25 MIN PRESENTATION

U.S. DEPARTMENT OF ENERGY RACE TO ZERO
2016 STUDENT DESIGN COMPETITION
PHILADELPHIA UNIVERSITY
TEAM EMERGENCE

House II

None of our success would have been possible without the countless hours, energy and resources the following people have contributed:

John Hubert, Matt Otricelli, Shawn Connell, Vince Lombardi, Andrew Hart, Joe Andracchio, Nicholas D'Ottavio, Bob Tracy, Don DiValerio, Ron Celentano, Barbara Klinkhammer, James Dorefler, Terry Ryan, Sara Miller

TEAM PROFILE

MULTI-DISCIPLINARY TEAM

SHAWN HALE
Bachelors of Architecture

Team Leader & Architectural Design

RONNIE ALLEY
Bachelors of Science in Graphic Design Communications

Graphics Consultant

JOHN MATERA
Bachelors of Science in Construction Management

Cost Analysis & Material Specifications

JON CLAUDIO
Bachelors of Science in Construction Management

Cost Analysis & Material Specifications

JOHN HUBERT
AIA

Faculty lead

INDUSTRY PARTNERS

UNDERSTANDING THE BUILDING INDUSTRY

FLATIRON BUILDING COMPANY
CONSTRUCTION MANAGEMENT

Budgeting and Construction Management Advising

MAGRAN ASSOCIATES
ENERGY/BUILDING CONSULTING

Energy and Sustainability Consulting

CELENTANO ENERGY SERVICES
SOLAR INDUSTRY CONSULTANT

Renewable Energy Consultant

TOTAL CONSTRUCTION INC
CONSTRUCTION MANAGEMENT

Budgeting and Construction Management Advising

JOHN HUBERT ASSOCIATES
CONSTRUCTION MANAGERS AND BUILDERS

Design Consultation

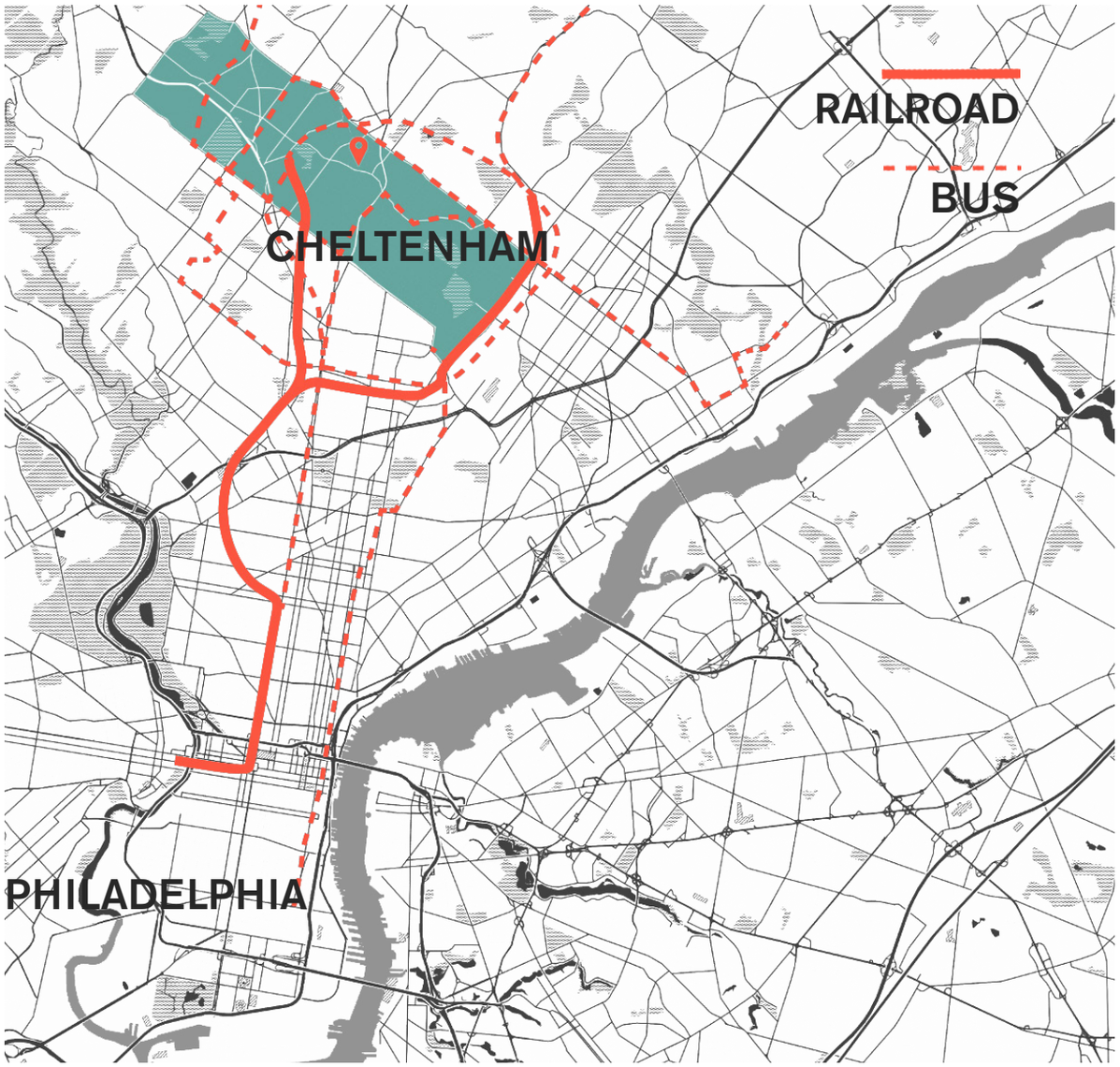
NEIGHBORHOOD ANALYSIS

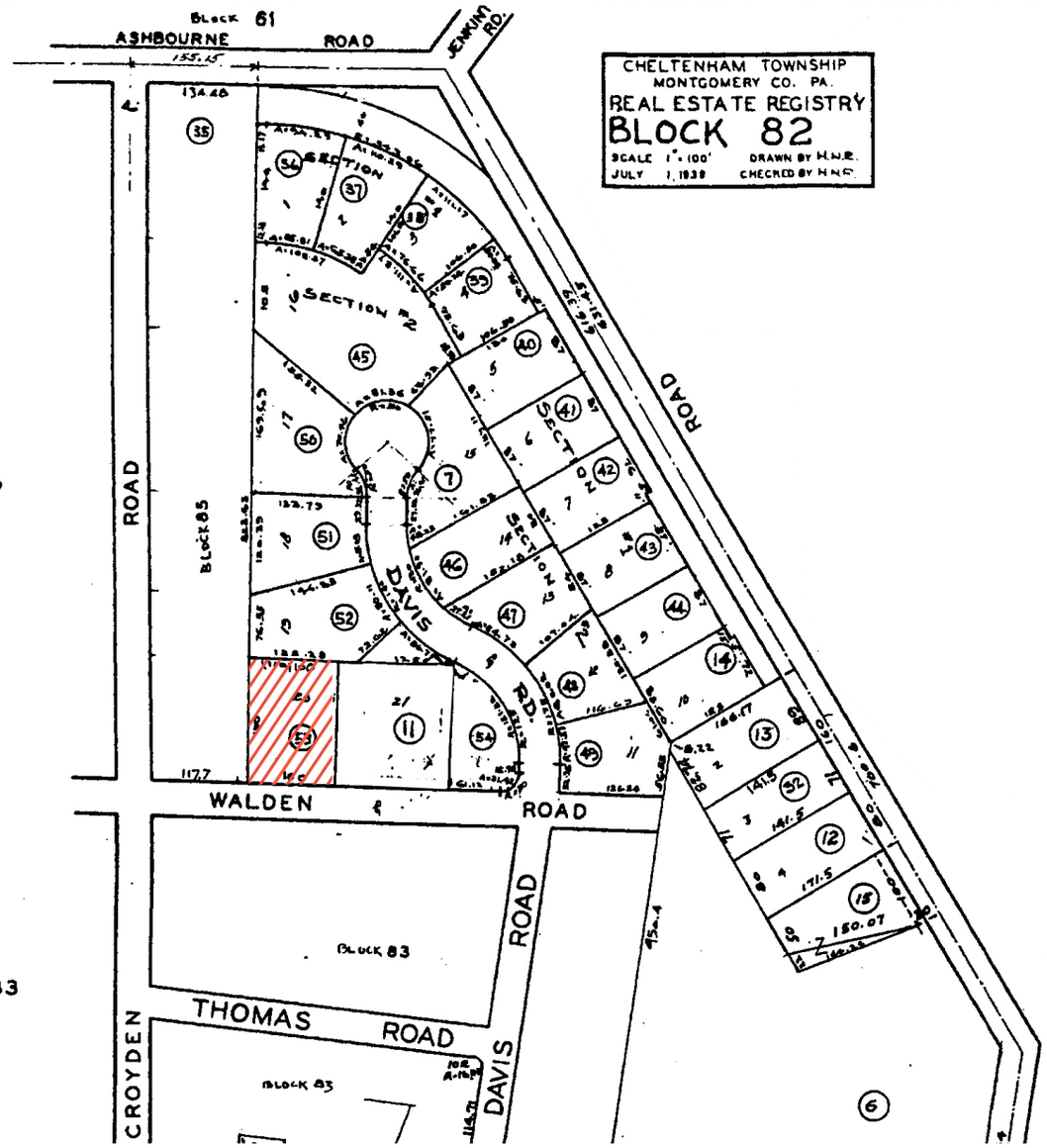
CHELTENHAM, PENNSYLVANIA

POPULATION
37,024

DENSITY
4,628 people / sq mi

TRANSPORTATION
Connected to the SEPTA transportation network by 5 train stations serving 5 different train lines and13 bus routes all connecting the neighborhood to Philadelphia.





