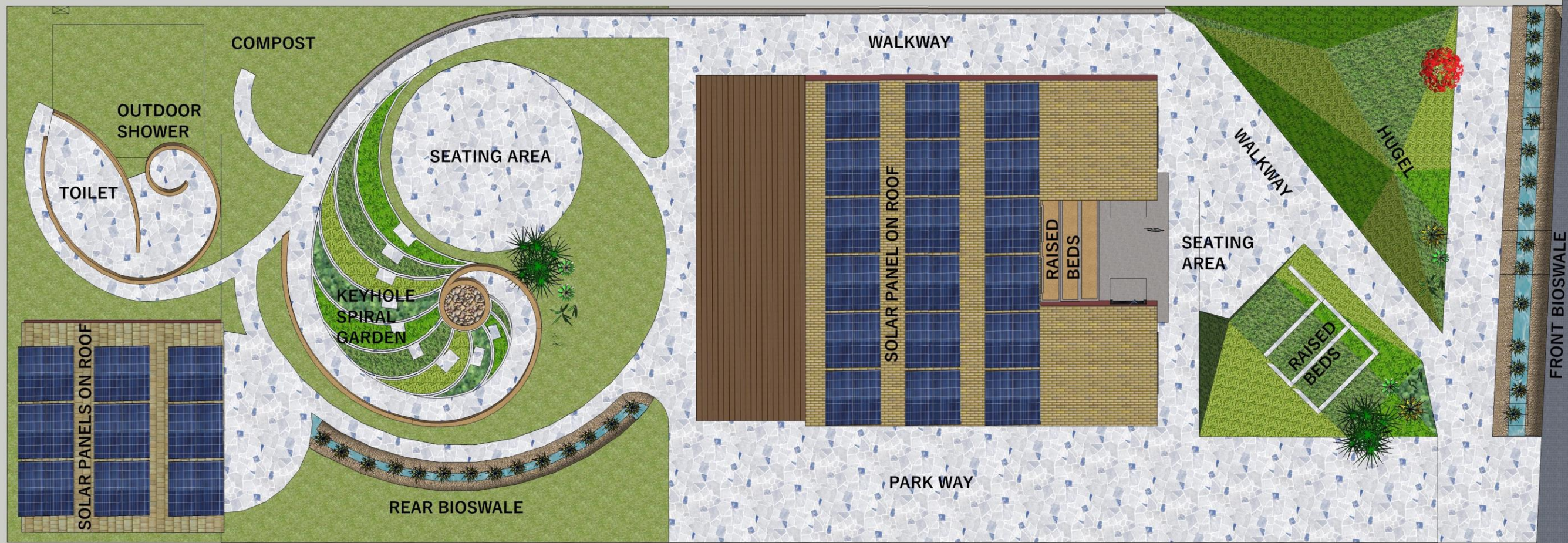






# URBAN RETROFIT

Ongoing regenerative retrofitting and landscaping design and build in Highland Park





# Thank you for your attention

## Rohan Guyot-Sutherland

[rohan@regenerative-systems.com](mailto:rohan@regenerative-systems.com)

(+1) 909-506-8392 @regenerativesystems

!!!



