CASA VERDE

"MAKING LIVING SUSTAINABLE FOR ALL"

FRIJOLES VERDE| UNIVERSITY OF ARIZONA | ATTACHED HOUSING | SOLAR DECATHLON DESIGN CHALLENGE 2023

ENVIRONMENTAL EXTREMES

100°+ SUMMER HIGH TEMPS

3.7 MONTHS OF SUMMER

25° DAILY TEMPERATURE SWING

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3.7 MONTHS OF SUMMER

25° DAILY TEMPERATURE SWING

ECONOMIC DISPARITY

19.8% POVERTY RATE

$48,000 AMI

12.6% FOOD INSECURITY

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3.7 MONTHS OF SUMMER

25° DAILY TEMPERATURE SWING

ECONOMIC DISPARITY

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$48,000 AMI

12.6% FOOD INSECURITY

SOCIAL STRATIFICATION

40% OF MINORITY STUDENTS

ATTEND ECONOMICALLY

SEGREGATED SCHOOLS

ENVIRONMENTAL COMFORT

-1,629 kWh ANNUAL ENERGY USE

$420 LOWER ANNUAL UTILITY BILL

ECONOMIC EMPOWERMENT

$500/MONTH RENT

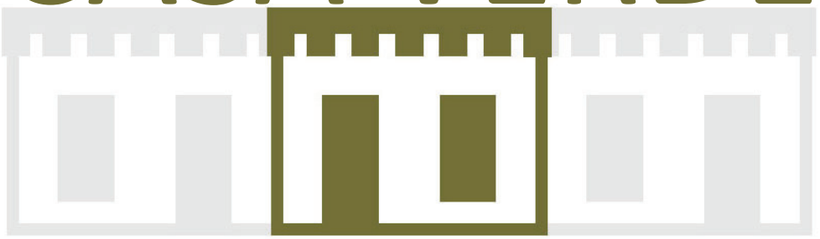
$123/SF

SOCIAL CONNECTION

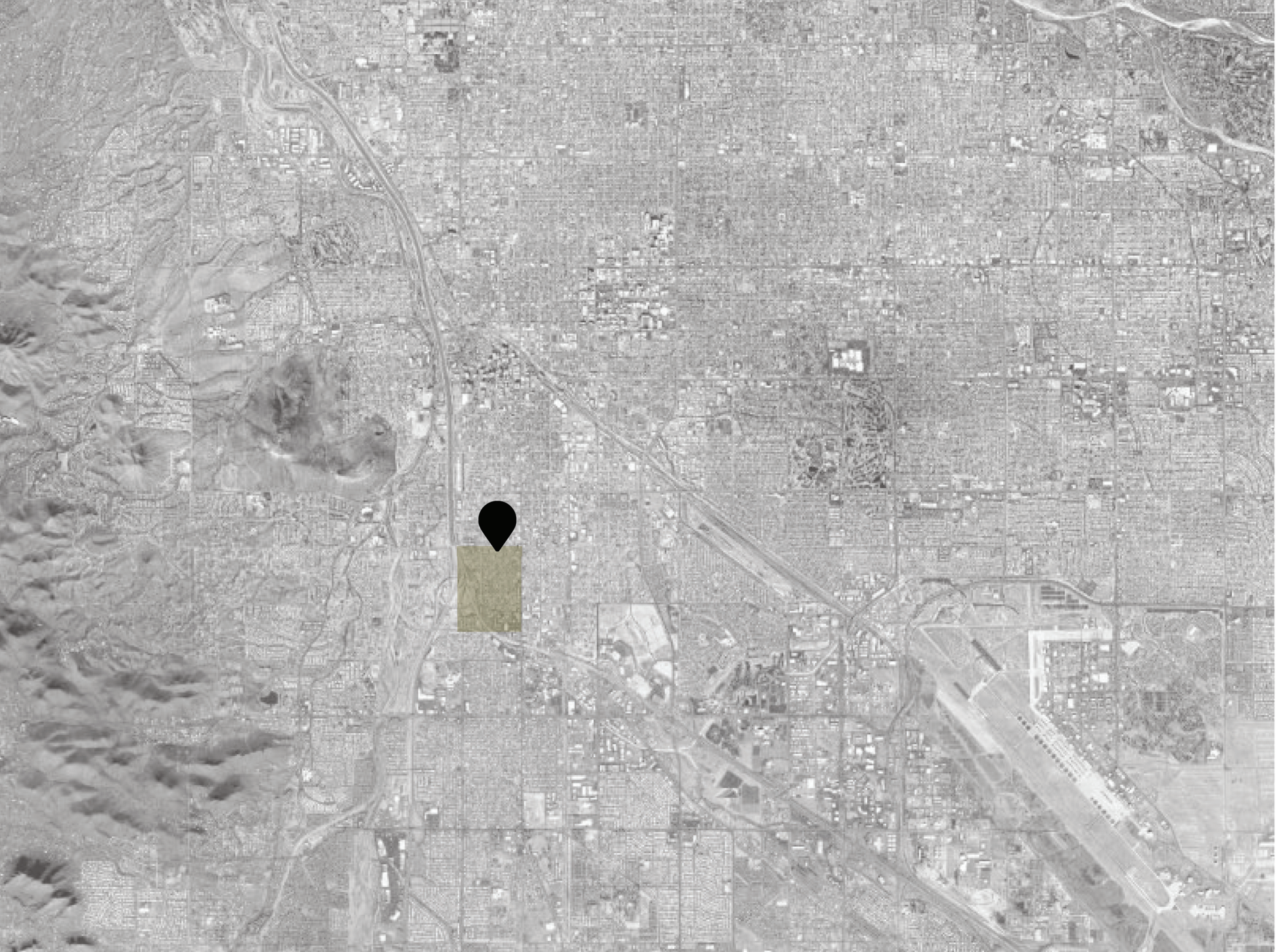
1 MIN WALK TO PUBLIC TRANSIT

28,126 SF OF COURTYARD

CASA VERDE



“MAKING LIVING SUSTAINABLE FOR ALL TUCSONIANS”



SOUTH TUCSON

$22,867
AREA MEDIAN INCOME

51%
POVERTY RATE

5,652
POPULATION

160
NEW RENTERS EACH YEAR

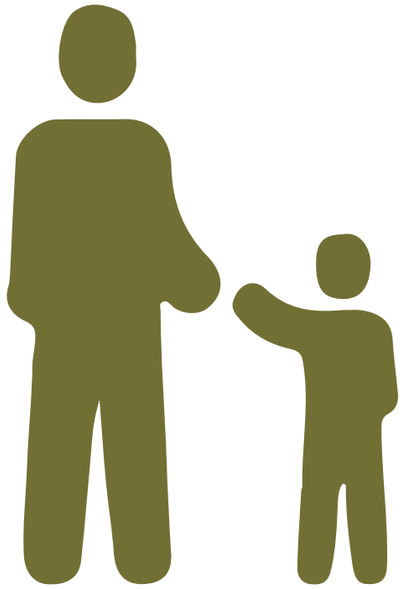
AFFORDABILITY

~$500/MONTH RENT

STUDIO/1BR UNITS

$100-$150/SF

$420 LOWER ANNUAL UTILITY BILL



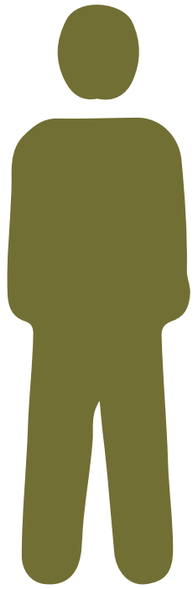
YOUNG, SINGLE PARENTS
MAKING LESS THAN $19,000 A YEAR

COMMUNITY

COMMUNAL COURTYARD

PRIVATE PATIO

SPONTANEOUS INTERACTION



YOUNG ADULTS
MAKING LESS THAN $19,000 A YEAR

SITE PLAN

- PUBLIC TRANSIT
- BIKE SHARE
- YOUTH CENTER
- SCHOOL
- CITY COURT
- LIBRARY
- POLICE STATION
- NEIGHBORHOOD

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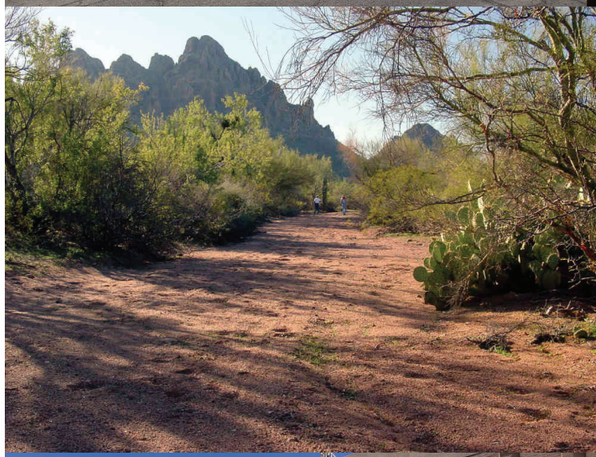
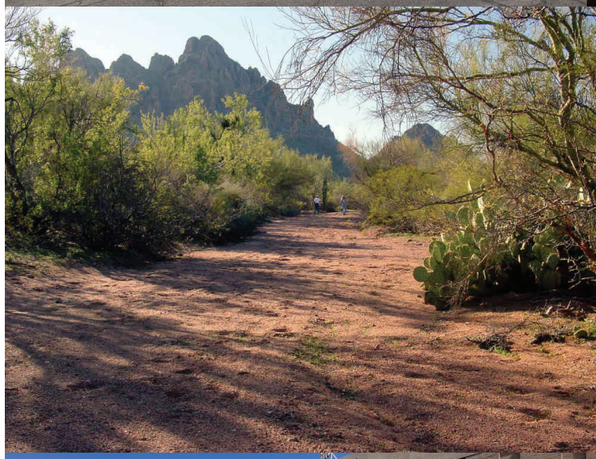
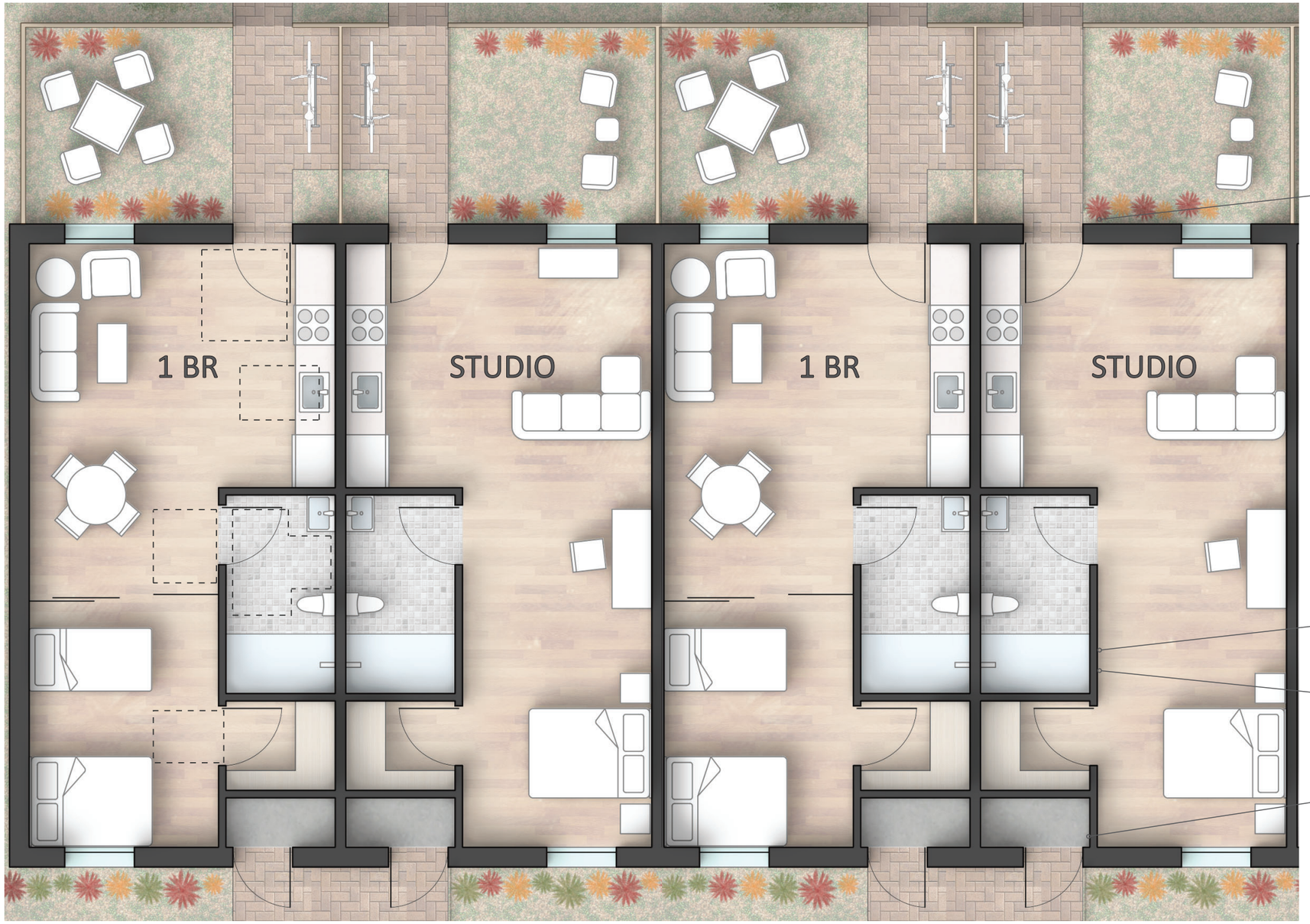
“PEDESTRIAN STREET” ENTRYWAY