INTENDED RESIDENTS

FLEXIBLE FOR A VARIETY OF HOMEOWNERS

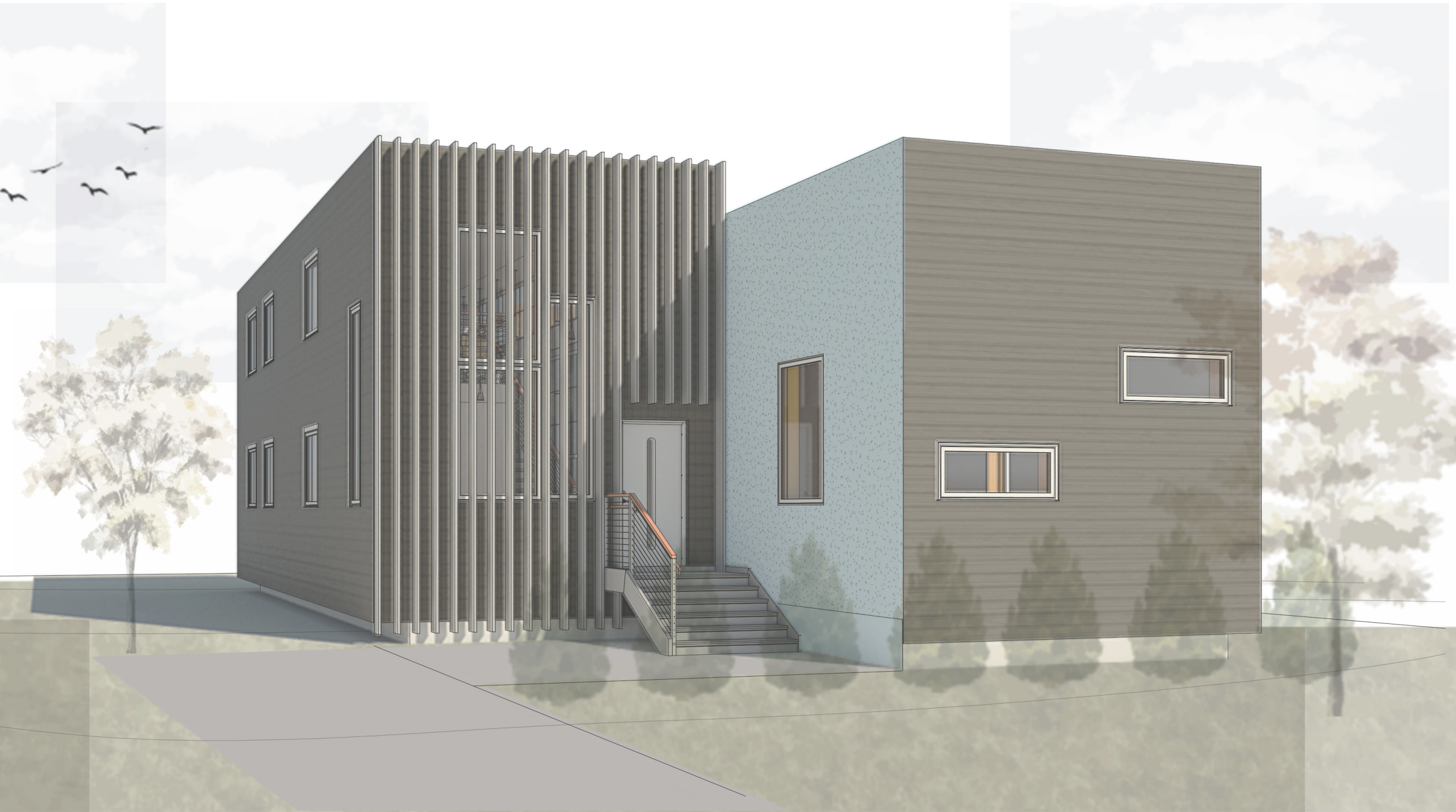
NUCLEAR FAMILY
Income: $80,000/yr
Size: 2 adults, 2 child