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SYSTEMS



# Hempcrete and Climate Change

*The Benefits of Industrial Hemp  
Now and in the Future!*

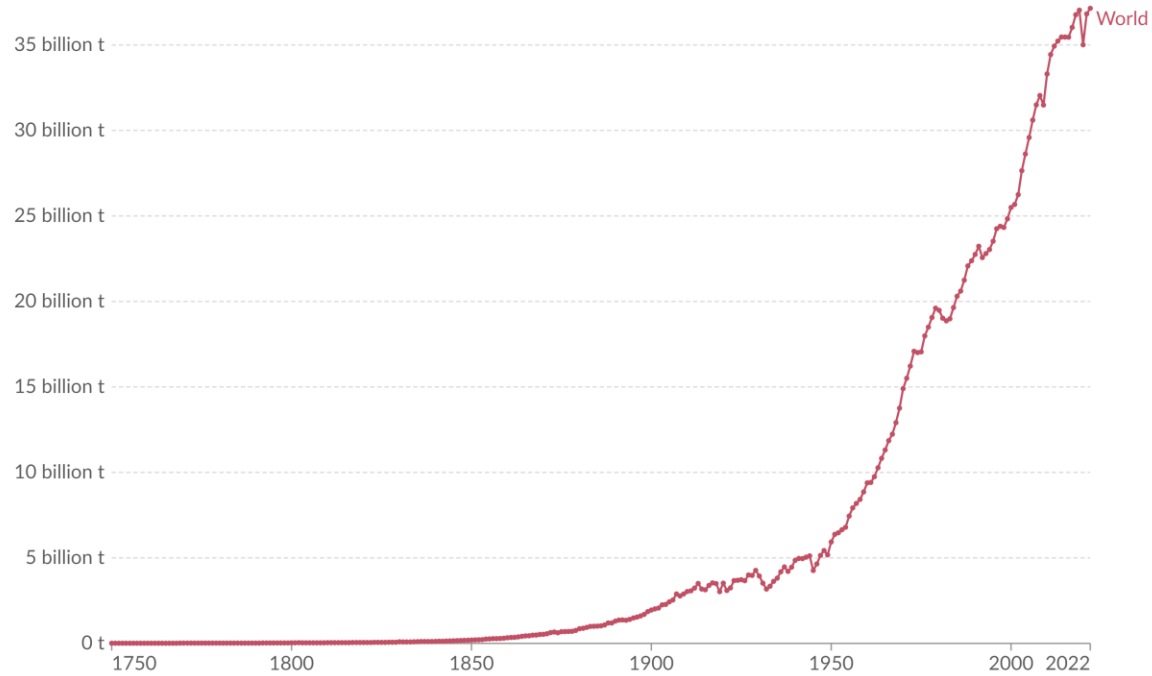


# Climate Change and CO<sub>2</sub> Emissions

## Annual CO<sub>2</sub> emissions

Carbon dioxide (CO<sub>2</sub>) emissions from fossil fuels and industry<sup>1</sup>. Land-use change is not included.