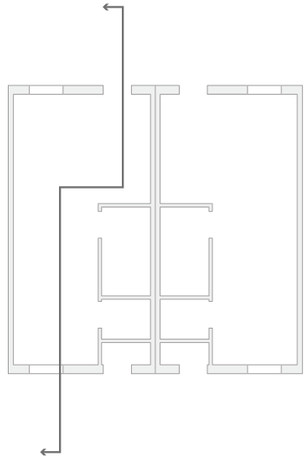
PRIVATE PATIO

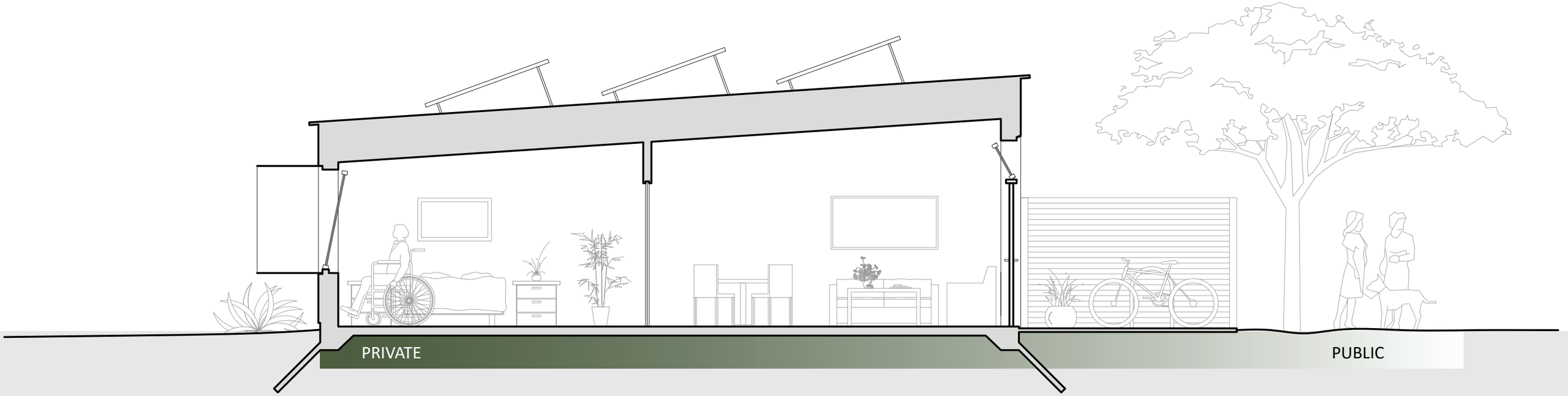


UNIT LAYOUTS



UNIT LAYOUTS

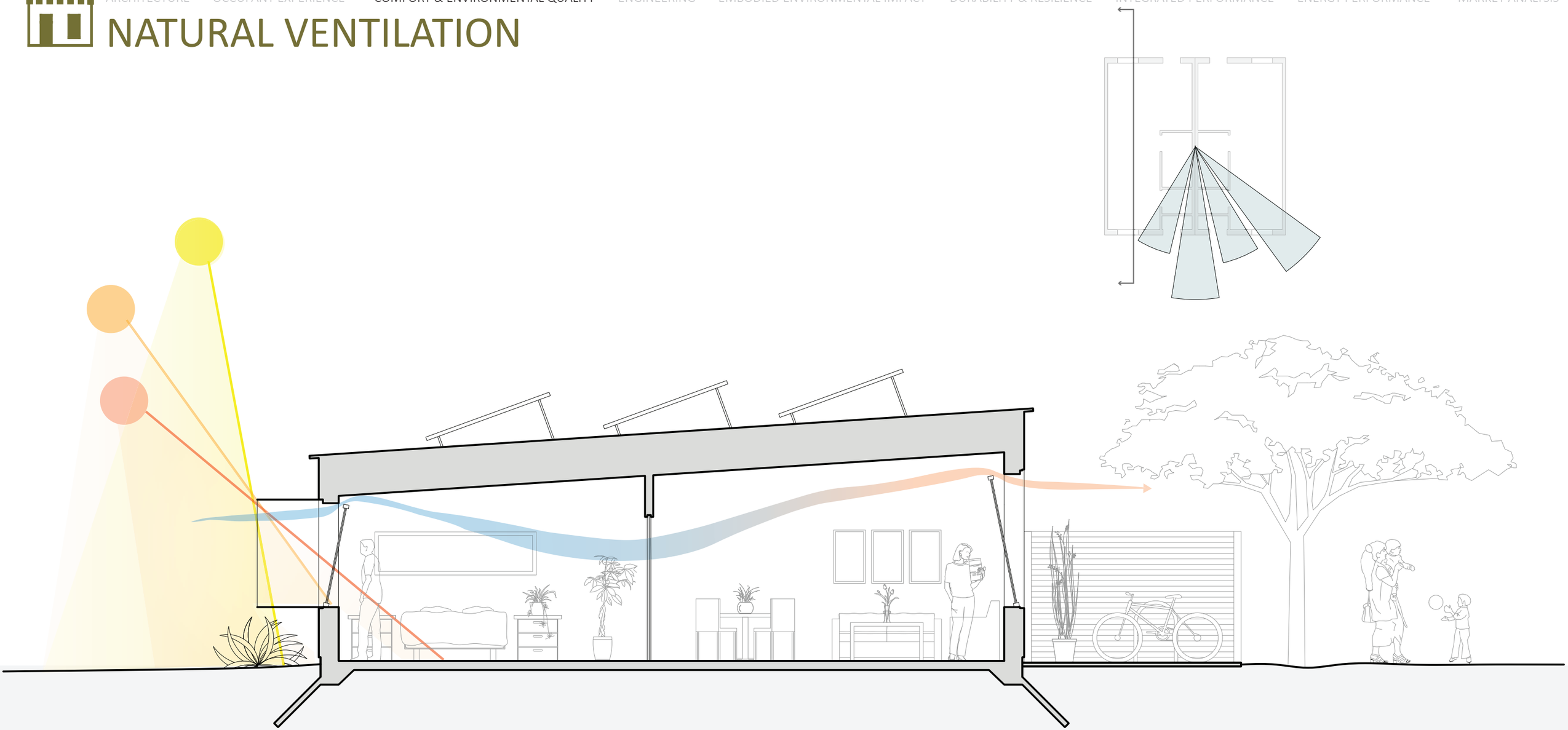




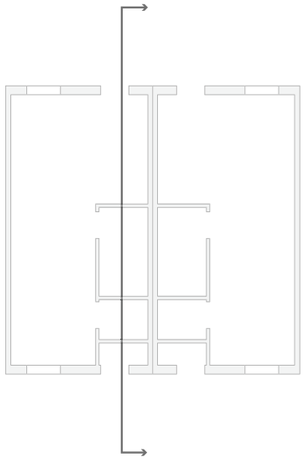

UNIT LIVING ROOM


SIMPLE FORM
SOLAR ORIENTATION
WHITE EXTERIOR
DAYLIGHT
SOUND INSULATION

NATURAL VENTILATION

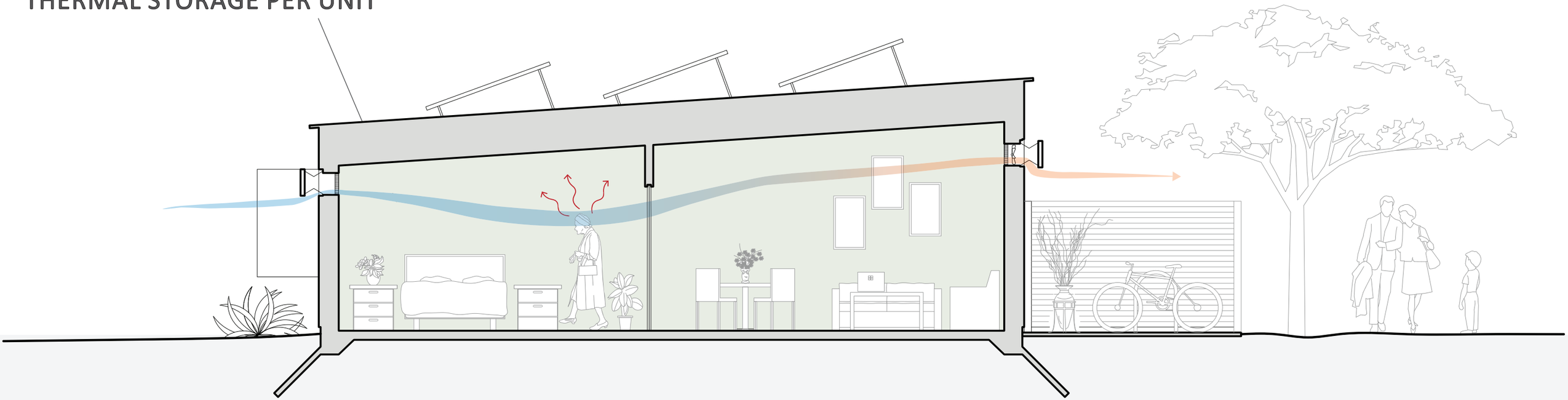


PHASE CHANGE MATERIALS

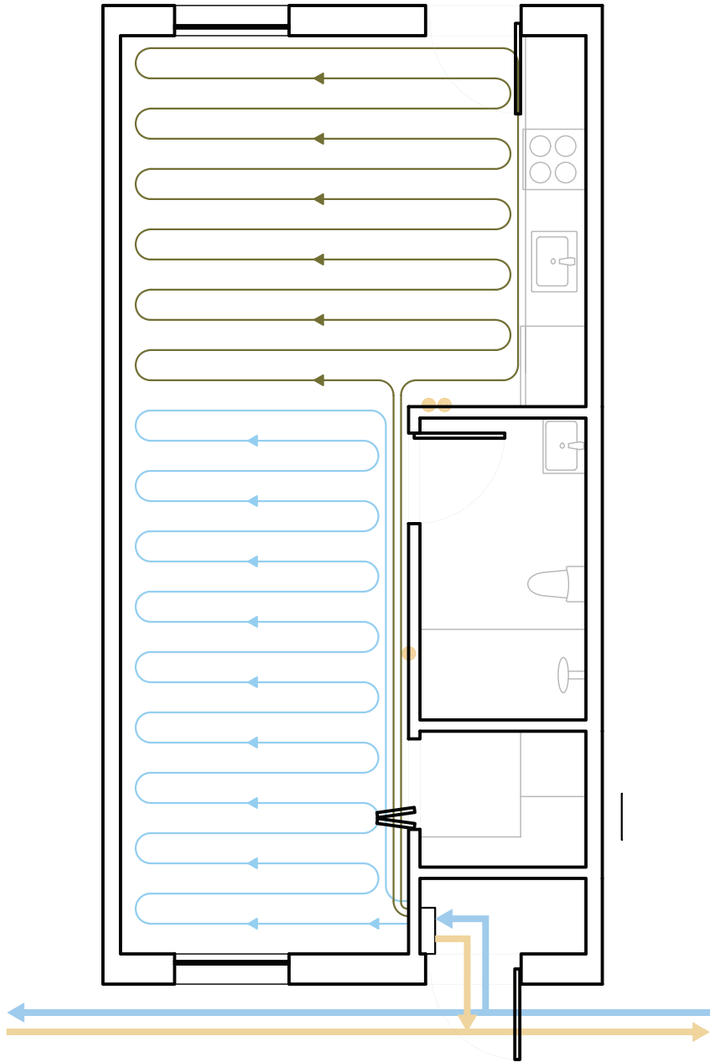


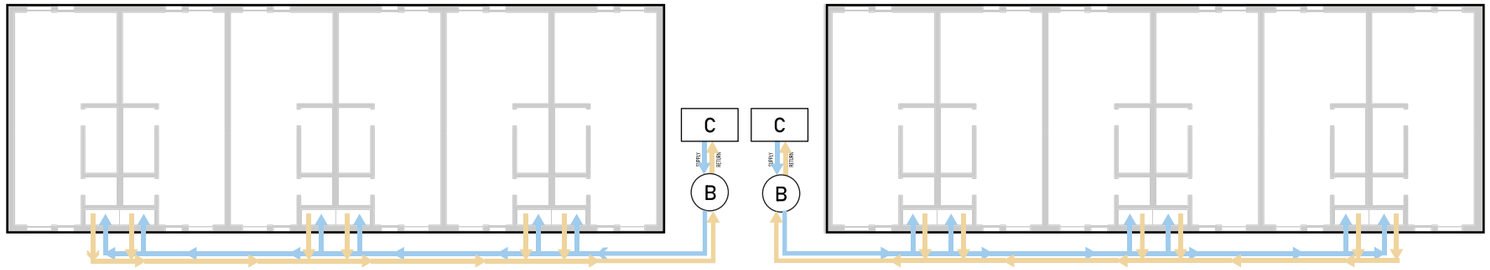
$1.82
COST PER SQUARE FOOT

77.7 kBTU
THERMAL STORAGE PER UNIT



RADIANT COOLING





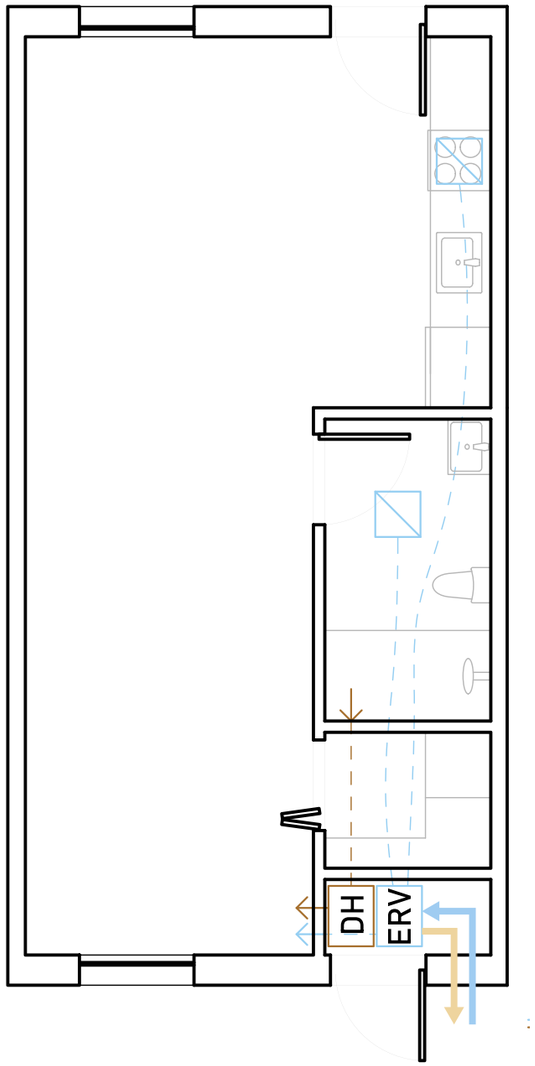
C - AIR TO WATER HEAT PUMP
B - BUFFER TANK
ZONE 1
ZONE 2
WATER SUPPLY
WATER RETURN