RETIRED COUPLE
Income: $65,000/yr
Size: 2 adults

YOUNG PROFESSIONAL
Income: $55,000/yr
Size: 1 adult

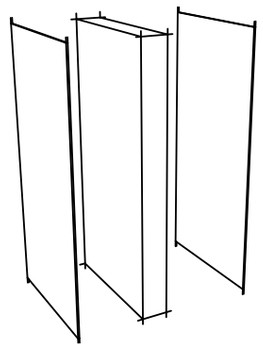
ARCHITECTURAL DESIGN

DESIGNING AT MULTIPLE SCALES



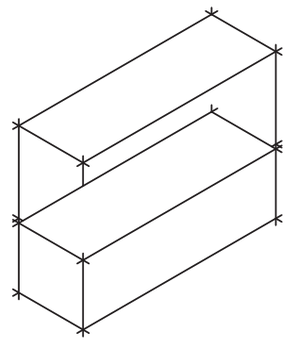
DESIGN GOALS

ARCHITECTURAL FRAMEWORKS



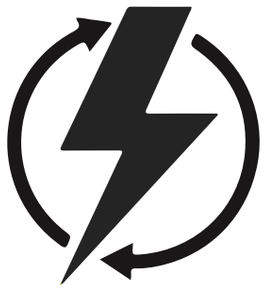
PANELIZATION

Framework for design



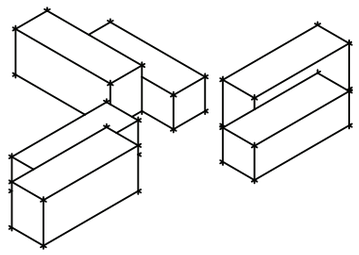
SUSTAINABILITY

A necessary response



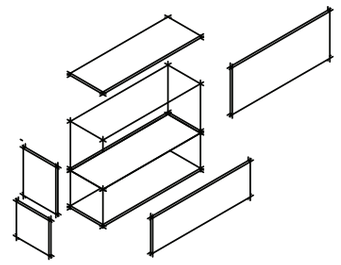
ENERGY

Reducing consumption at multiple scales



CLUSTERING

Fostering a sense of community



STRUCTURE

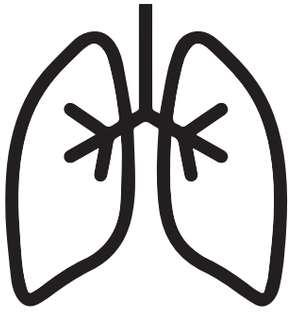
Reducing the number of components

INFILTRATION

Detail based design

RAINWATER

Addressing local concerns



AIR QUALITY

An improved indoor environment

BETTER LIVING BY DESIGN

DESIGNING FOR A CONTEMPORARY LIFESTYLE

ARCHITECTURAL FIGURES

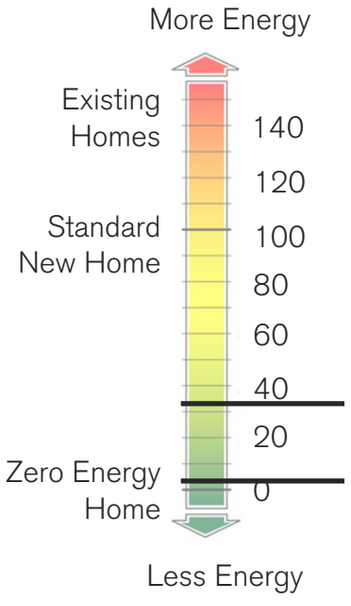
1,726 sq ft living space

3 Bedrooms

2.5 Bathrooms

$430 Monthly Utility Bill

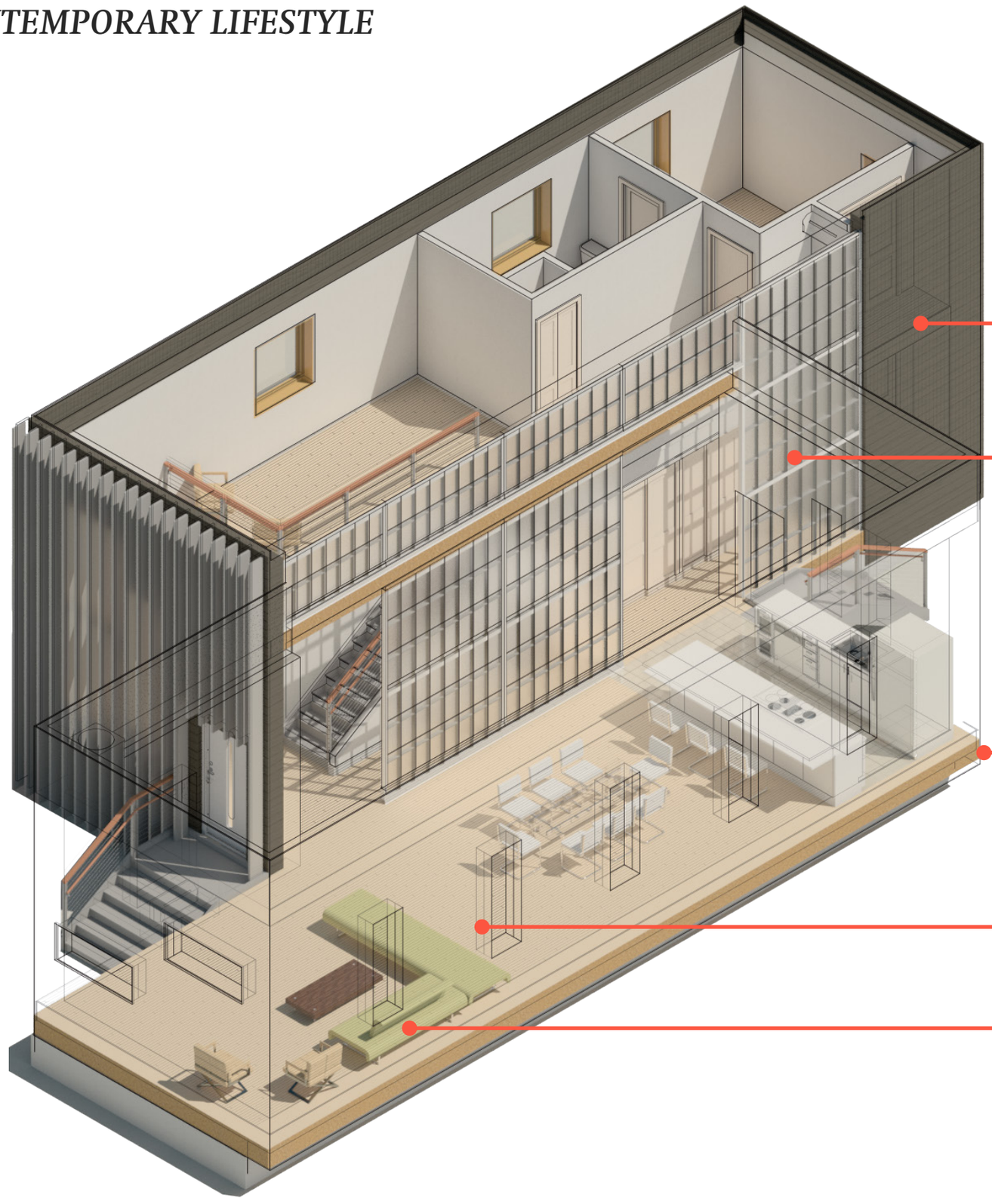
$35 per month with PV



HERS INDEX

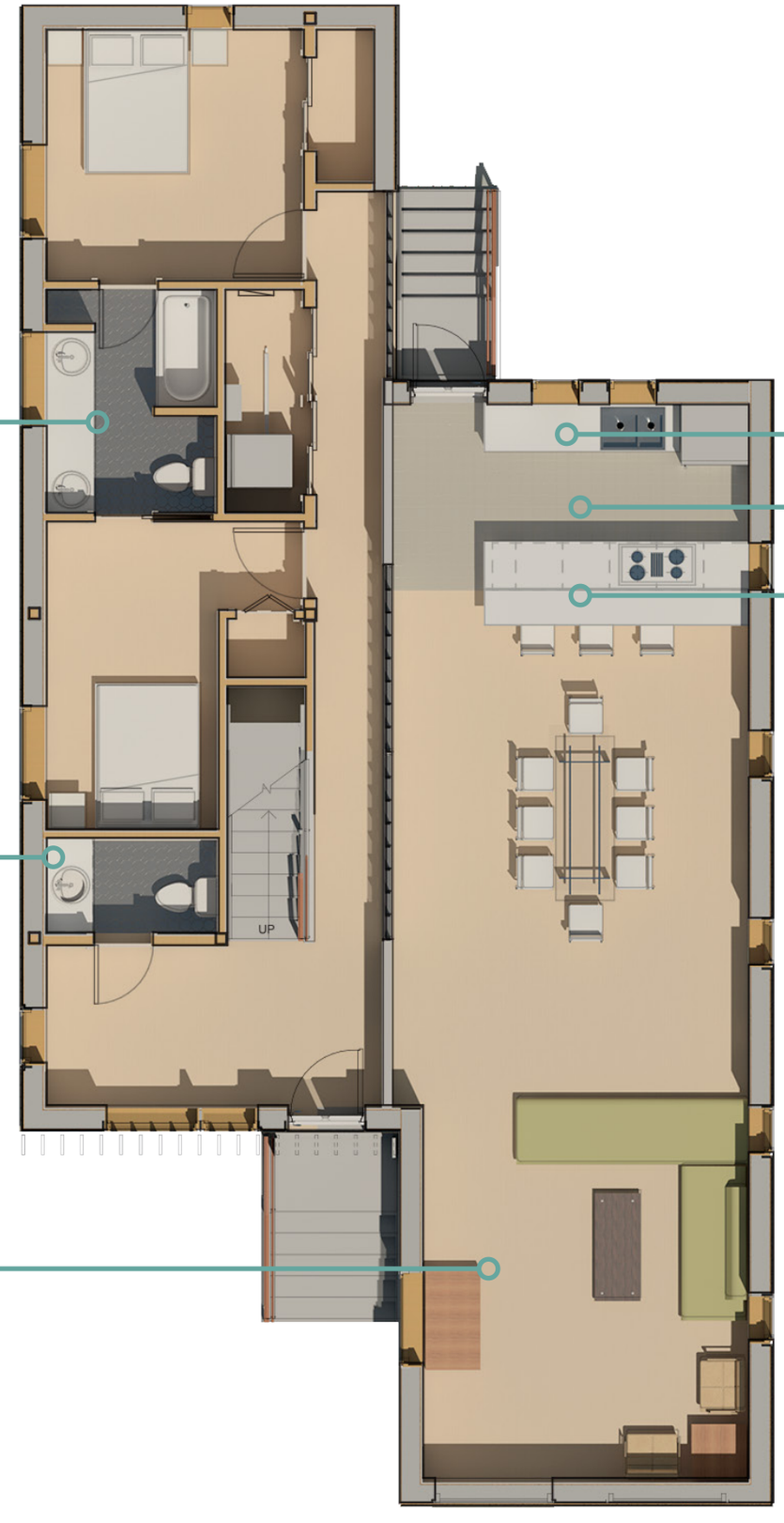
32 without pv

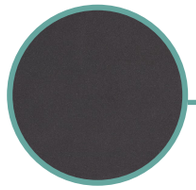
5 with 4kw array



MATERIALITY

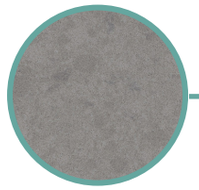
INTEGRATED SUSTAINABILITY





BATHROOM FLOORING

NERO PORCELAIN
Contains a minimum of 4% recycled content and is Green Squared Certified

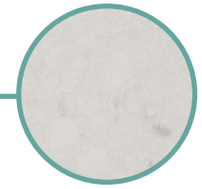


BATHROOM COUNTERTOP

PEBBLE QUARTZ
Quartz surfaces meet the most stringent indoor air emission standards.

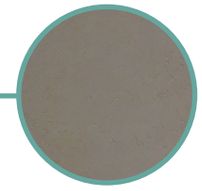
BAMBOO FLOORING

EDGE GRAIN BAMBOO
Manufactured using formaldehyde-free resins and are100% FSC Certified.



KITCHEN COUNTERTOPS

MISTY CARRERA QUARTZ
Quartz provides a durable, sustainable and bacteria resistant surface for the kitchen.



KITCHEN FLOORING

CEMENT GREY CORK
100% recycled; all pigments, varnishes and adhesives are water-based, solvent-free and have no VOCs.

KITCHEN BACKSPLASH

MIDNIGHT TIIKERI
Contains 50% per-consumer recycled waste and rapidly renewable sorghum straw.

CONTEMPORARY LIVING

CREATING HEALTHY, COMFORTABLE SPACE

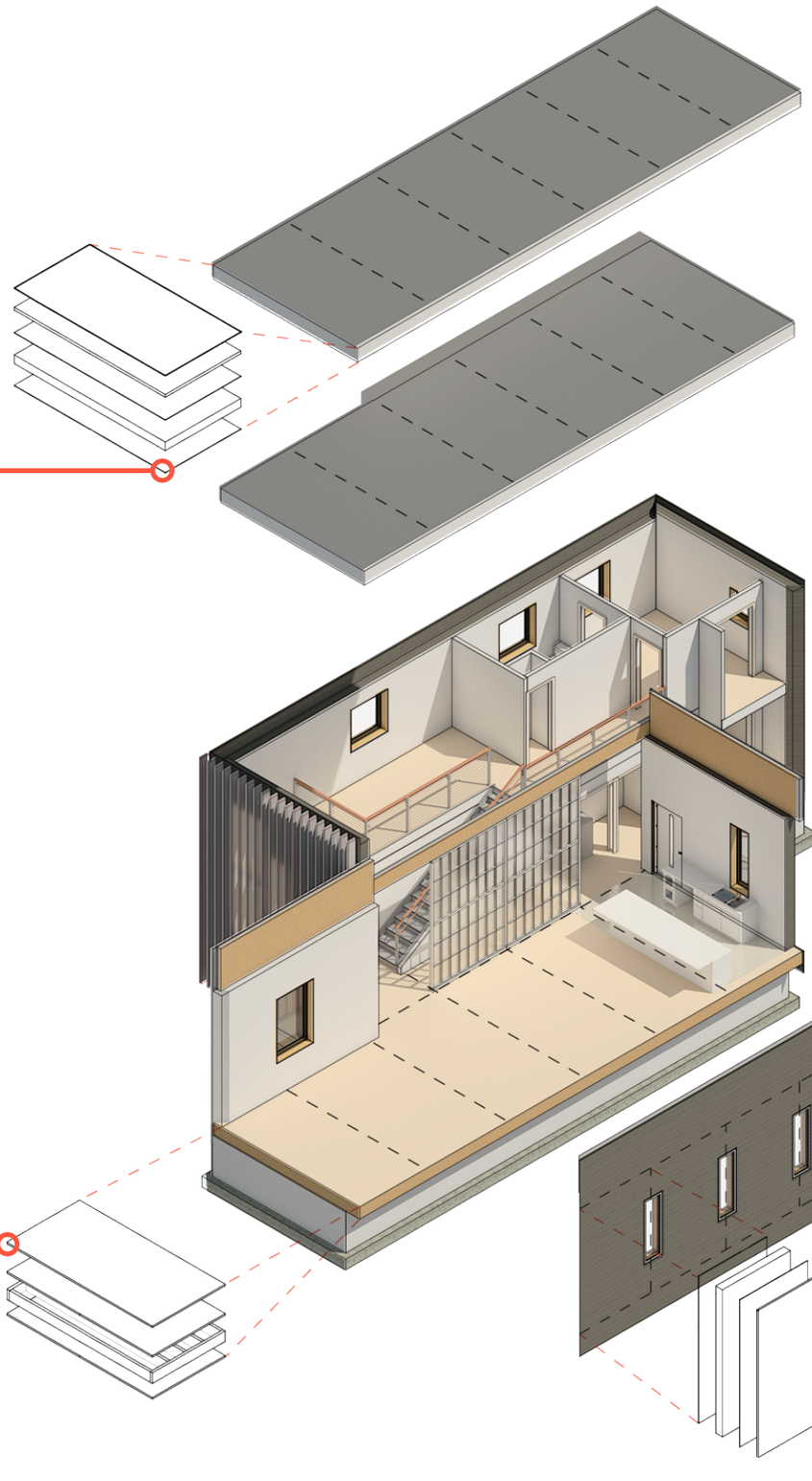
LOFTED FOYER

FLEXIBLE LAYOUT

DAYLIGHT SPACES

PREFABRICATION

REDUCING COMPONENTS
INCREASING PRECISION



SIP / EPDM ROOF PANEL R-57
EPDM Membrane
2” XPS Insulation
9 1/4” SIP Roof
1/2” GWB

TRANSLUCENT PANEL R-20
0.07” Fiber Reinforced Plastic
3 7/8” Thermally Broken I-Beam
(AeroGel Insulation)
0.07” Fiber Reinforced Plastic

TJI FLOOR PANEL R-36
Finish Floor
5/8” OSB
11 7/8” TJI Joist
11” Blown Cellulose Insulation @