Our World  
in Data

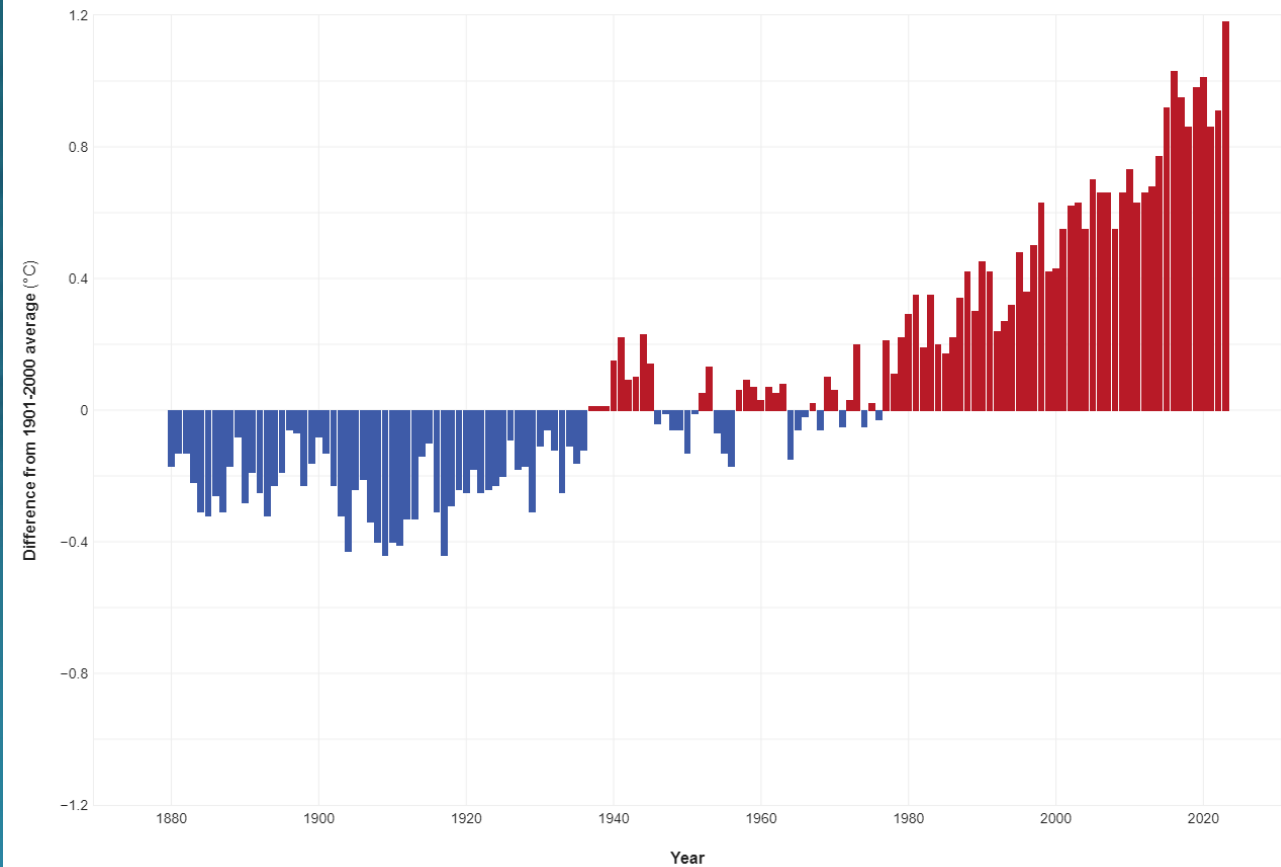


Data source: Global Carbon Budget (2023)

OurWorldInData.org/co2-and-greenhouse-gas-emissions | CC BY

**1. Fossil emissions:** Fossil emissions measure the quantity of carbon dioxide (CO<sub>2</sub>) emitted from the burning of fossil fuels, and directly from industrial processes such as cement and steel production. Fossil CO<sub>2</sub> includes emissions from coal, oil, gas, flaring, cement, steel, and other industrial processes. Fossil emissions do not include land use change, deforestation, soils, or vegetation.

## GLOBAL AVERAGE SURFACE TEMPERATURE





# Why should we care about climate change and CO<sub>2</sub> Emissions?

## More **EXTREME EVENTS** in a **warmer** world

### HEAVY PRECIPITATION

More rain and snow are falling in **heavy** and **intense** rainfall and snowfall events. Extreme rainfall has **increased** flood risk.



### STORMS

A warmer atmosphere means **more energy** for storms. Storms are projected to become **more frequent** and **stronger**.



### ATMOSPHERIC RIVERS

A warmer atmosphere holds **more moisture**. Atmospheric rivers are projected to be **longer**, **wider**, and **wetter**. This increase in intensity will lead to **increased** flood damage.



### HEATWAVES

Heatwaves are becoming **more frequent**, **hotter** and they last **longer**.



### DROUGHT

Climate change is **increasing** the chance of droughts in places. A warmer atmosphere makes droughts **drier** and **longer**.



### WILDFIRES

Wildfires are burning **larger areas** over **longer seasons**. They are **more dangerous** and now happen more in **unlikely places**.





# Why should we care about climate change in the Construction and Building Industry?

- The United Nations estimates that the buildings and construction industry accounts for 37% of global emissions.
- The production and use of materials such as cement, steel, and aluminum have a significant carbon footprint.
- New home construction in the US creates over 50 million tons of embodied carbon emissions annually, equivalent to the emissions from 138 natural gas-fired power plants or the yearly emissions from entire countries such as Norway, Peru, and Sweden.
- Much of the sector's progress has centered around reducing the "operational" carbon emissions of buildings – those emissions stemming from heating, cooling, and lighting.