2
CONTROLLABLE ZONES PER UNIT

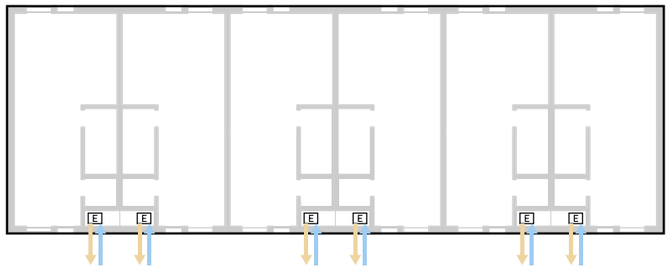
60°F
COOLING WATER TEMPERATURE

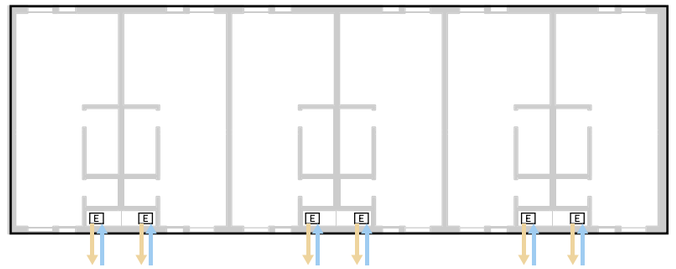
22.21
INTEGRATED PART LOAD VALUE ENERGY EFFICIENCY RATIO

MECHANICAL VENTILATION



DH - DE-HUMIDIFIER
ERV - ENERGY RECOVERY VENTILATOR





35 CFM
BALANCED VENTILATION

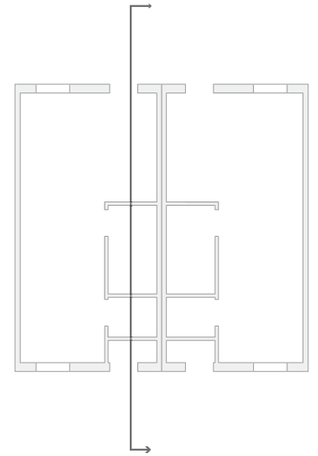
88%
ERV LATENT HEAT RECOVERY

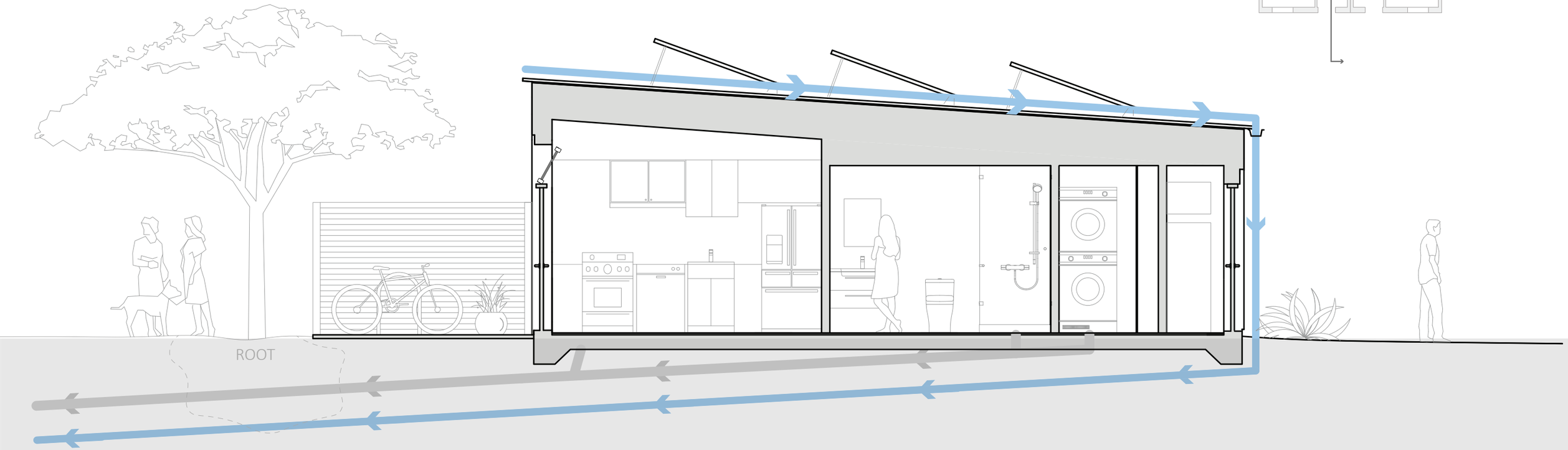
19W
POWER CONSUMPTION FOR CFM

WATER MANAGEMENT

45,711
GALLONS/YEAR ROOF RAINWATER COLLECTION

157,248
GALLONS/YEAR GRAYWATER COLLECTION

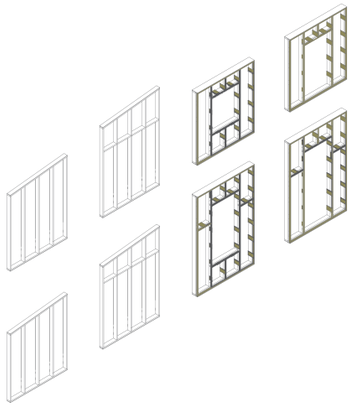




PREFABRICATION

HABITAT FOR HUMANITY

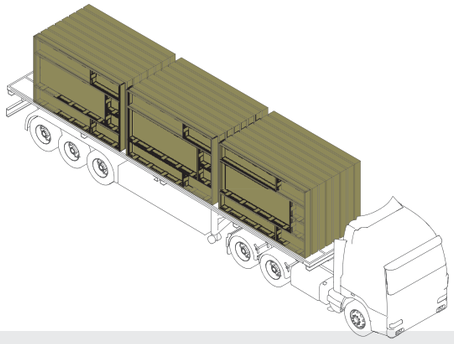
8 WALL TYPES



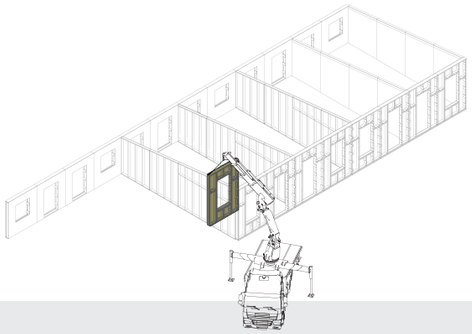
LARSEN DEPTH ADDED

OSB INSTALLED

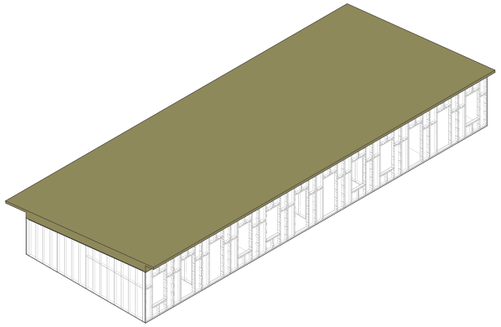
9
PANELS/DAY



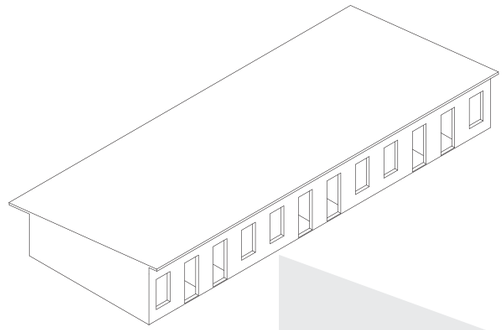
PANELS TRANSPORTED



WALLS CRANED IN



ROOF CONSTRUCTED



INSULATION AND
FINISHES INSTALLED

2-3
WEEKS TO TOTAL DRY-IN

PREFABRICATION

FRAMING JIGS AT HABITAT FOR HUMANITY TUCSON

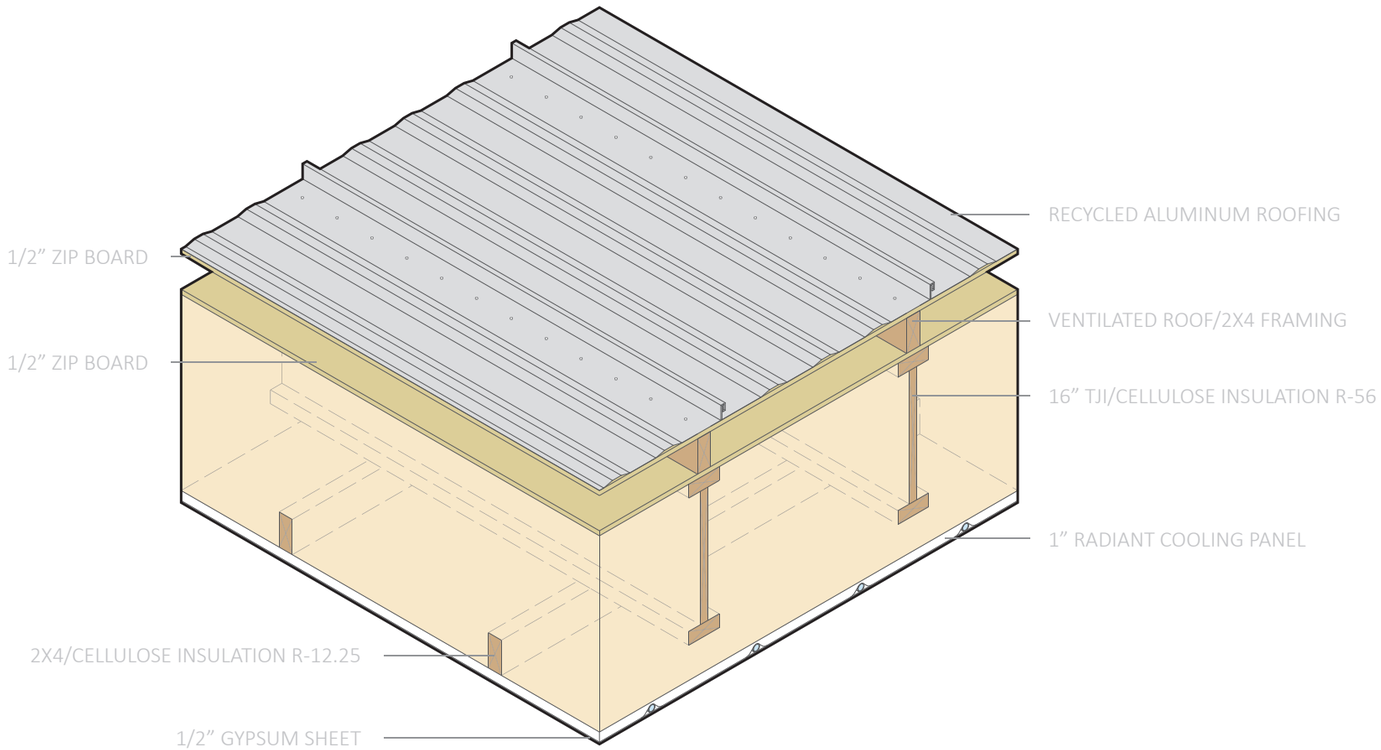
3-4 MONTHS

TO TOTAL SHELL DRY-IN FOR TYPICAL CONSTRUCTION

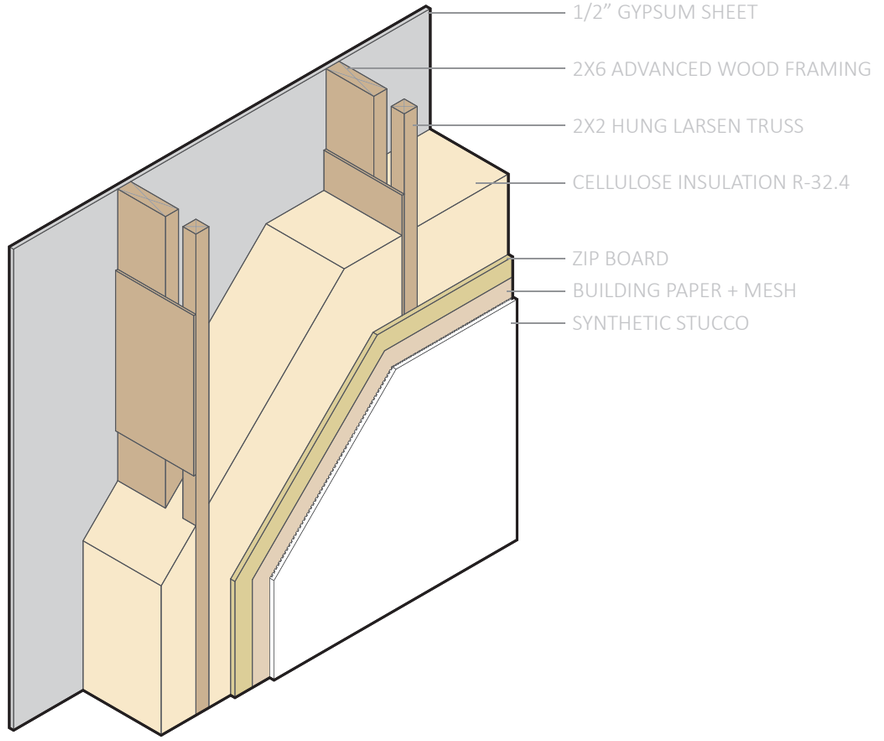
2-3 WEEKS

TO TOTAL SHELL DRY-IN FOR PREFAB CONSTRUCTION

MATERIAL SELECTION



R-70.5
ROOF ASSEMBLY



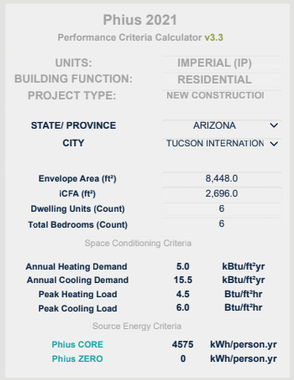
R-32.1
WALL ASSEMBLY

ENERGY TARGETS

phius CORE

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

ZERO ENERGY READY REQUIREMENTS



Phius 2021
Performance Criteria Calculator v3.3

UNITS:	IMPERIAL (IP)
BUILDING FUNCTION:	RESIDENTIAL
PROJECT TYPE:	NEW CONSTRUCTIOI
STATE/ PROVINCE	ARIZONA
CITY	TUCSON INTERNATION
Envelope Area (ft²)	8,448.0
iCFA (ft²)	2,696.0
Dwelling Units (Count)	6
Total Bedrooms (Count)	6

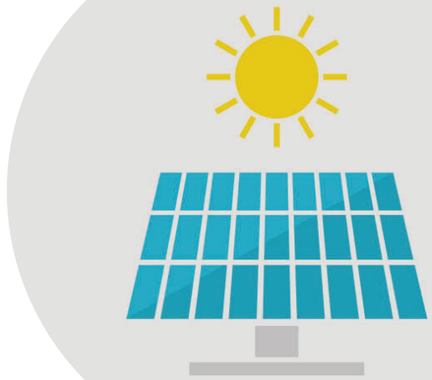
Space Conditioning Criteria

Annual Heating Demand	5.0	kBtu/ft²yr
Annual Cooling Demand	15.5	kBtu/ft²yr
Peak Heating Load	4.5	Btu/ft²hr
Peak Cooling Load	6.0	Btu/ft²hr