SIP WALL PANEL R-44
Cedar Siding
3/4” Air Gap
9 1/4” SIP
1/2” GWB

CLUSTERING

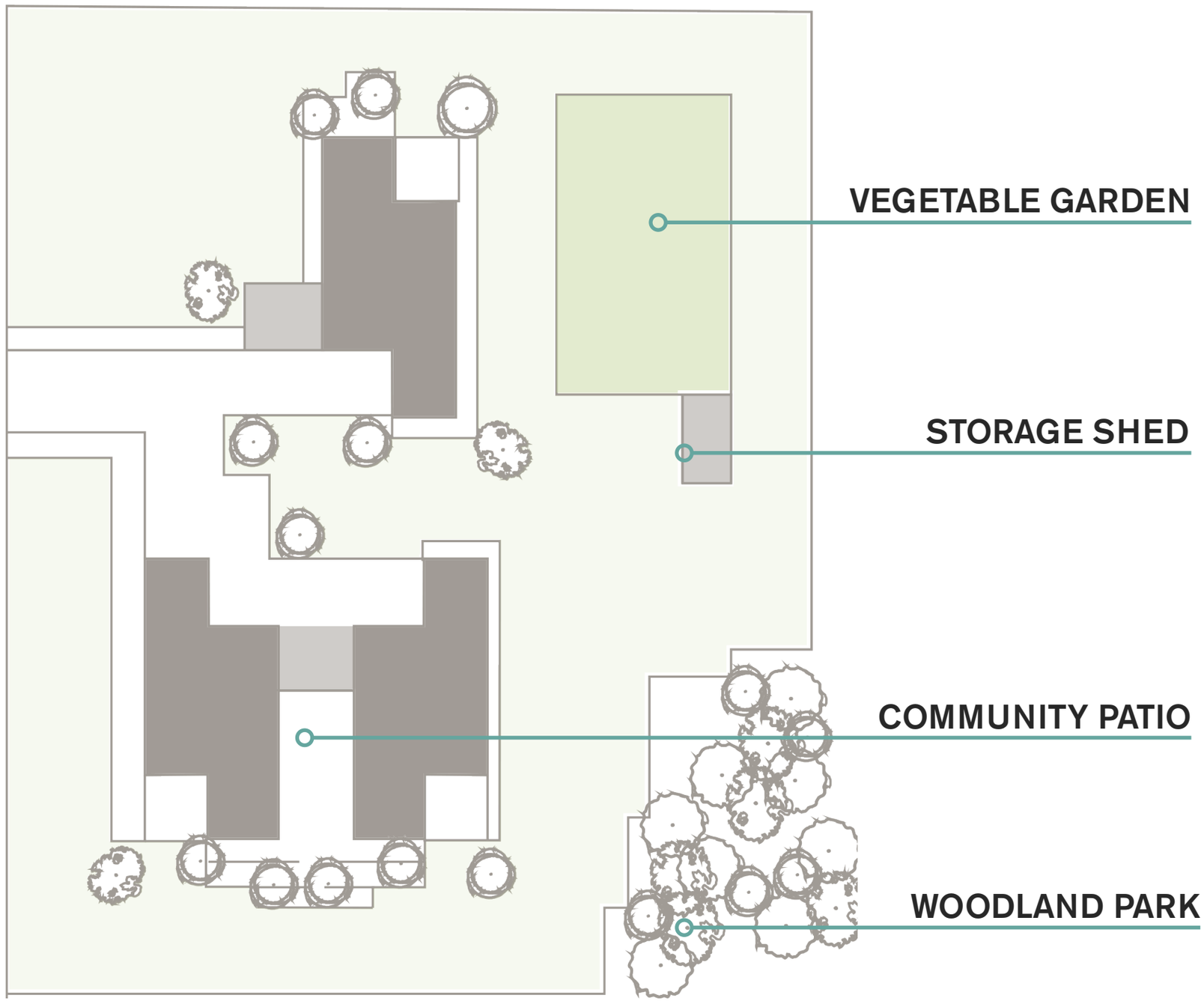
INTEGRATING SUSTAINABILITY AT A COMMUNITY SCALE

Reduces community footprint

Facilitates interaction among neighbors

Reinforces the importance of community

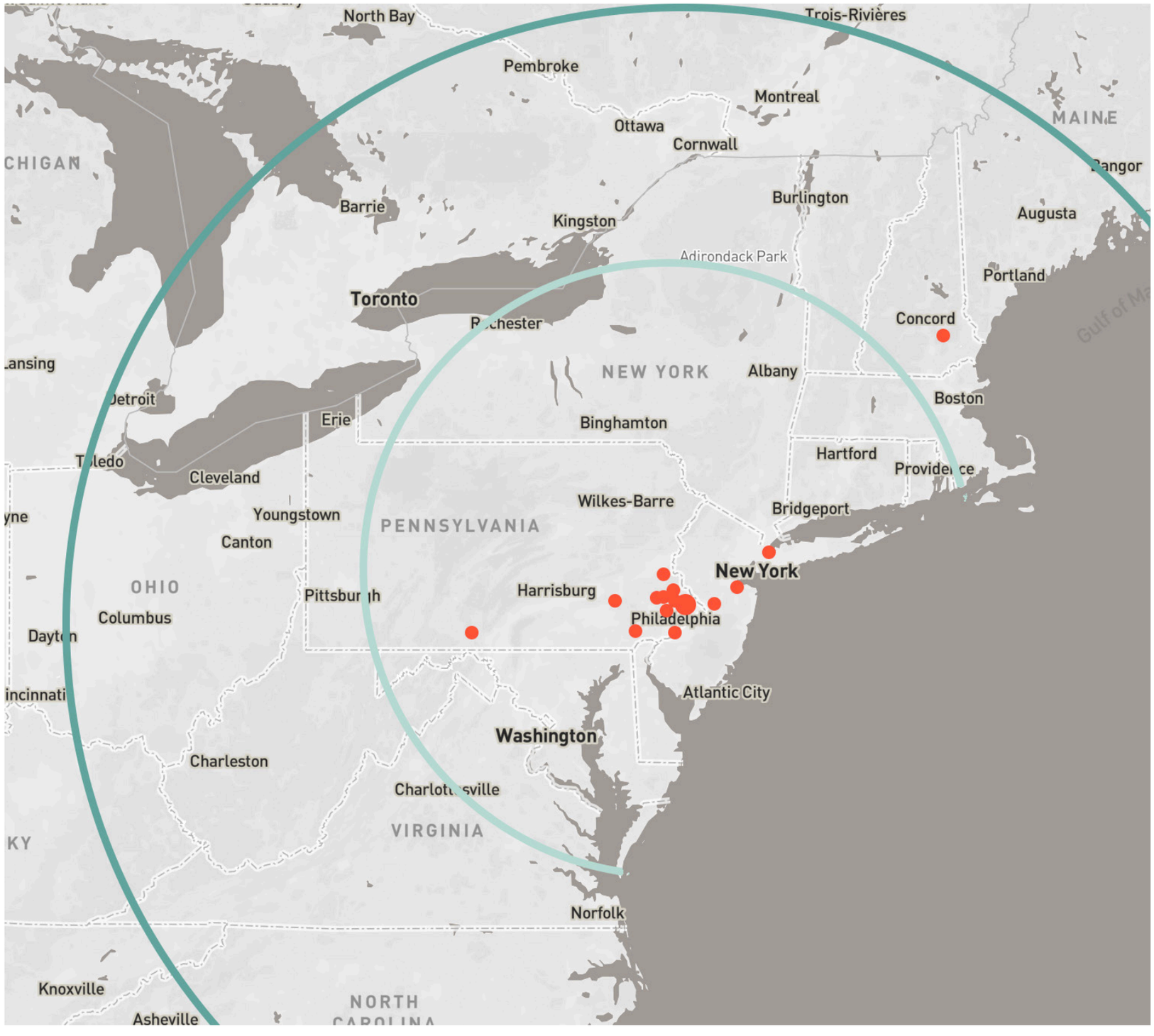
Provides space for recreation



LOCAL SOURCING

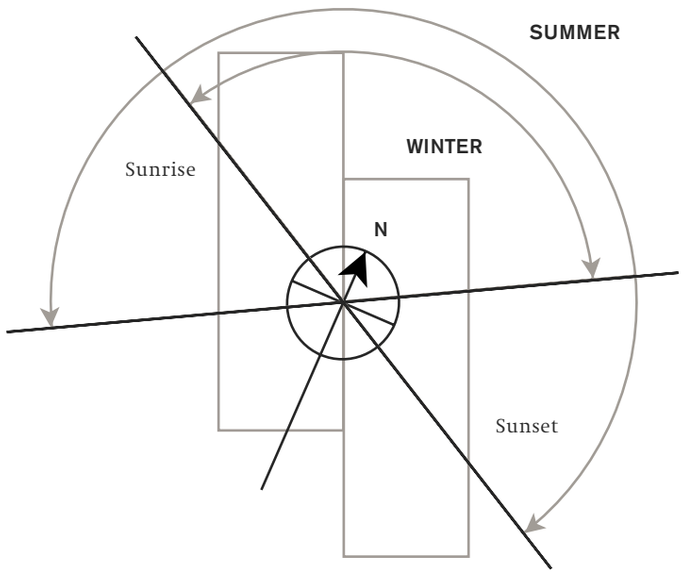
80% OF MATERIALS WITHIN 50 MILES

Material	Company	City, State	MI
SIPS	Eastern Exterior Wall Systems	Horsham, PA	10
EPDM Roofing	Jameson Roofing	Philadelphia, PA	6
KalWall	KalWall	Manchester, NH	337
Louvers	Dinario Custom	Pottstown, PA	39
Pavers	Kleinberg Landscape Design	Newtown Square, PA	29
Porous Asphalt	Seravalli Inc.	Philadelphia, PA	6
Solar	Exact Solar	Yardley, PA	27
Windows & Doors	Trevdan Building Supply	Chester Springs, PA	41
Cedar Siding	reSawn Timber Co	Telford, PA	24
Plants	Father Nature	Cherry Hill, NJ	18
Metals	Construction Technology Inc.	Cliffton Heights, PA	32
Bamboo Flooring	Ferma Flooring	Edison, NJ	15
Cork Tiles	Globus Cork	Bronx, NY	115
Porcelain Tiles	Daltile	Gettysburg, PA	105
Straw Tiles	Caragreen	Philadelphia, PA	5
Counters	Caesarstone	Perth Amboy, NJ	30