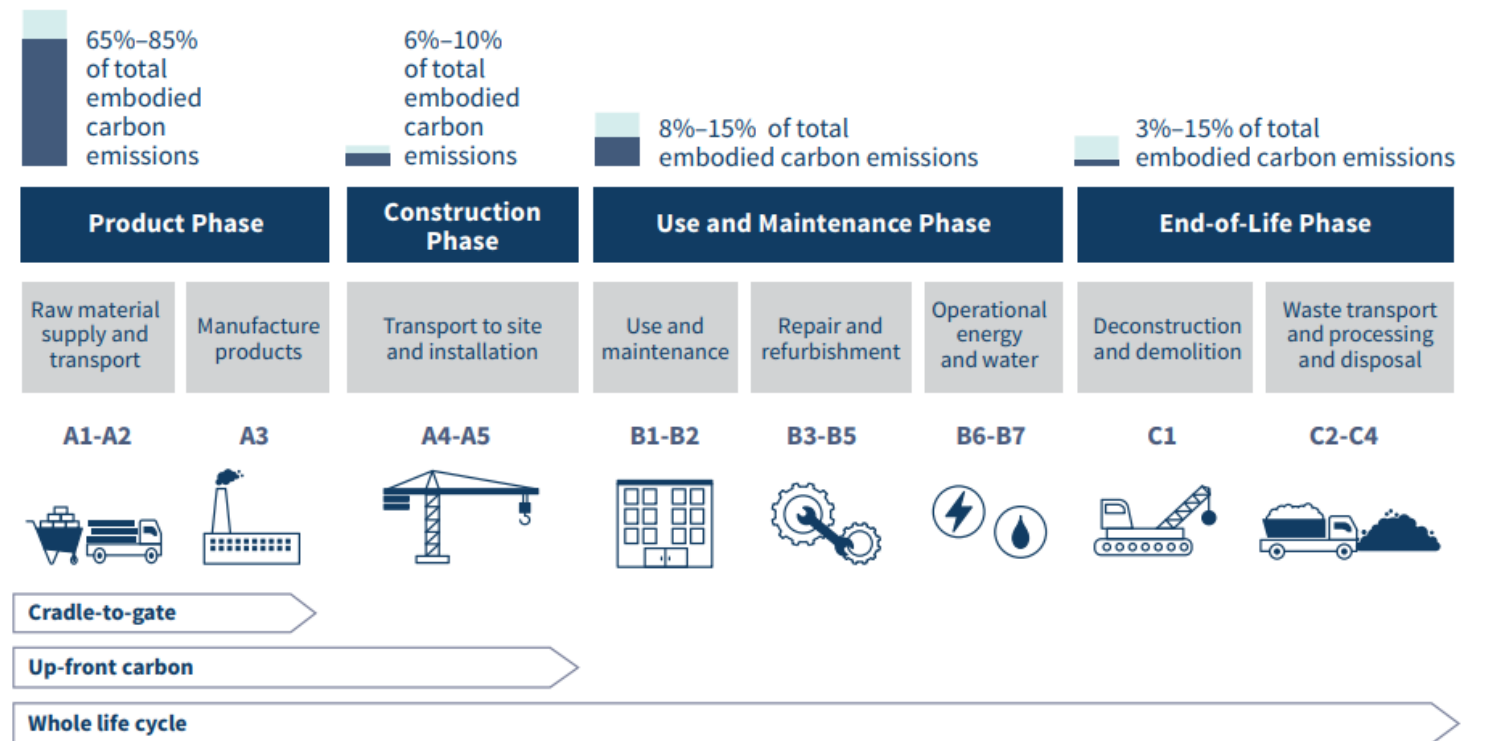
# A Little Hemp History in the Automotive Industry

- The applications of hemp-reinforced composites had been traced in the automotive industry in the 1940s.
- Henry Ford produced car components from hemp fiber with soybeans-based bio-matrices.
- It is predominantly used in the automotive sector to reinforce door panels, passenger rear decks, pillars, and trunk linings.
- BMW has turned to hemp as a sustainable and renewable alternative to plastics in car construction.
- This helps reduce our dependence on oil-based materials and contributes to a more sustainable automotive industry.