Source Energy Criteria

Phius CORE	4575	kWh/person.yr
Phius ZERO	0	kWh/person.yr

SPACE CONDITIONING LOAD LIMITS



SOURCE ENERGY USE LIMIT

WUFI®

TESTED THROUGH ENERGY MODELING

MATERIAL SELECTION

EMBODIED ENERGY BY MATERIAL

kg CO_2eq/100m² OR R30

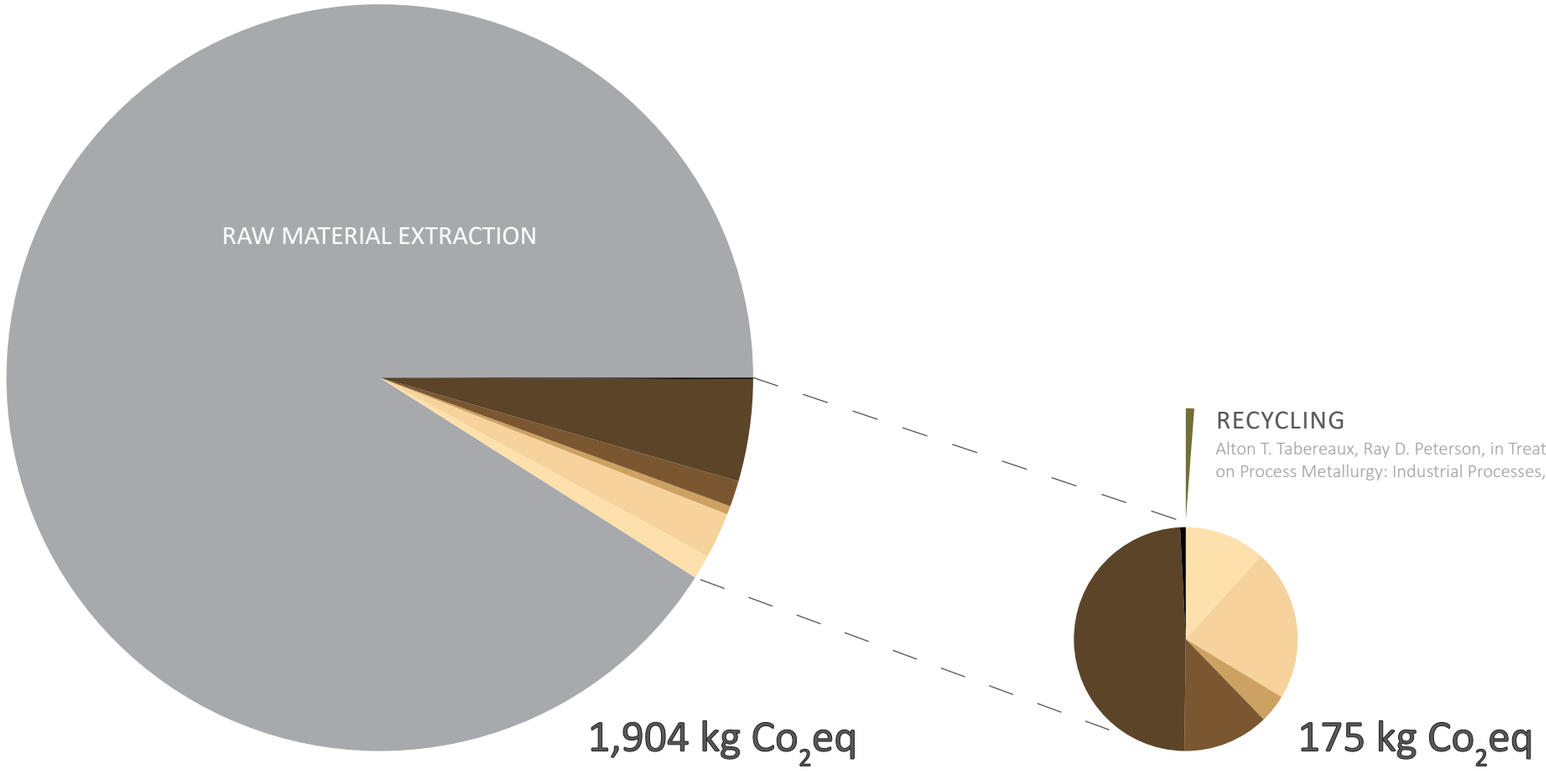
ADVANCED WOOD FRAMING

CELLULOSE INSULATION

RECYCLED ALUMINUM ROOF

Building Emissions Accounting for Materials. (n.d.). Retrieved February 21, 2023
Underwood, T. (n.d.). Stone-Coated Metal Roofing vs. Standing Seam Metal Roofing: What is the Difference?
Green Fiber Cellulose Insulation. (n.d.). How To Update Insulation In Walls Of Old Homes.
Holladay, M. (n.d.). Energy-Efficient Framing, a.k.a. Advanced Framing. Green Building Advisor.

RECYCLED ALUMINUM



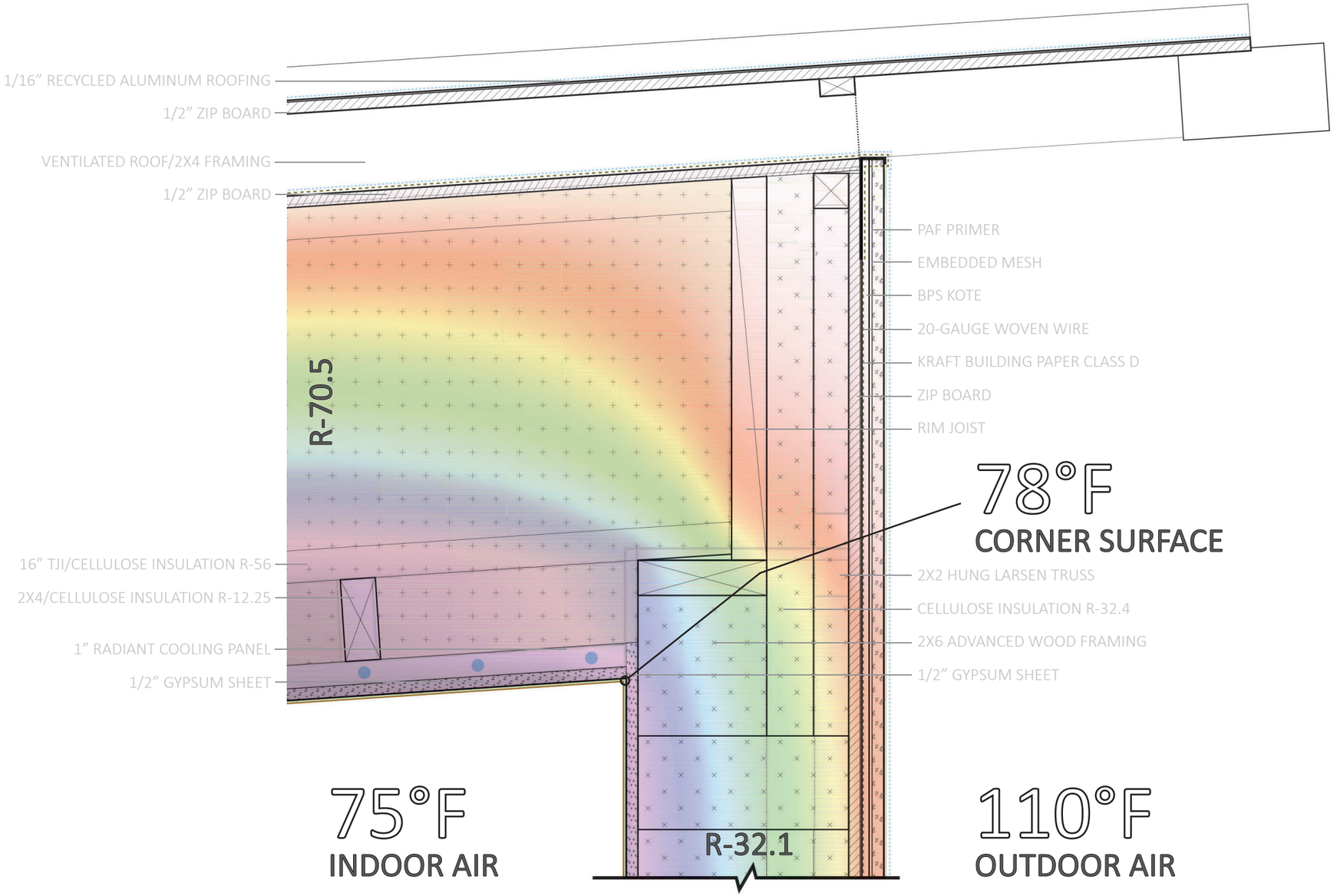
91%

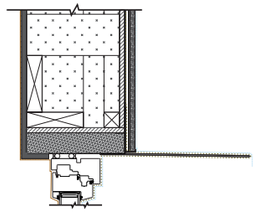
EMBODIED ENERGY REDUCTION

	kg Co2eq
RECYCLING	2
DISPOSAL	1
MAINTENANCE	84
ASSEMBLY	21
TRANSPORTATION	7
MANUFACTURING	37
TRANSPORTATION (INITIAL)	20
RAW MATERIAL EXTRACTION	1,730