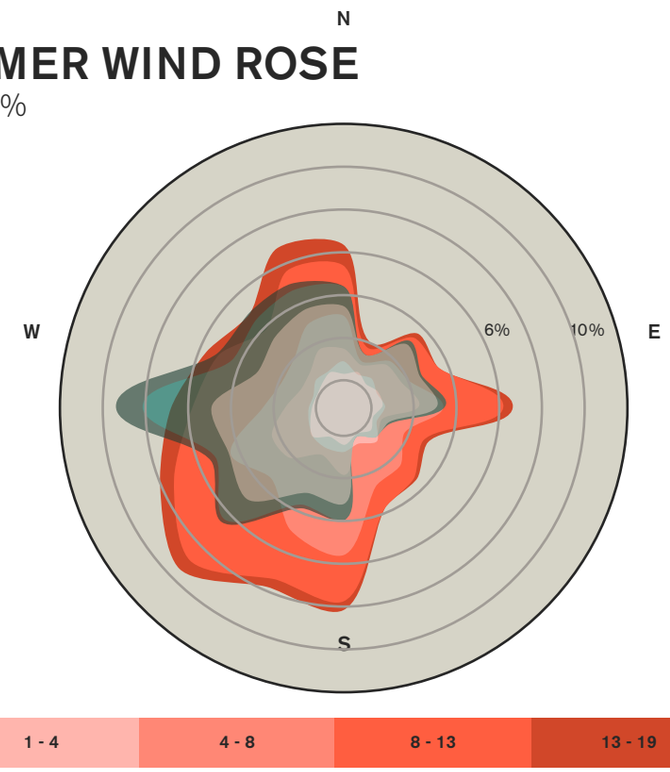
ENVIRONMENTAL ANALYSIS

40° 3’ 38.6748’’ N 75° 6’ 7.1352’’ W

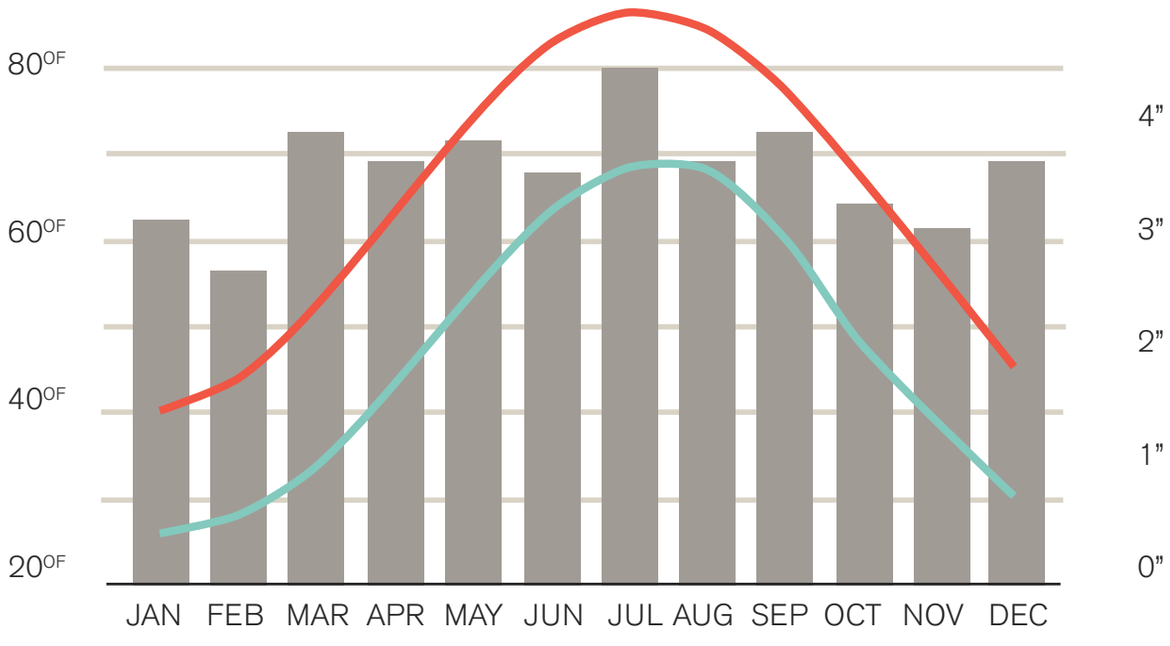


SUMMER WIND ROSE

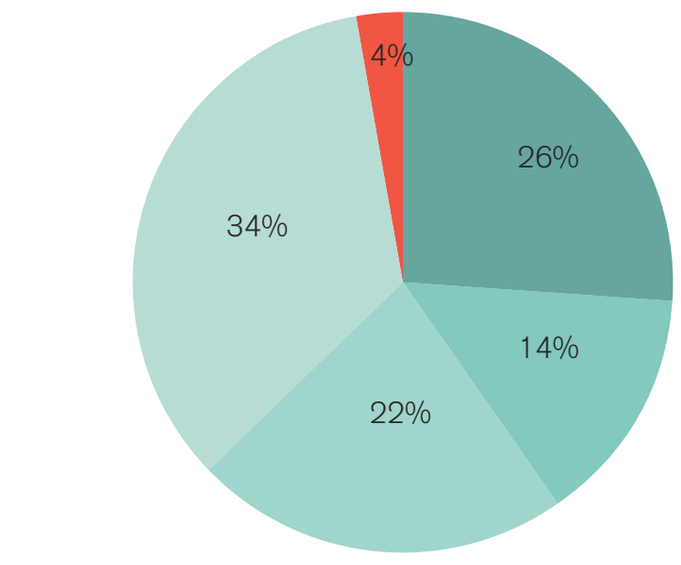
Calm 10%



PRECIPITATION & TEMPERATURE



AIR QUALITY INDEX



ENERGY ANALYSIS

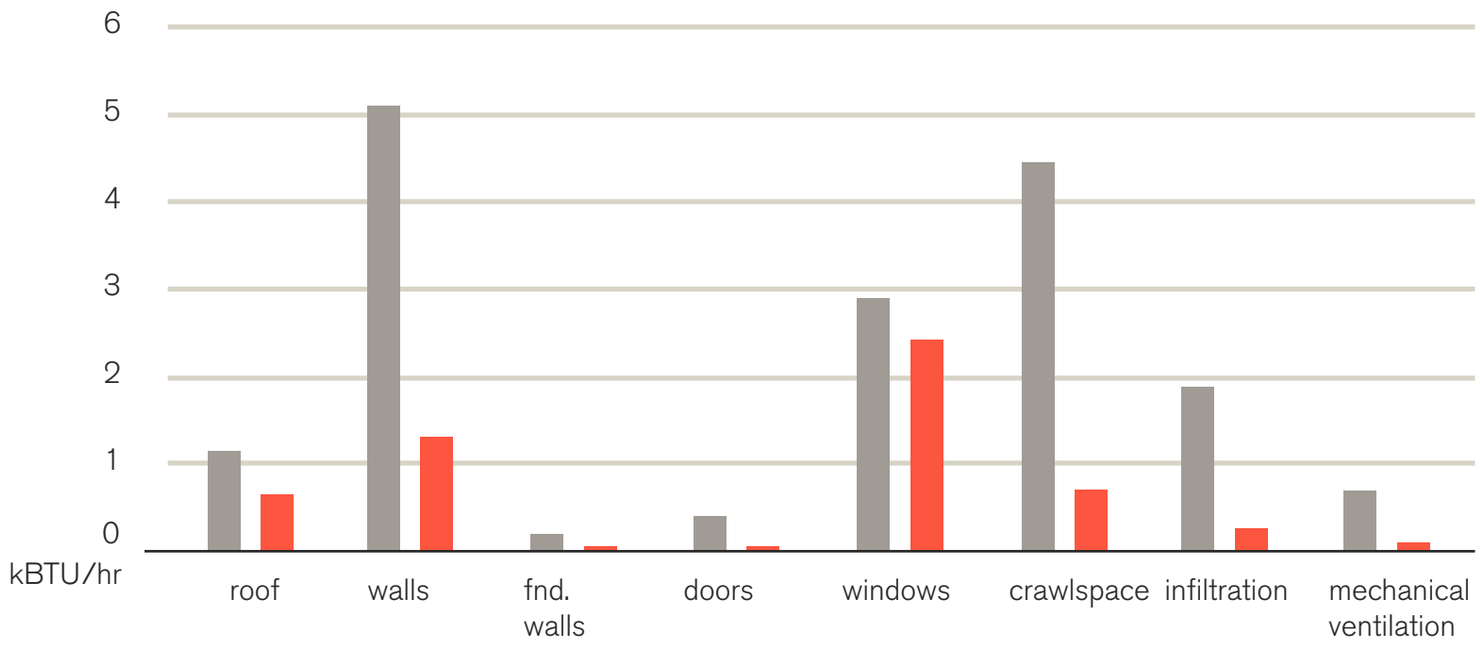
81% better than the baseline home in heating

60% better than baseline in cooling
Low air infiltration rates

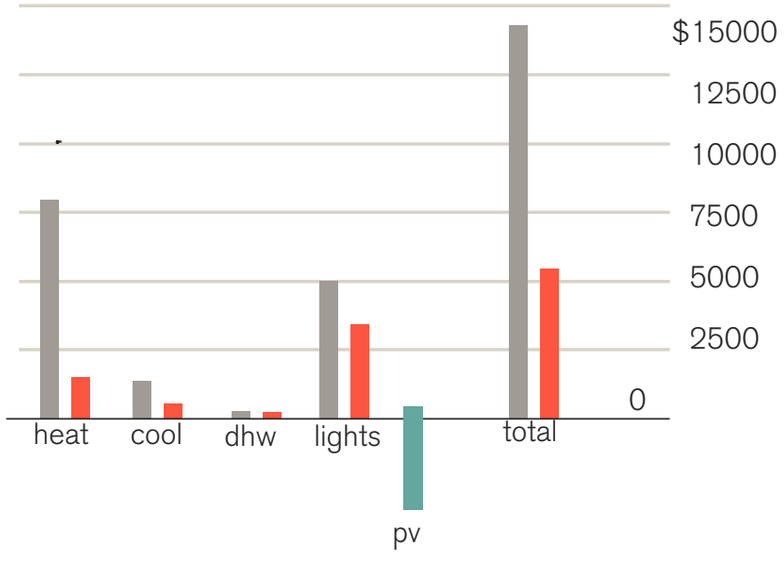
Continuous high grade insulation with SIP construction