# Where are the Carbon Emissions in the Construction Industry?

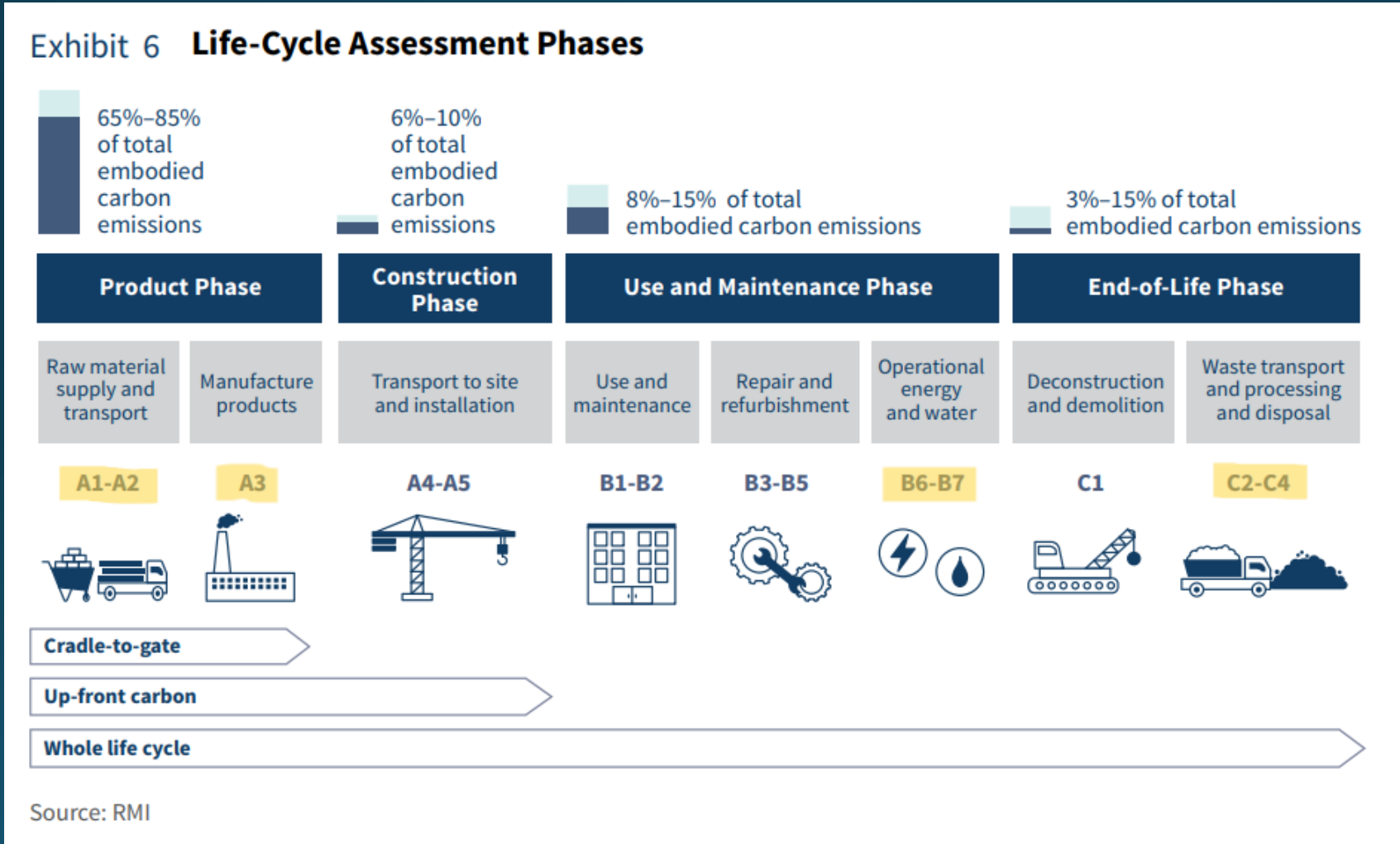
Exhibit 6 **Life-Cycle Assessment Phases**



Source: RMI



# Where can Hempcrete play a positive role?





# Growing Hemp absorbs CO<sub>2</sub>

- Hemp is a fast-growing, highly fibrous plant that absorbs lots of CO<sub>2</sub>, carbon dioxide, from the air as it grows.
- Different varieties will absorb different amounts of CO<sub>2</sub>.
  - Varieties grown for seed will sequester around 6 tons of CO<sub>2</sub> per acre in a single growing season.
  - High-fibre varieties will sequester around 10 tons of CO<sub>2</sub> per acre in a single growing season. In hot countries, three crops per year are possible.
- Replanting a typical forest can take up to 30-40 years to show a net carbon benefit.



# Hemp vs Forestry Nature Based Solutions

## HEMP VS FOREST NBS

AN ACRE OF HEMP  
ABSORBS UP TO

10

TONS OF CO2 IN  
A YEAR



5 MONTHS, SEED TO HARVEST  
IMMEDIATE BENEFITS



OVER 40 YEARS, AN ACRE  
OF HEMP ABSORBS

400

TONS OF CO2



AN ACRE OF NEW FOREST  
ABSORBS APPROX.