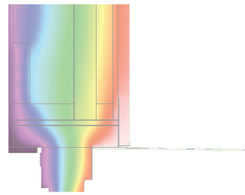
PER 100m² OF ROOFING

MINIMIZING HEAT GAIN

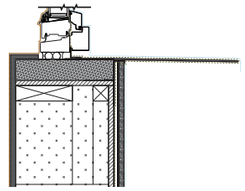




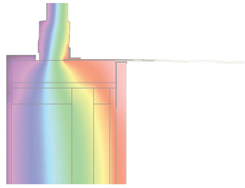
WALL TO HEADER DETAIL



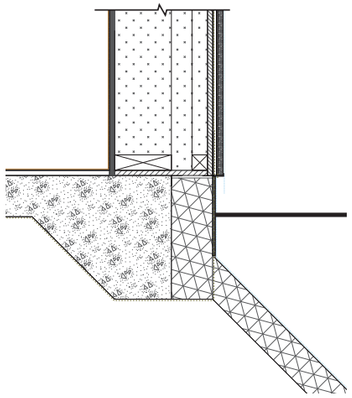
THERM MODEL



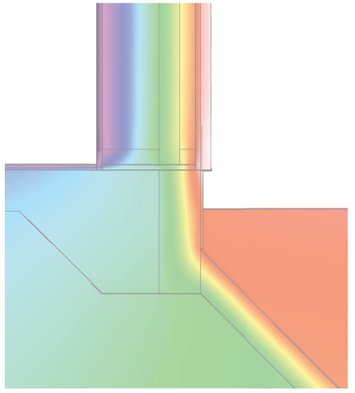
WALL TO SILL DETAIL



THERM MODEL

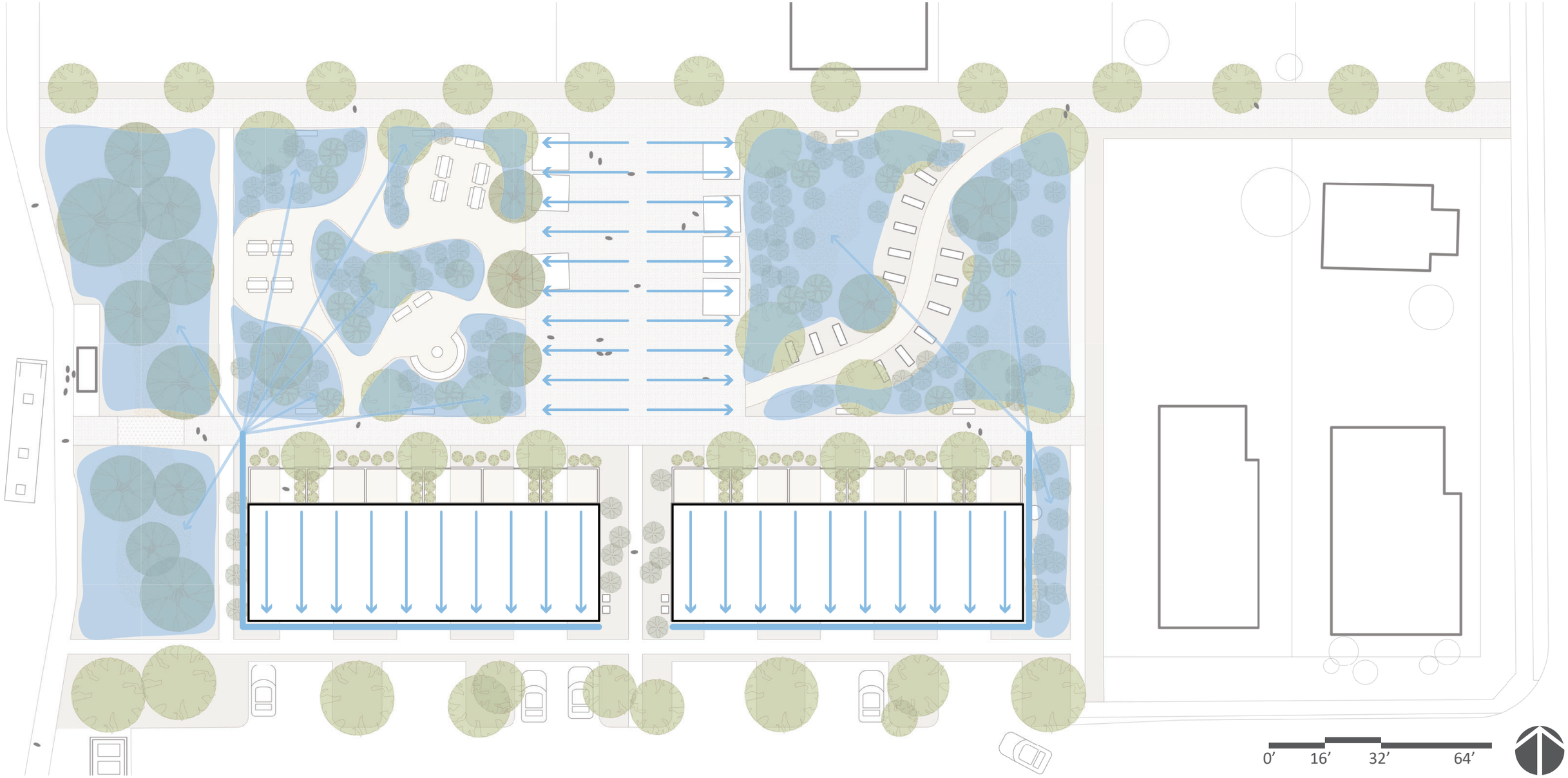


WALL TO FOUNDATION DETAIL

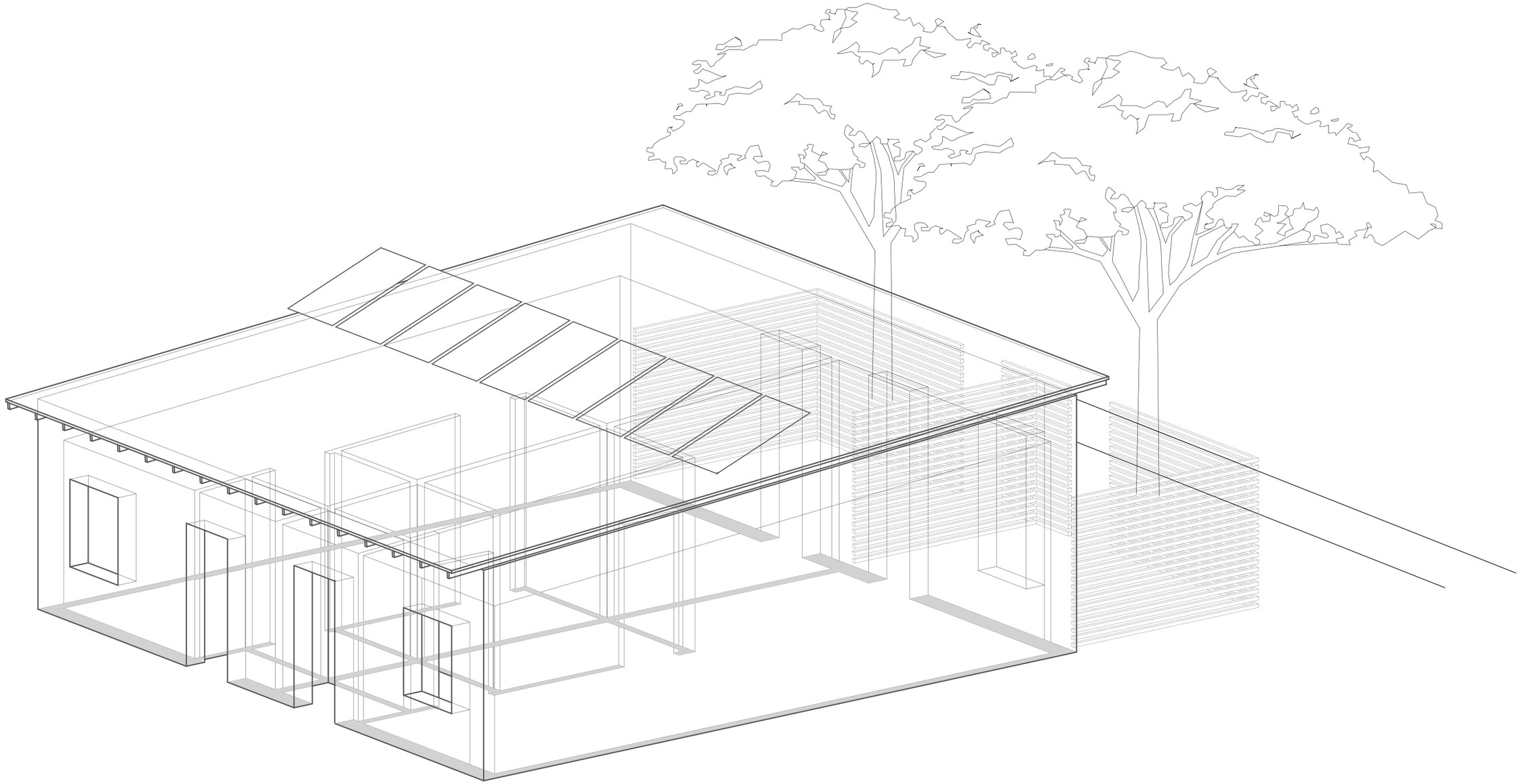


THERM MODEL

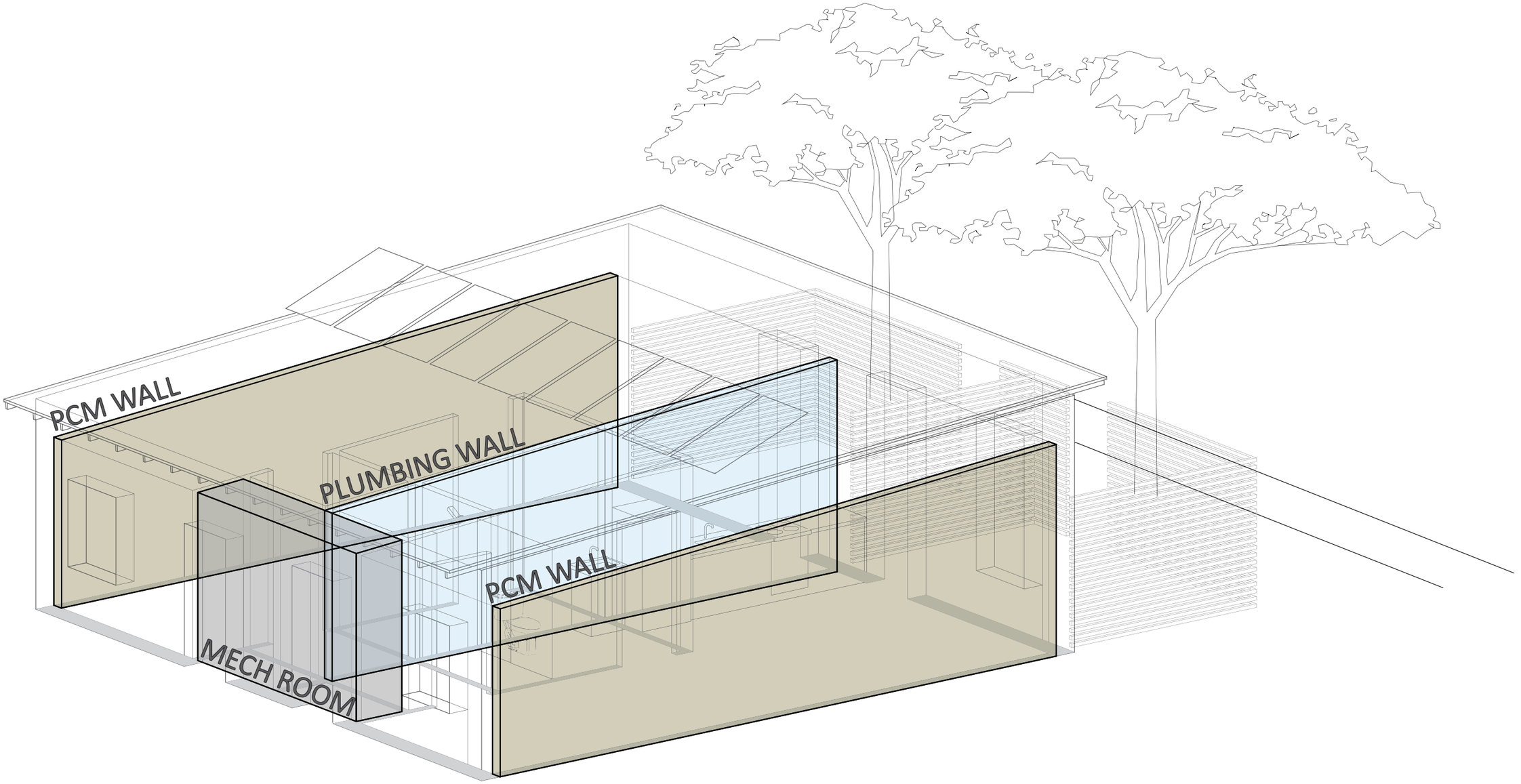
WATER MANAGEMENT



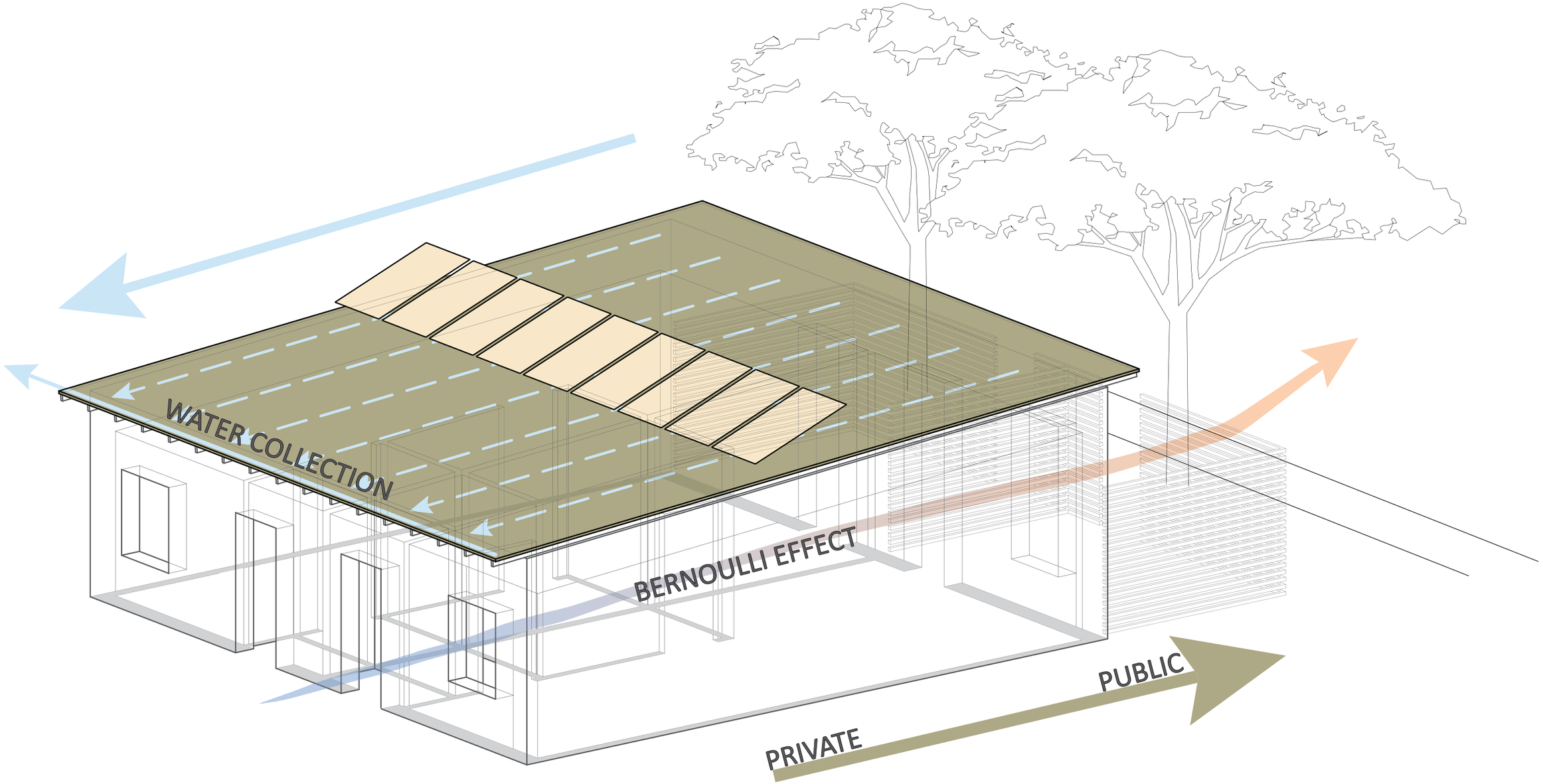
INTEGRATED PERFORMANCE



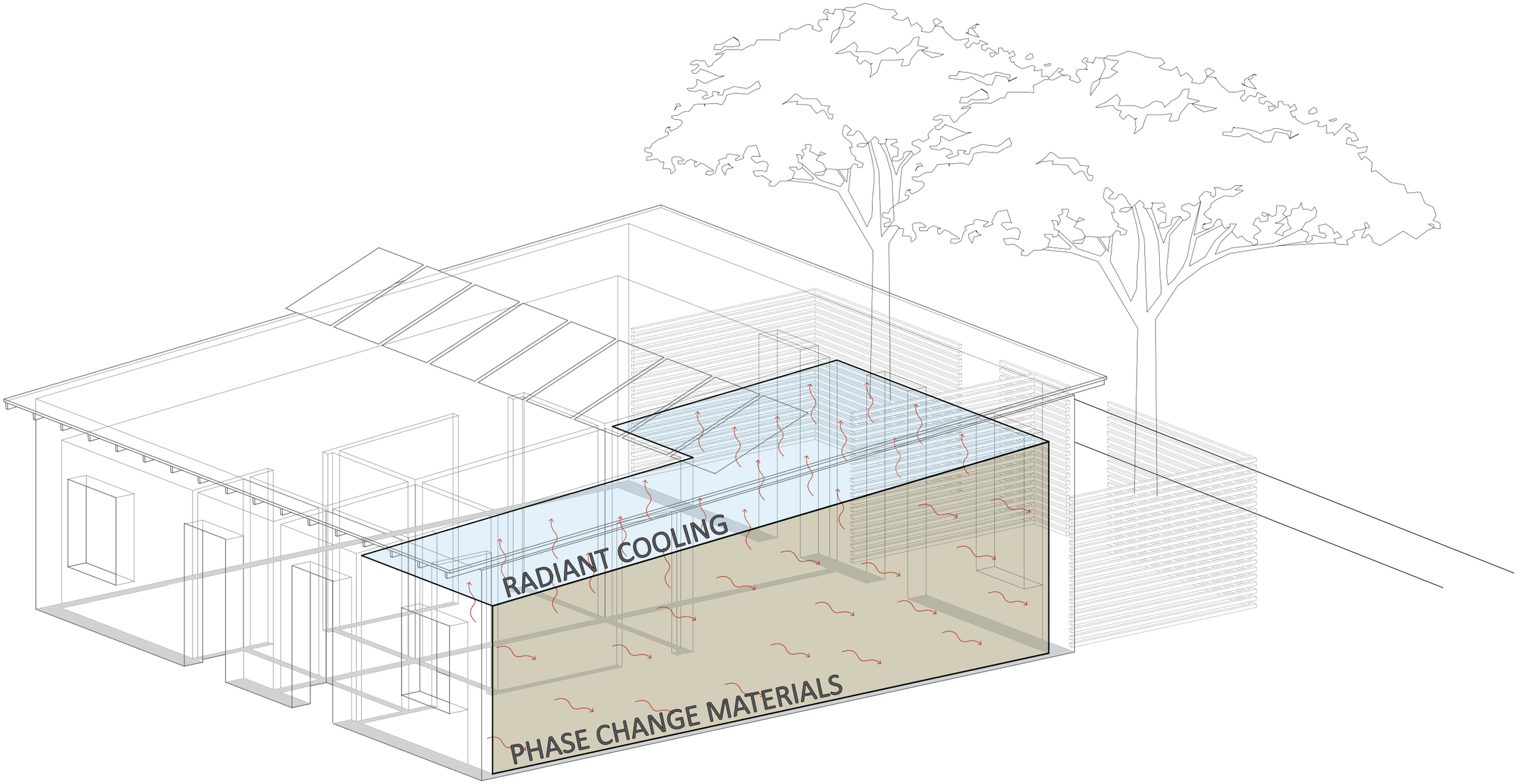
INTEGRATED PERFORMANCE



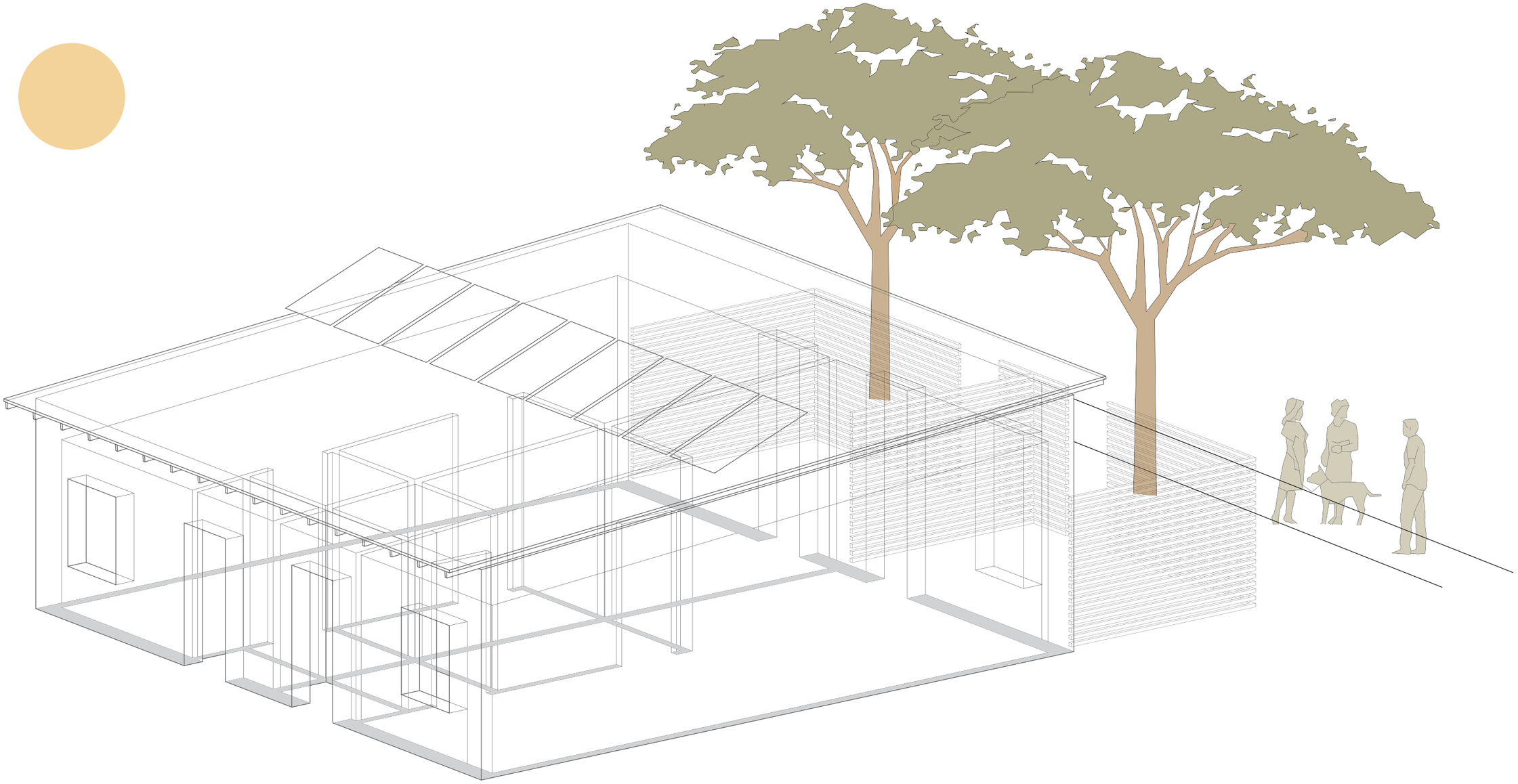
INTEGRATED PERFORMANCE



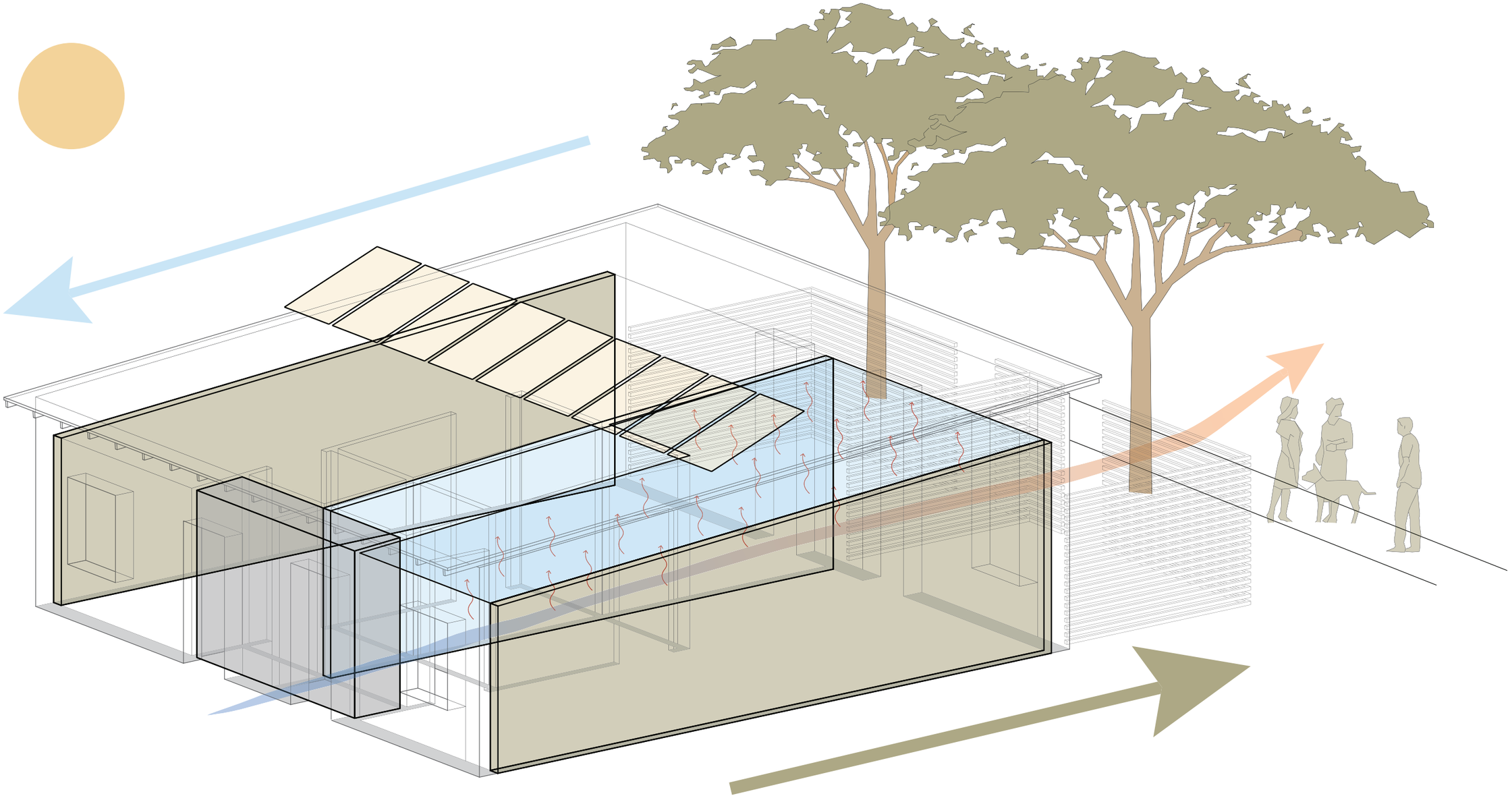
INTEGRATED PERFORMANCE



INTEGRATED PERFORMANCE



INTEGRATED PERFORMANCE



MINIMIZING ENERGY NEED

PASSIVE STRATEGIES BEFORE ACTIVE STRATEGIES