HOUSE II
BASELINE

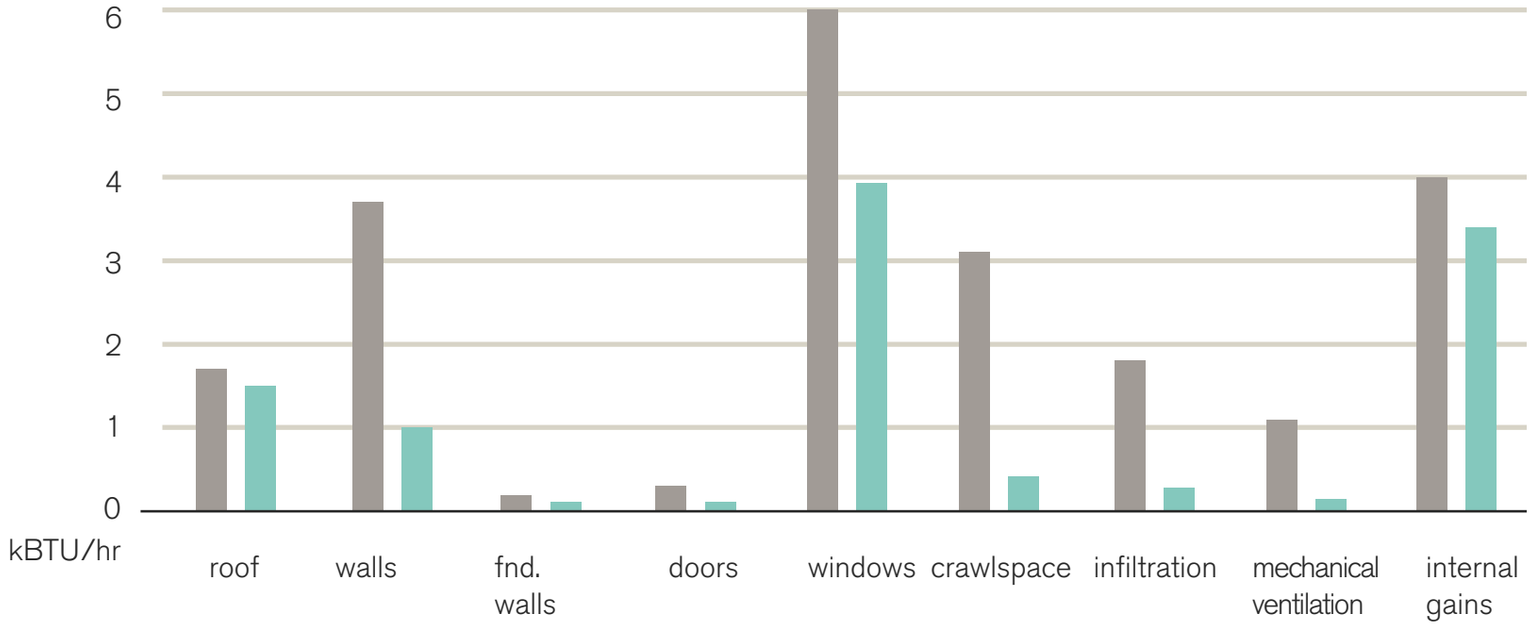
HEATING DESIGN LOADS



ANNUAL ENERGY COST



COOLING DESIGN LOADS



SOLAR ARRAY

EQUIPMENT LAYOUT

Solar is used for heating and electricity generator

Two direct solar water heater collectors with electric backup

Peak demand for a family of 4 of 48.5 gallons

4.14kw array ÷ 315w per panel

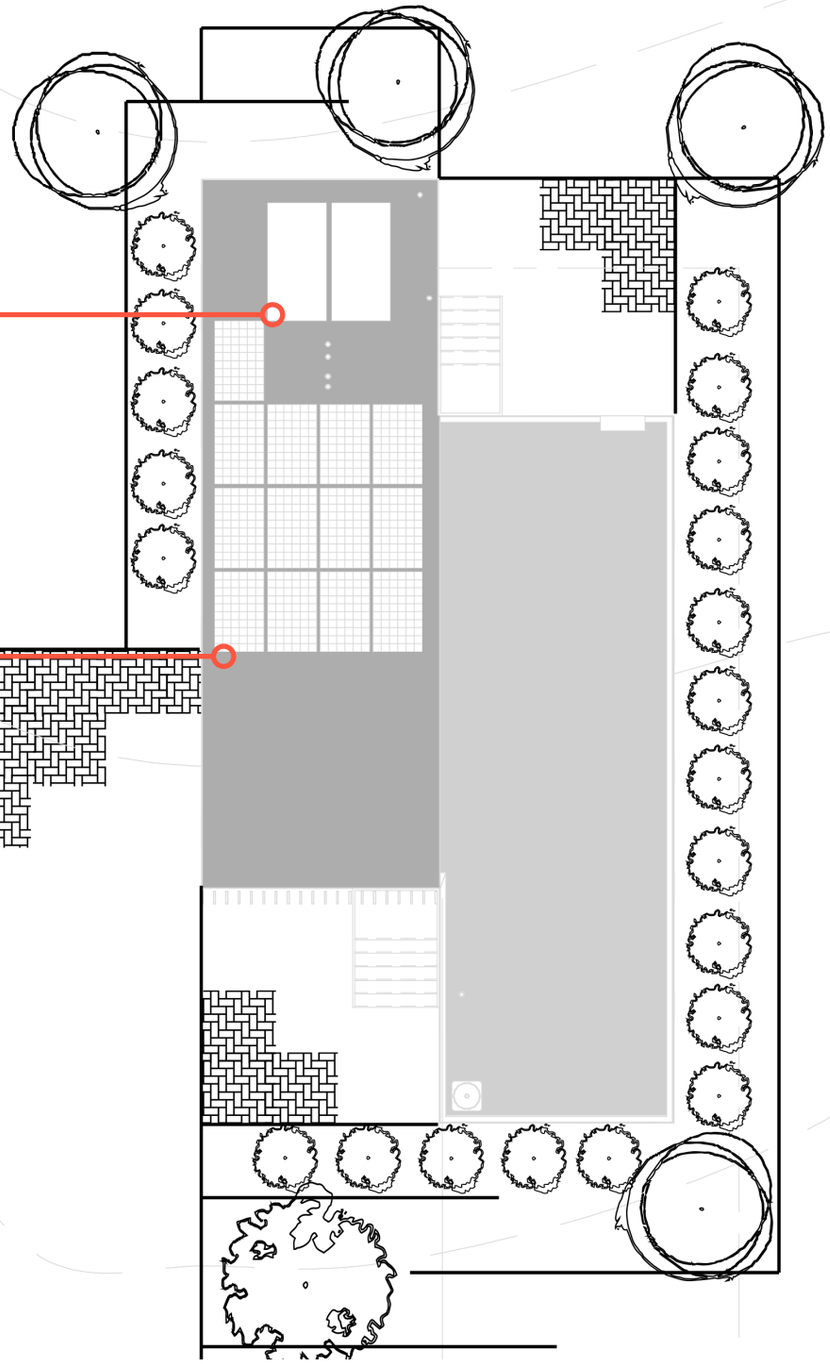
13 panel solar array

4.14kw array ÷ 315w per panel

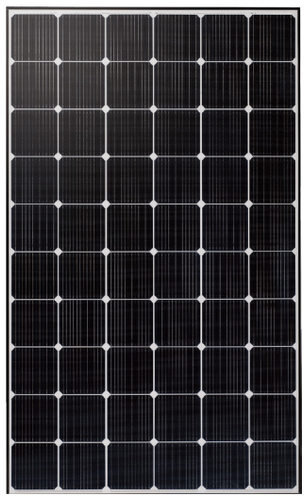
35% PA Sunshine Solar Program
30% Residential Renewable Tax Credit

CIRREX SOLAR ASSISTED WATER HEATING

LOAD MONITOR



LG 315W PANEL



POWER INVERTER

ELECTRIC LOADS

Component	MMBTU/yr	KW/yr
Heating	6.1	1,787
Cooling	2.2	644
Water	7.7	2,256
Lights	15	4,396
		9,083

INTEGRATED DESIGN PROCESS

COORDINATING LOGISTICS WHILE DESIGNING

Our team's unique composition of construction management students and professionals allowed for greater control of the construction process and coordination of project delivery.