2.5

TONS OF CO2 IN  
A YEAR



BUT IT CAN TAKE 30-40 YEARS  
TO SEE NET BENEFITS



OVER 40 YEARS, AN ACRE  
OF FOREST ABSORBS

100

TONS OF CO2



2 crops of hemp  
per year is possible  
in hot climates!



Hemp is highly  
profitable, with  
150% ROI.



Hemp can be  
processed into  
25,000 products.



Hemp needs  
50% less water  
than most crops.



Hemp does  
not require  
pesticides.



Hemp thrives  
on marginal  
land.



Hempoffset is carbon neutral made easy

Learn more about hemp carbon offset and how we will stop climate change with the power of hemp.  
Opportunities for consumers, growers, makers, sellers and shoppers.  
[www.hempoffset.com](http://www.hempoffset.com) / [hello@hempoffset.com](mailto:hello@hempoffset.com)



# Embedded Energy and CO<sub>2</sub> in Hempcrete



A 10-inch thick, 10 square foot hemp-lime wall requires 394 MJ (109 kwh) of energy and sinks 35 kg of CO<sub>2</sub> over a 100-year life span.



A Portland cement-based equivalent concrete wall requires 560 MJ of energy with an additional release of 52.3 kg of CO<sub>2</sub>.



The most potential use of hempcrete in terms of CO<sub>2</sub> sinking is that its regrowth cycle is in one year, much shorter than forest regrowth for storing carbon over the lifetime of the composite and thereby delaying the emission of greenhouse gas.



# Carbon Sponges

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Both concrete and hempcrete do something that's important to factor in: they both absorb CO<sub>2</sub> during their life.

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In 2018, each ton of concrete produced released between 0.5 and 0.6 tons of CO<sub>2</sub>, but according to an Intergovernmental Panel on Climate Change (IPCC) report, concrete absorbs about half of that CO<sub>2</sub> during its life.

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Hemp is carbon-negative, sequestering more CO<sub>2</sub> from the atmosphere than is emitted during its production. One hectare of industrial hemp can take 15 tons of CO<sub>2</sub> from the atmosphere.



# Efficiency of Absorbing and Locking CO<sub>2</sub>



Hemp is one of the fastest-growing plants in the world and can grow 4 metres high in 100 days.



Research suggests hemp is twice as effective as trees at absorbing and locking up carbon, with 1 hectare (2.5 acres) of hemp reckoned to absorb 8 to 22 tonnes of CO<sub>2</sub> a year, more than any woodland.



# Benefits Post Construction

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When we're talking about sustainable homes, one of the biggest things to look at is insulation value

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Homes built with hempcrete can achieve fantastic thermal performance

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The thermal conductivity of a material is defined as the ability to transfer heat under a temperature difference.

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While concrete has thermal insulation from 0.62 to 3.3 W/mK (Watts per meter-Kelvin), hempcrete's value ranges from 0.06 to 0.07 W/mK — the lower, the better.

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A lower value means less heat can pass through the hempcrete than concrete, keeping a house warmer in the winter and cooler in the summer.



## Benefits Post Construction, con't

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R-value: a material's resistance to conduct heat — the higher the R-value, the greater the insulating effectiveness.

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R-value of concrete used in floor slabs ranges from 0.1 to 0.2 per inch of thickness. A 6-inch-thick slab would have an R-value between 0.6 and 1.2.

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R-value for hempcrete ranges from 2.4 to 4.8 per inch. That same 6-inch slab would have an R-value of 14.4 to 28.8.



# Real World Numbers

- A home built by a French developer utilizing hempcrete and a timber frame system combined with an insulating wall and ground floor slab, had a heating bill of about \$340 for six to seven months of heating.
- The heating bill for a similar sized house would be about \$1,055.





# Conclusion

- Using Hemp as an alternative to conventional products can provide significant GHG reductions.
- Using Hemp can provide benefits not only in its ability to capture CO<sub>2</sub> but also in its ability to sequester CO<sub>2</sub> for many decades, if not longer.



Questions?