SIMPLE ENVELOPE

PROPER SOLAR ORIENTATION

15% WWR

CROSS VENTILATION

PHASE CHANGE MATERIALS/THERMAL MASS

CLIMATE-BASED R-VALUES

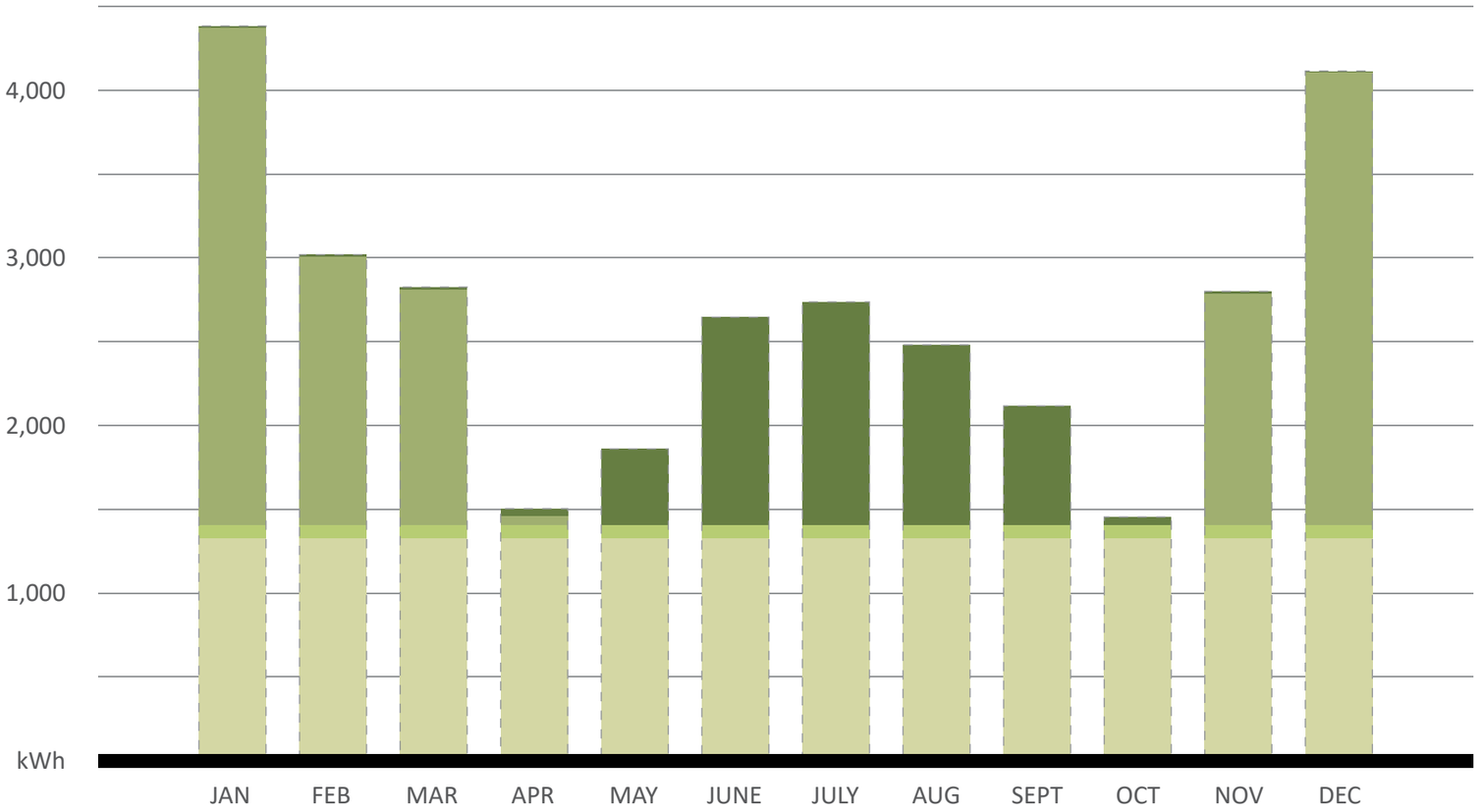
HIGH-EFFICIENCY SYSTEMS

BALANCED VENTILATION

LED LIGHTING

BUILDING AUTOMATION SYSTEM

ENERGY CALCULATIONS - CODE MINIMUM



CODE MIN. SITE LOAD

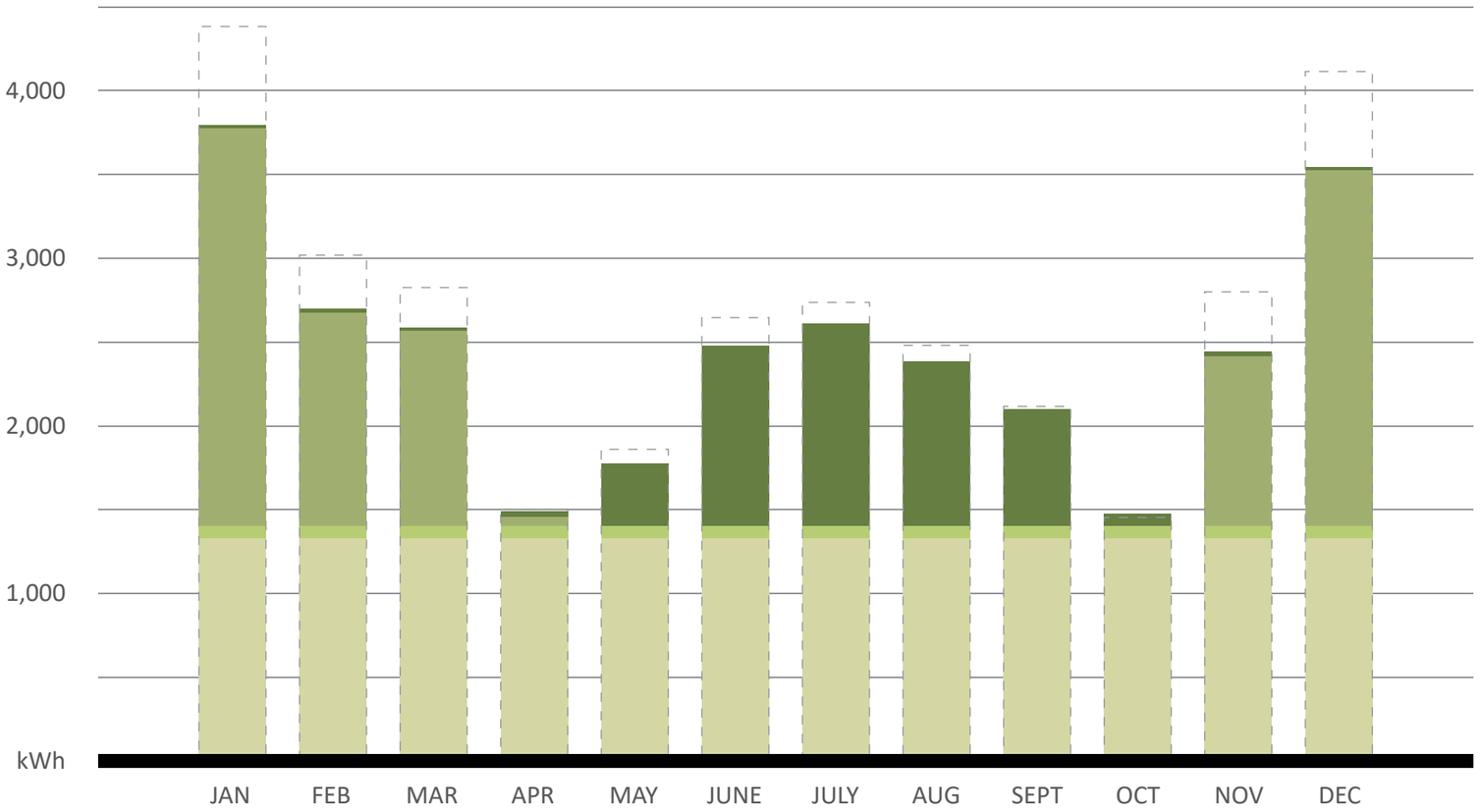
31,943 kWh

CODE MIN. H/C LOAD

15,106 kWh

COOLING
HEATING
LIGHTING
APPLIANCES

ENERGY CALCULATIONS - ORIENTATION AND WWR



CODE MIN. SITE LOAD

31,943 kWh

IMPROVED SITE LOAD

29,384 kWh

CODE MIN. H/C LOAD

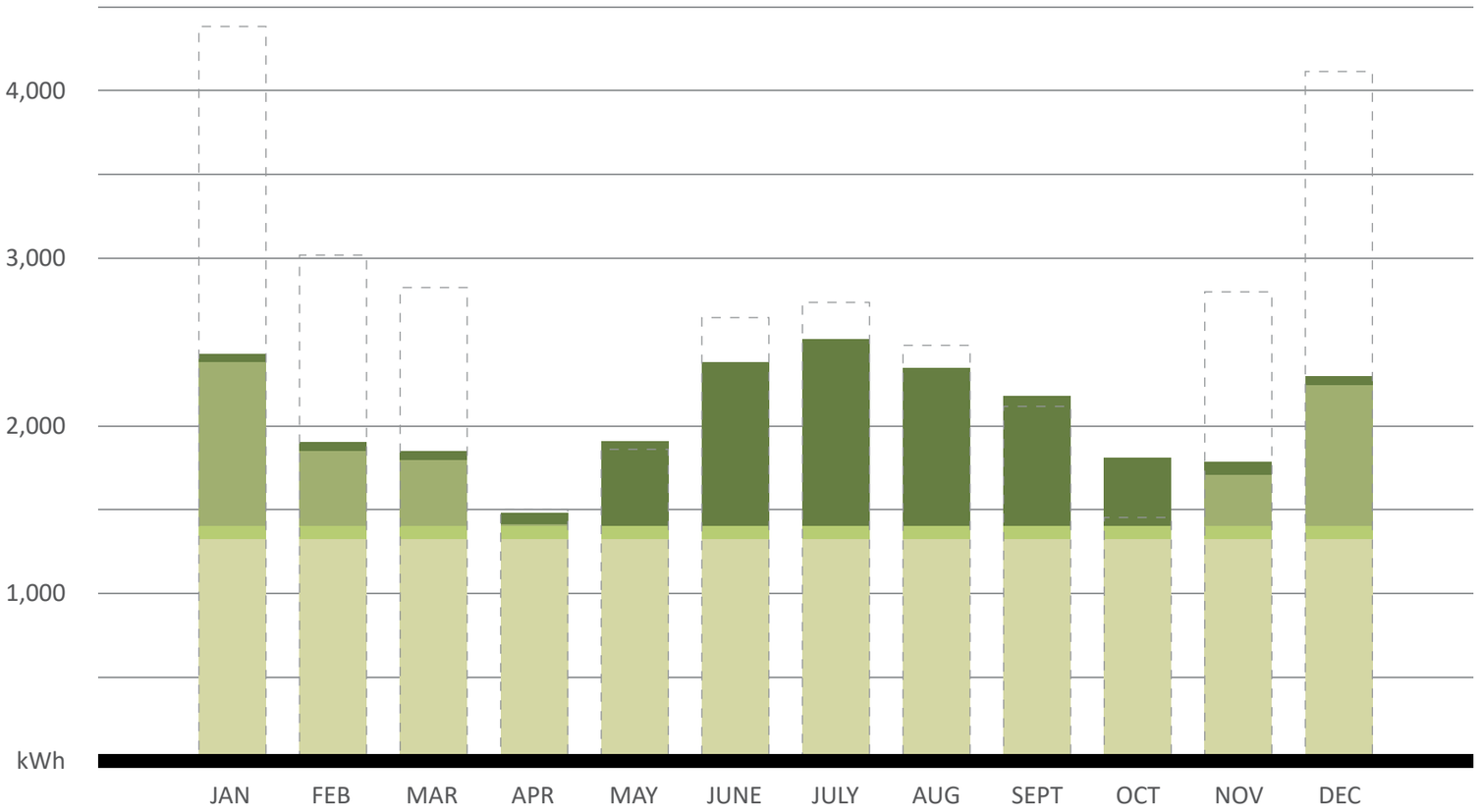
15,106 kWh

IMPROVED H/C LOAD

12,550 kWh

COOLING
HEATING
LIGHTING
APPLIANCES

ENERGY CALCULATIONS - ENVELOPE



CODE MIN. SITE LOAD

31,943 kWh

IMPROVED SITE LOAD

24,885 kWh

CODE MIN. H/C LOAD

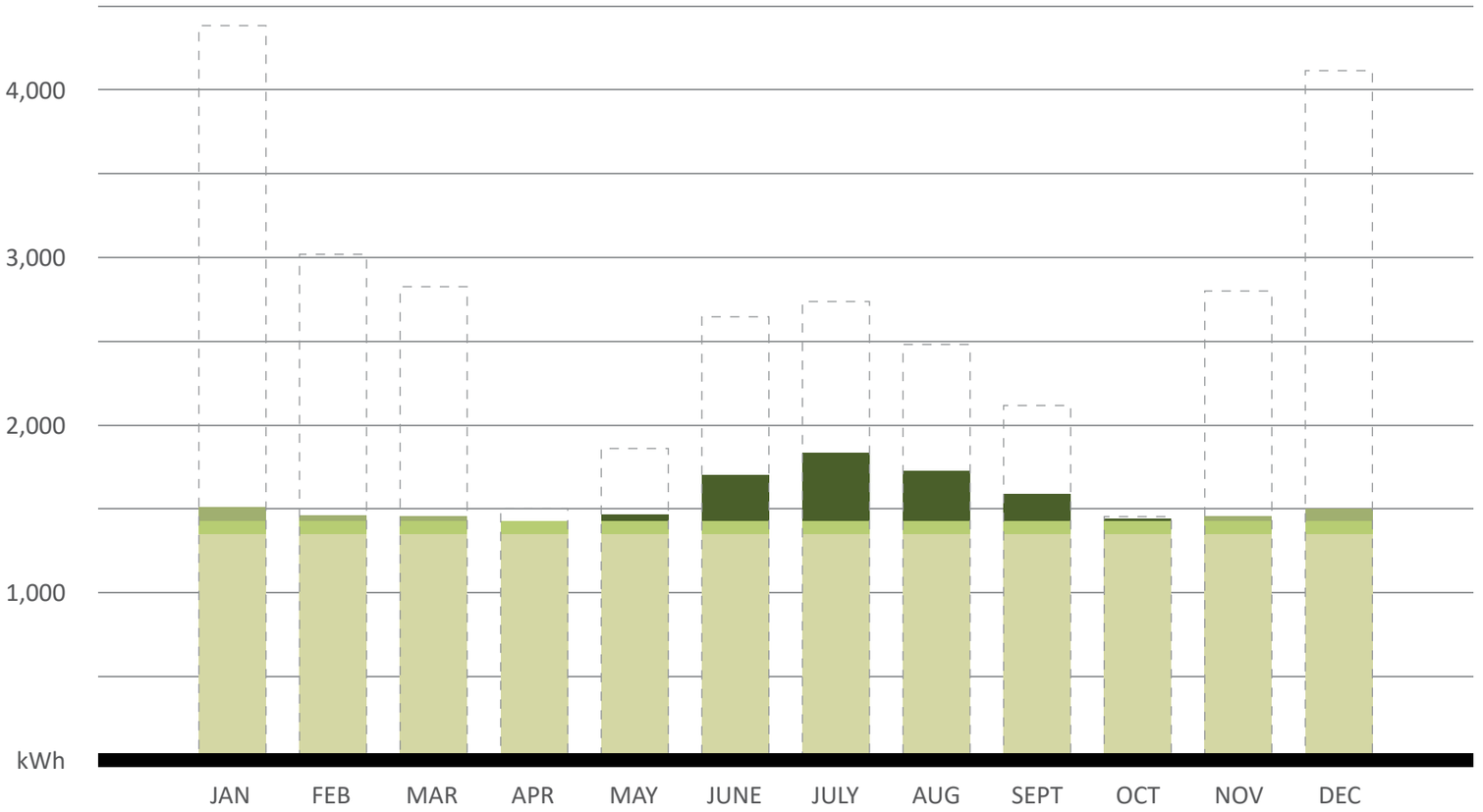
15,106 kWh

IMPROVED H/C LOAD

8,054 kWh

COOLING
HEATING