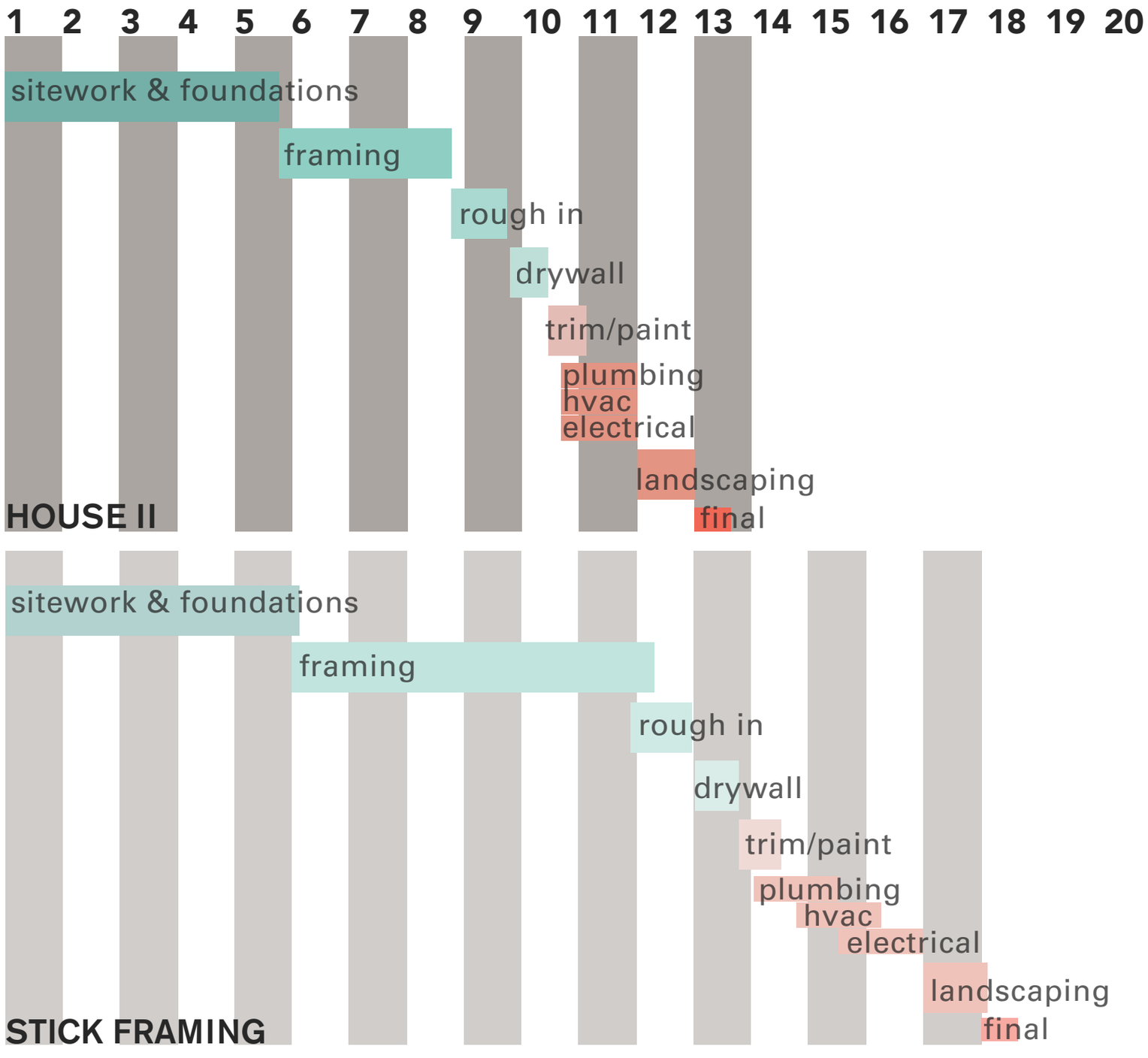
Coordination saves cost

Reduces errors and RFI's by working side by side

Stick Framing build time: 19-24 weeks

House II Build Time: 13 weeks

Faster dry in time improves indoor air quality and improved finishing



AFFORDABILITY THROUGH DESIGN

CONSTRUCTION COST ANALYSIS

INTERIOR FINISHES
$52,967

FRAMING
$31,853

FOUNDATIONS
$54,500

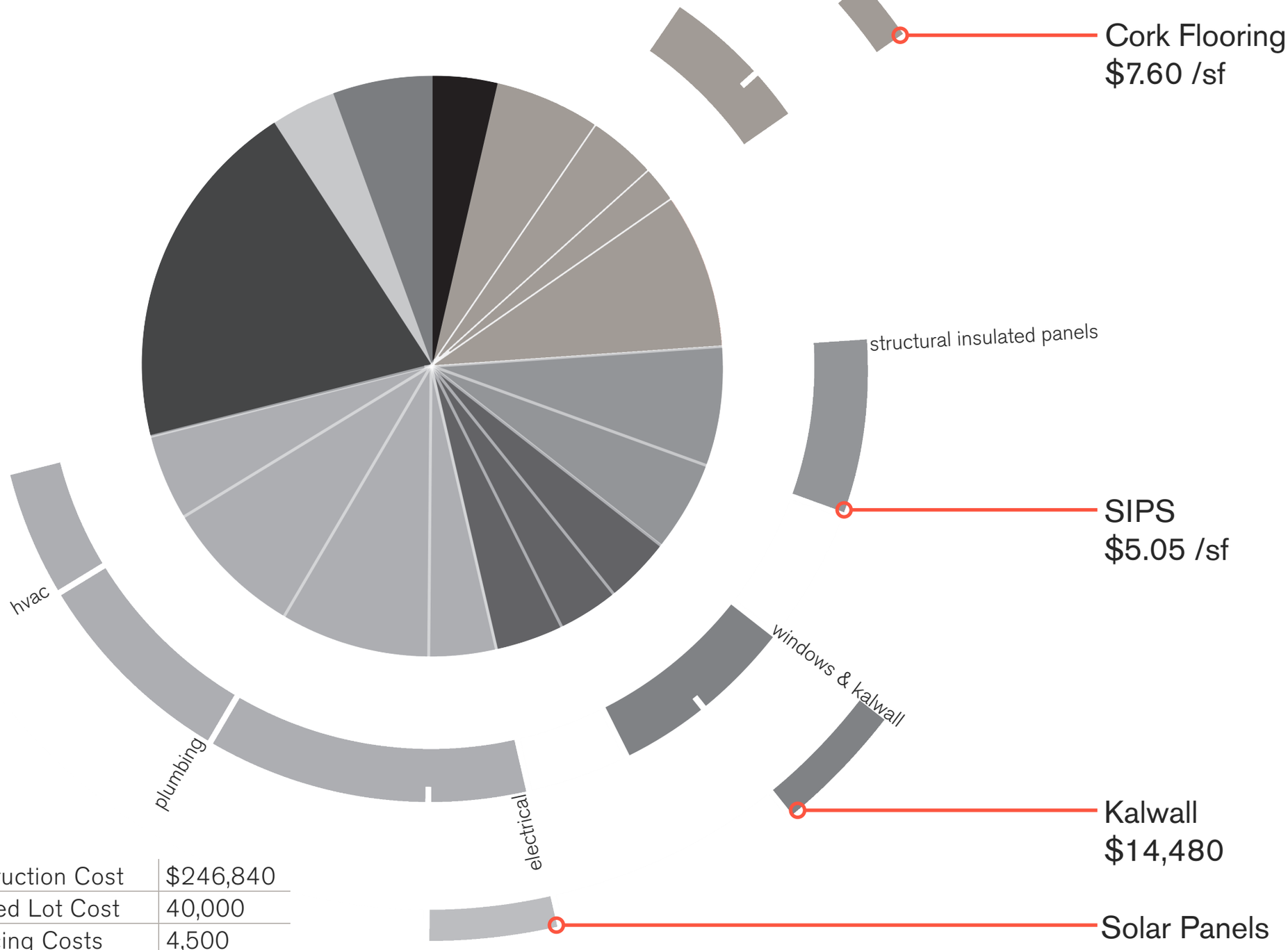
SITEWORK
$10,000

GENERAL CONDITIONS
$14,390

EXTERIOR FINISHES
$29,236

SYSTEMS
$67,095

LANDSCAPING
$9,998



Construction Cost	$246,840
Finished Lot Cost	40,000
Financing Costs	4,500
Sales Commission	6,000
Profit	12,000
Total Sale Price	**$317,340**

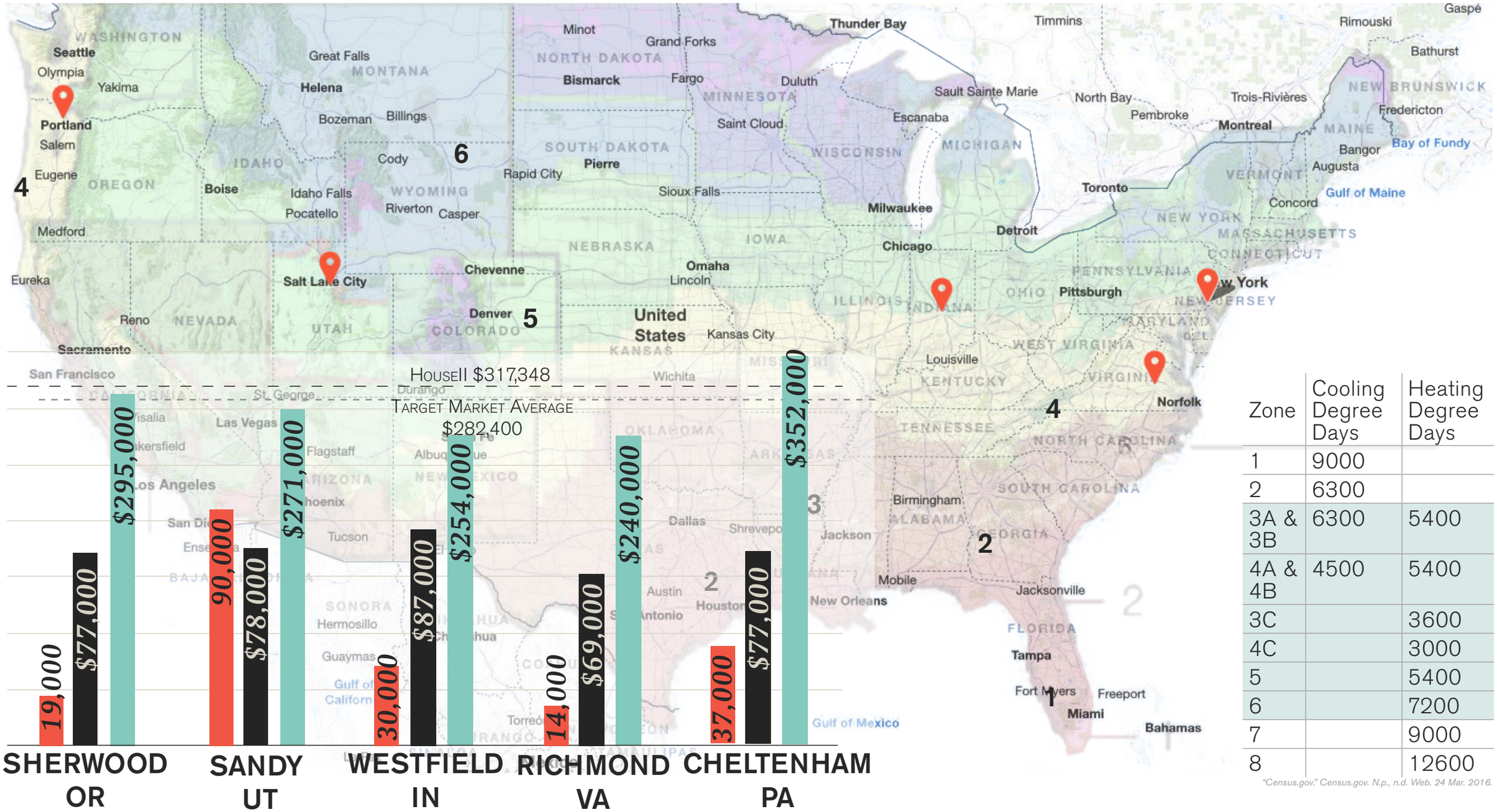
MARKET ADAPTABILITY

DESIGNED FOR A NATIONAL AUDIENCE

POPULATION

HOUSEHOLD INCOME

MEDIAN HOME PRICE



Zone	Cooling Degree Days	Heating Degree Days
1	9000	
2	6300	
3A & 3B	6300	5400
4A & 4B	4500	5400
3C		3600
4C		3000
5		5400
6		7200
7		9000
8		12600

"Census.gov." Census.gov. N.p., n.d. Web. 24 Mar. 2016.