LIGHTING
APPLIANCES

ENERGY CALCULATIONS - PHASE CHANGE MATERIALS



CODE MIN. SITE LOAD

31,943 kWh

IMPROVED SITE LOAD

18,265 kWh

CODE MIN. H/C LOAD

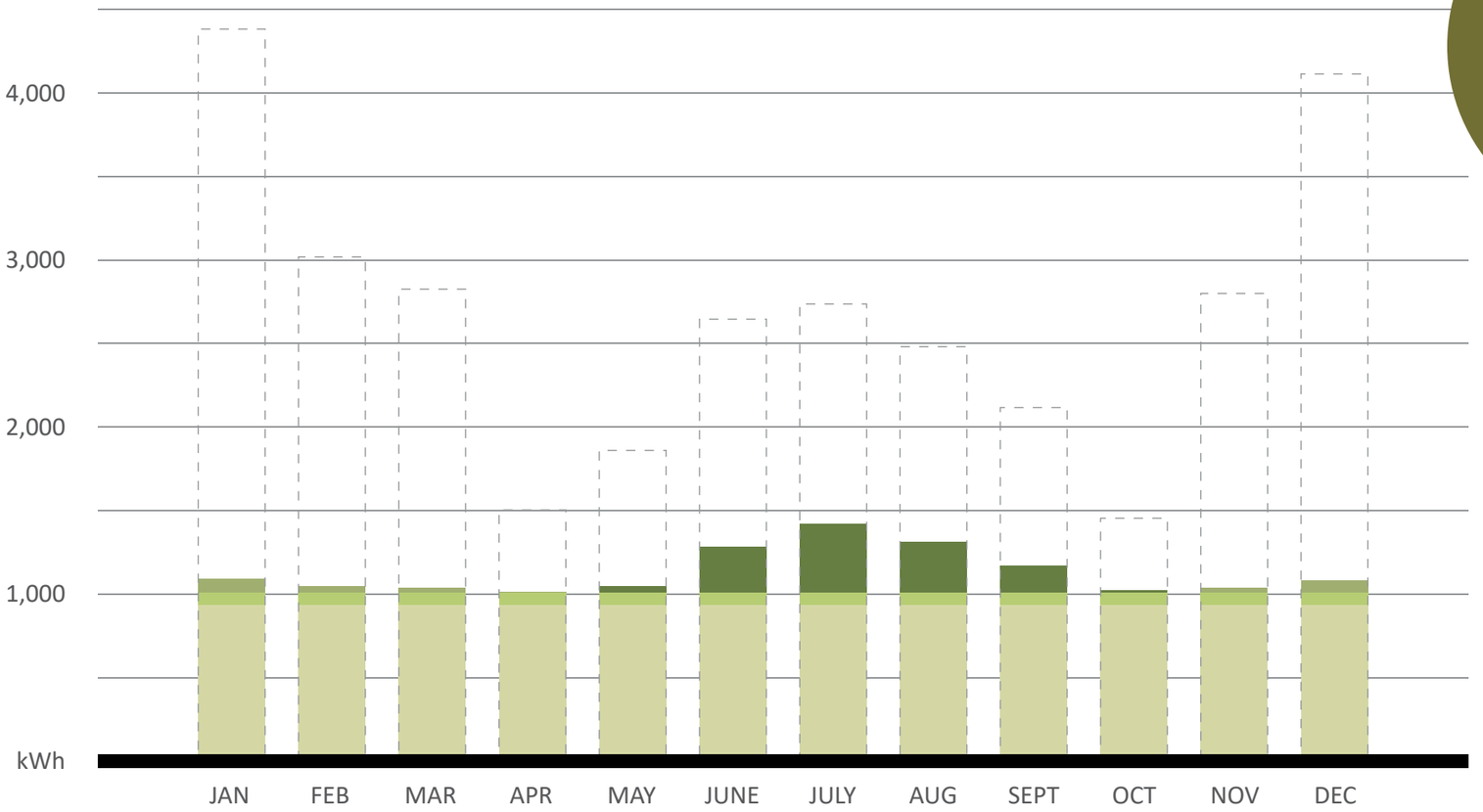
15,106 kWh

IMPROVED H/C LOAD

1,434 kWh

COOLING
HEATING
LIGHTING
APPLIANCES

ENERGY CALCULATIONS - SYSTEMS



32
HERS SCORE
BEFORE SOLAR

CODE MIN. SITE LOAD
31,943 kWh

IMPROVED SITE LOAD
13,554 kWh

CODE MIN. H/C LOAD
15,106 kWh

IMPROVED H/C LOAD
1,434 kWh

COOLING
HEATING
LIGHTING
APPLIANCES

ENERGY CALCULATIONS - SOLAR

5
HERS SCORE
AFTER SOLAR

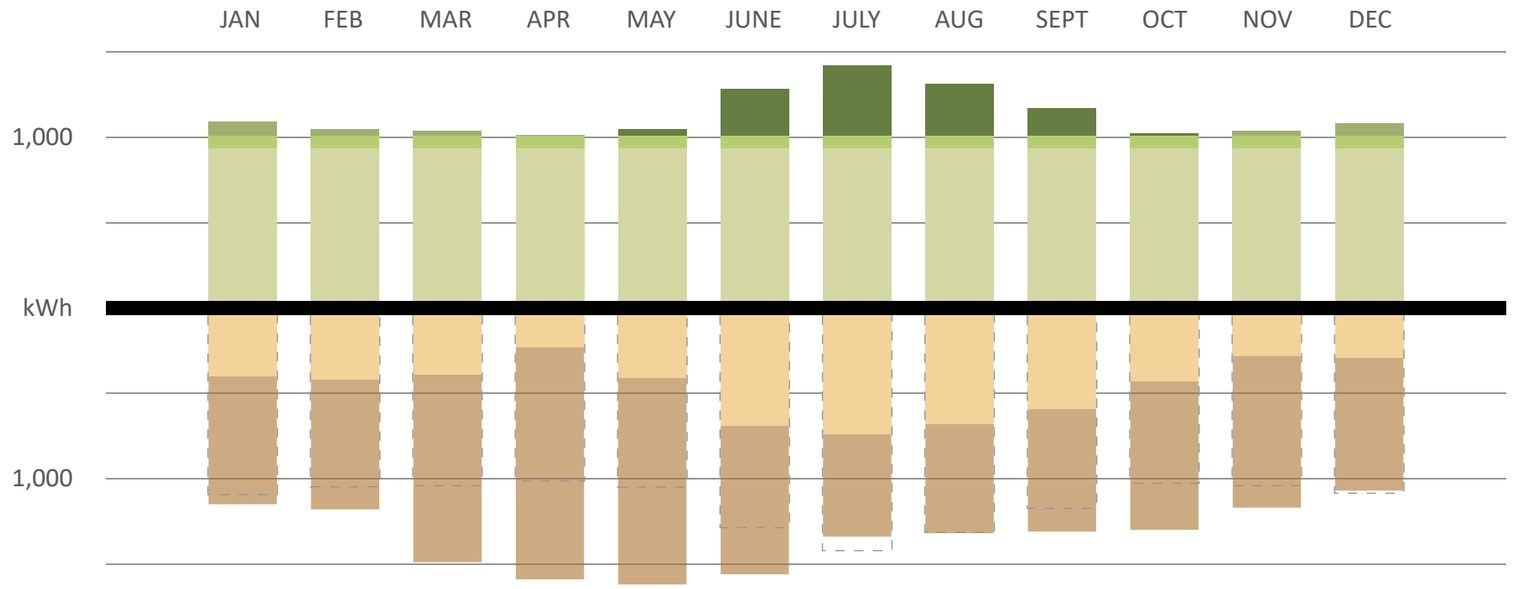
SOLAR PRODUCTION
16,100 kWh

CODE MIN. SITE LOAD
31,943 kWh

FINAL SITE LOAD
13,554 kWh

DIRECT SOLAR
5,550 kWh

SOLAR EXPORTS
10,550 kWh



CONSTRUCTION COST

COST MINIMIZING MOVES

- WOOD FRAME CONSTRUCTION
- ADVANCED WOOD FRAMING
- PREFABRICATED WALL MODULES
- CELLULOSE INSULATION
- HIGH PERFORMING SYSTEMS

$123

COST PER SQUARE FOOT

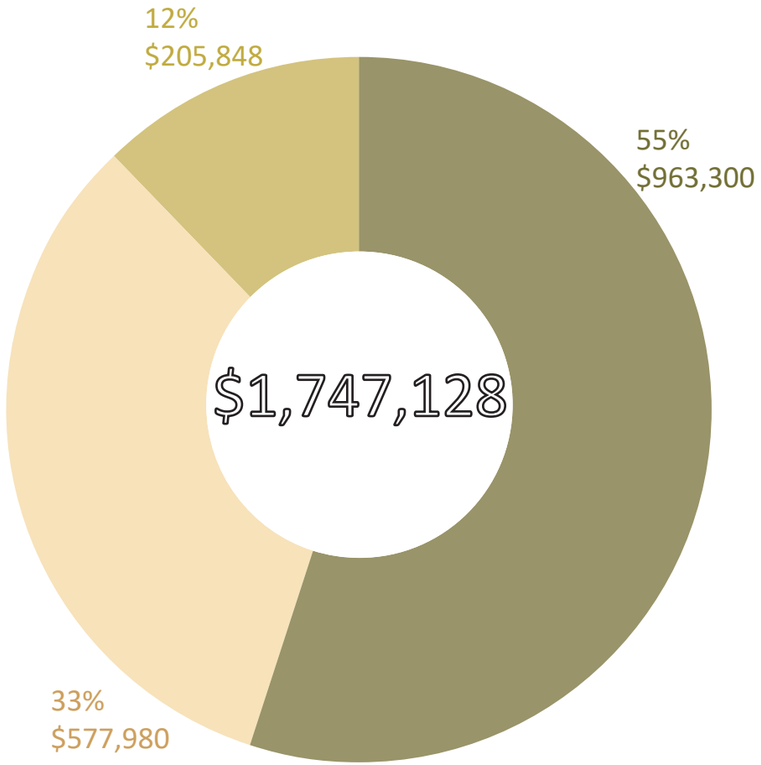
CONSTRUCTION COST SUMMARY

ACCOUNTING FOR MATERIALS AND LABOR

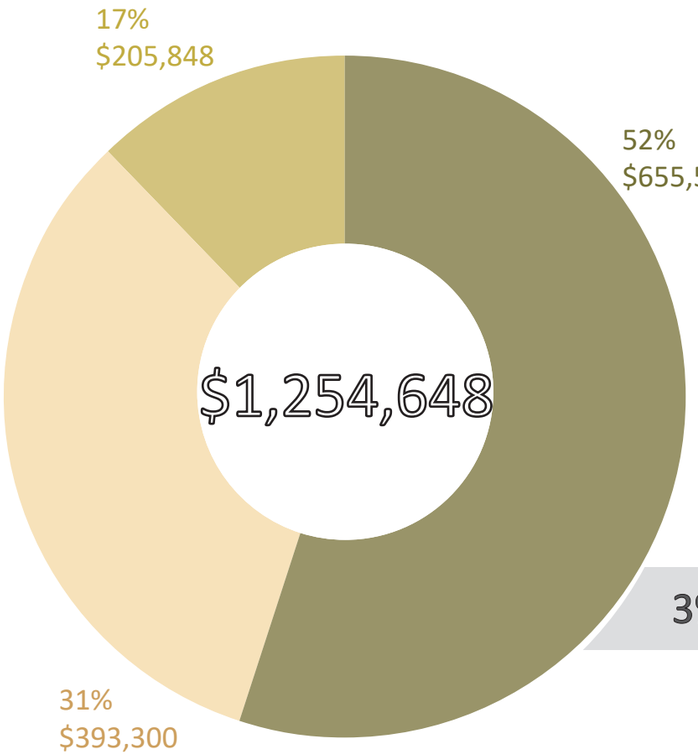
SITE WORK	$10,652.20
FOUNDATION WORK	$33,389.40
ASSEMBLY	$233,260.28
EXTERIOR FINISHES	$68,064.00
INTERIOR FINISHES	$121,199.80
APPLIANCES	$54,044.40
SYSTEMS	$191,402.90
SOLAR	$16,009.00
TOTAL	**$728,021.98**

30-YEAR LIFE CYCLE COST

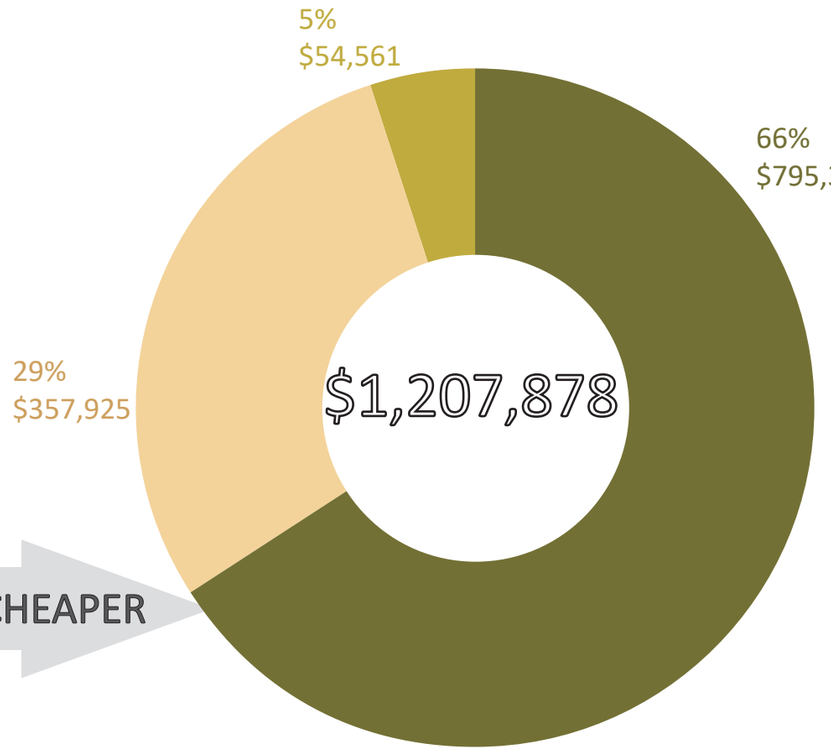
AFFORDABLE-HIGH
$150/SF



AFFORDABLE-LOW
$100/SF



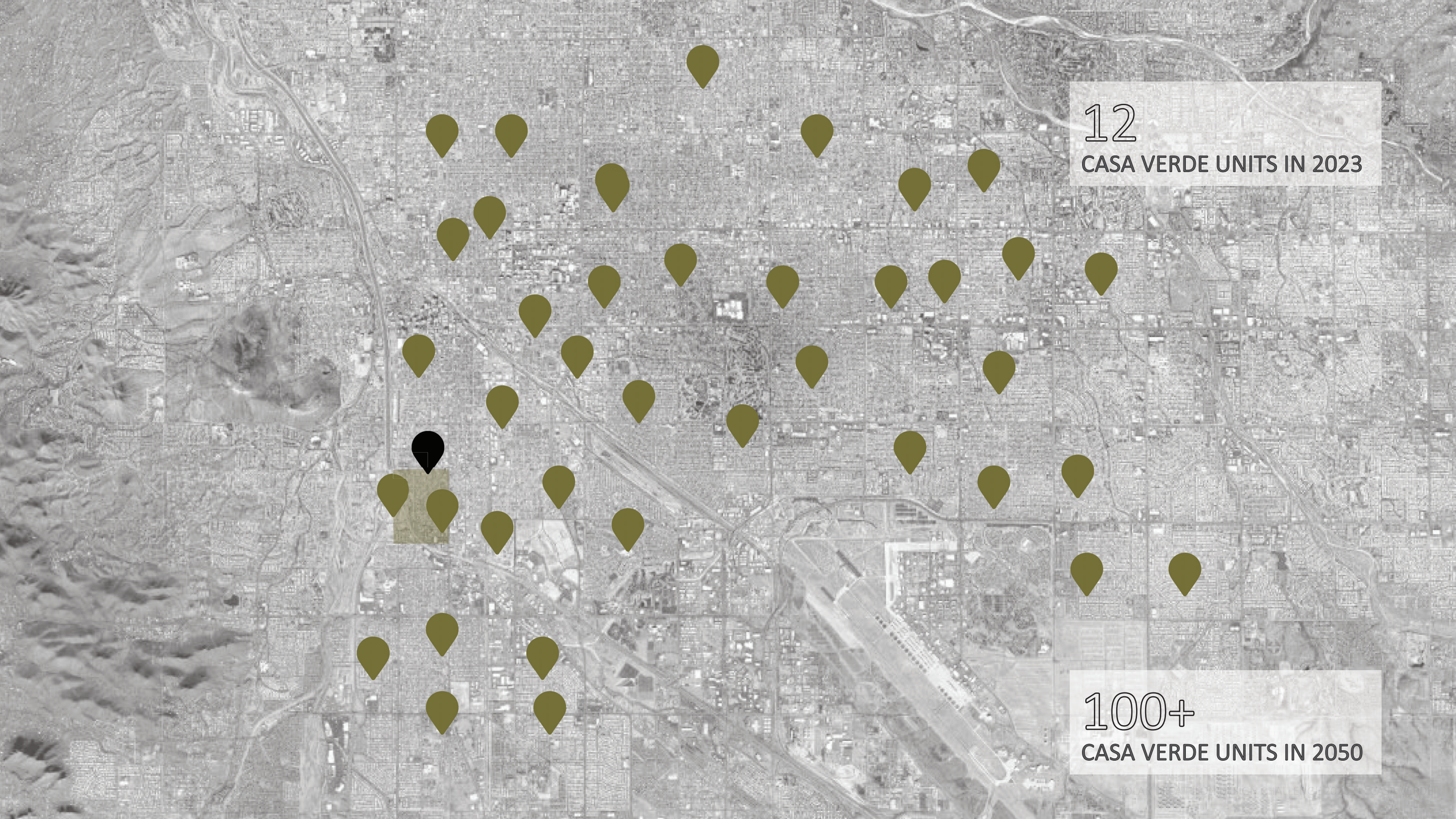
CASA VERDE
$123/SF

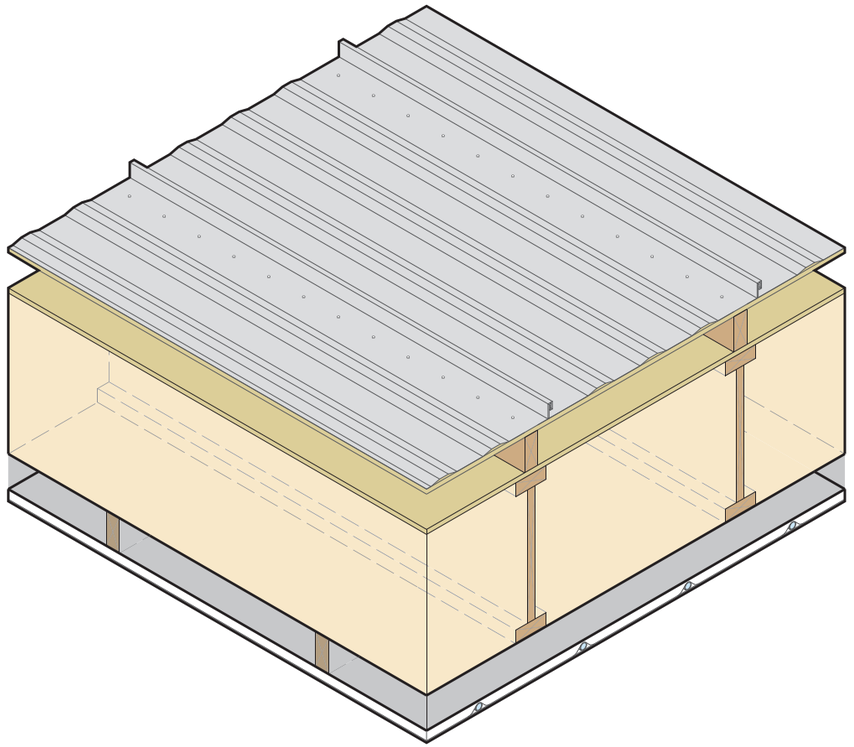


3% CHEAPER

30% CHEAPER

- INITIAL BUILDING COST
- 30-YEAR MAINTENANCE COST
- 30-YEAR UTILITY COST


12
CASA VERDE UNITS IN 2023
100+
CASA VERDE UNITS IN 2050



R-70.5 → R-58.4

220 kW
ANNUAL SOURCE ENERGY INCREASE

$4.34
ANNUAL PROJECT ENERGY COST INCREASE

$0.06
MONTHLY UNIT ENERGY COST INCREASE

$10-15
CONSTRUCTION COST SAVED PER SF

CASA VERDE

"MAKING LIVING SUSTAINABLE FOR ALL"

FRIJOLES VERDE| UNIVERSITY OF ARIZONA | ATTACHED HOUSING | SOLAR DECATHLON DESIGN CHALLENGE 2023