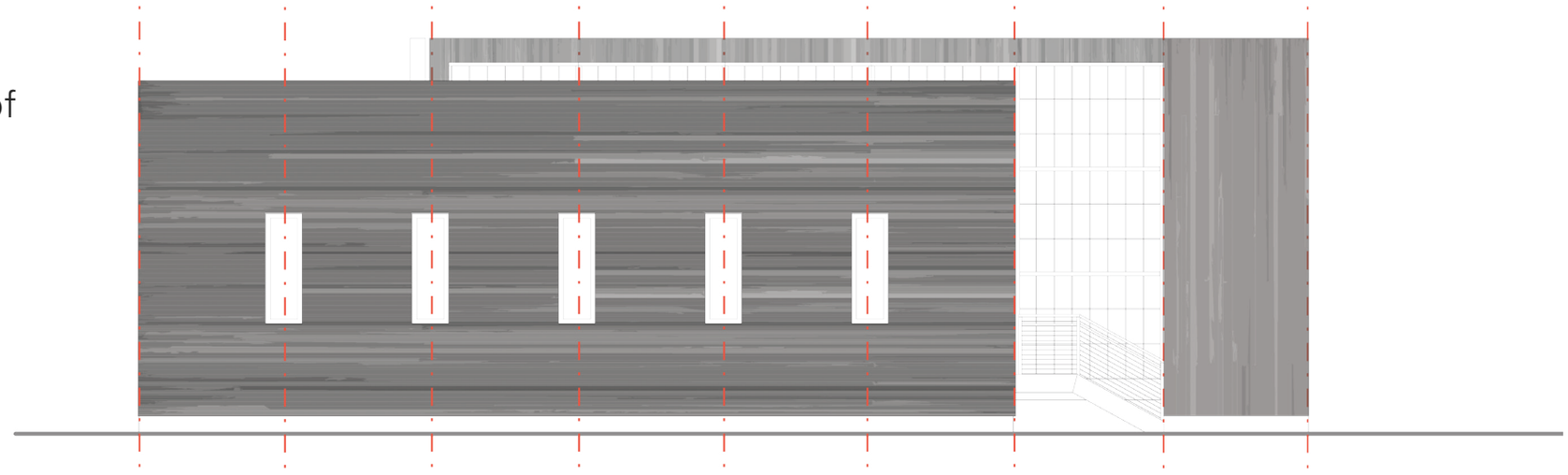
AIRTIGHT ENVELOPE

EXCEEDING STANDARDS THROUGH BETTER BUILDING PRACTICES

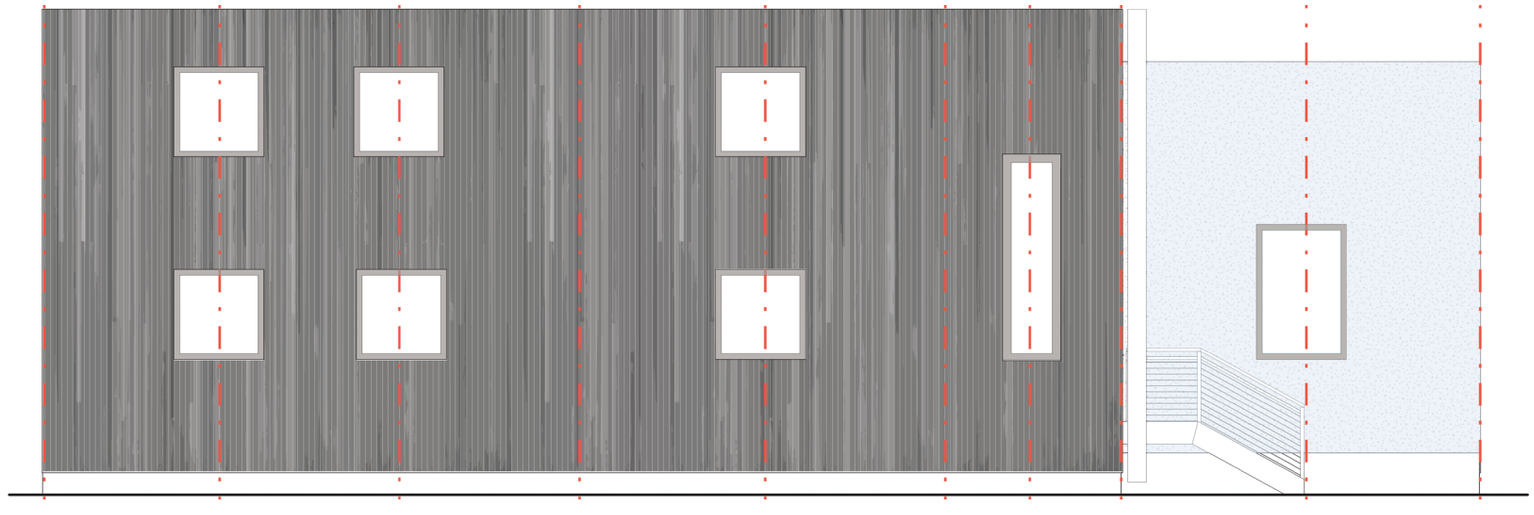
Extremely low air infiltration rate due to prefabricated panels

Windows located to reduce number of seams in SIP system

Reduced heating and cooling loads



	IEEC 2015	Energy Star	House II
U- Factor	0.35	0.27	0.27
SHGC	---	0.30	0.30
Glazing	---	Qualified	Low-E 270 Argon
Ceiling [R]	38		57
Walls [R}	13		44
Floor [R]	19		36
Slab [R] & Depth	10, 2ft		10, 2.5ft
Crawlspace [R]	10		10
Infiltration		2.5 @ ACH50	0.5 @ ACH50



DURABLE ENVELOPE

INCREASING LIFESPAN AND REDUCING MAINTENANCE

KALWALL GLAZING

DOUBLE SKIN ROOF

CHARRED CEDAR SIDING

RAISED FLOOR SYSTEM

ENCLOSED CRAWLSPACE

MATERIAL SCIENCE

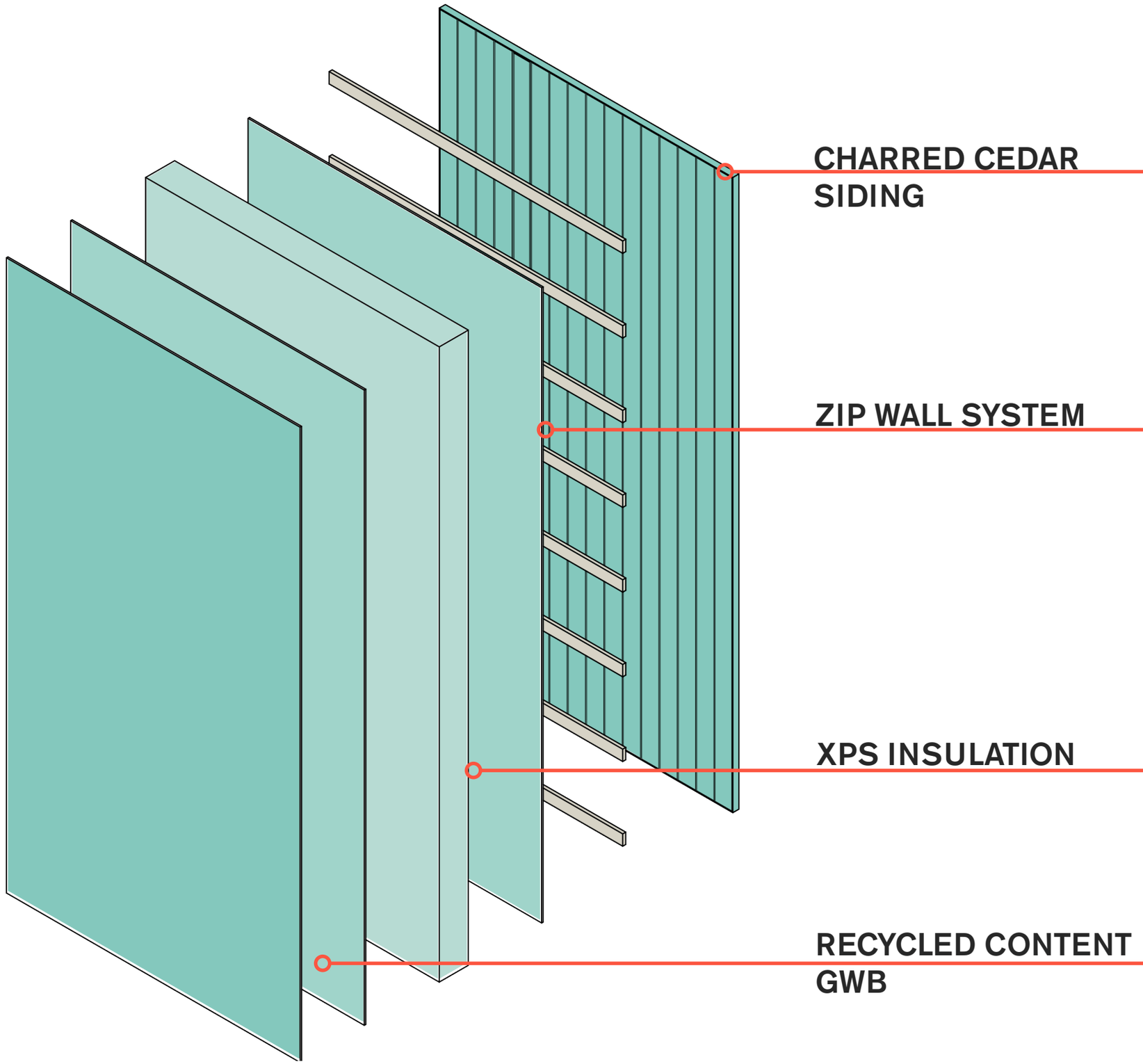
COMBINING RESEARCH AND PROVEN METHODS

Charred cedar repels insects, water and does not require refinishing as it ages

3/4” Air gap back-vents SIP panel to prevent SIP rot

XPS is a Class I insulation and does not deteriorate over time

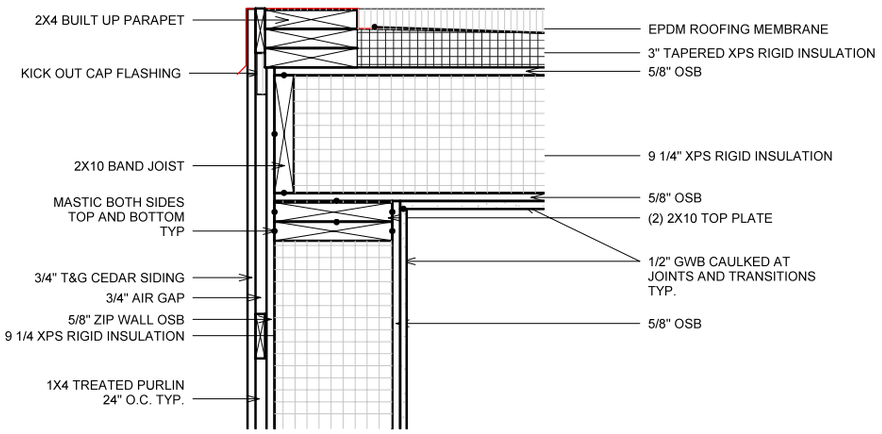
Recycled content GWB contains atleast 25% post-consumer waste

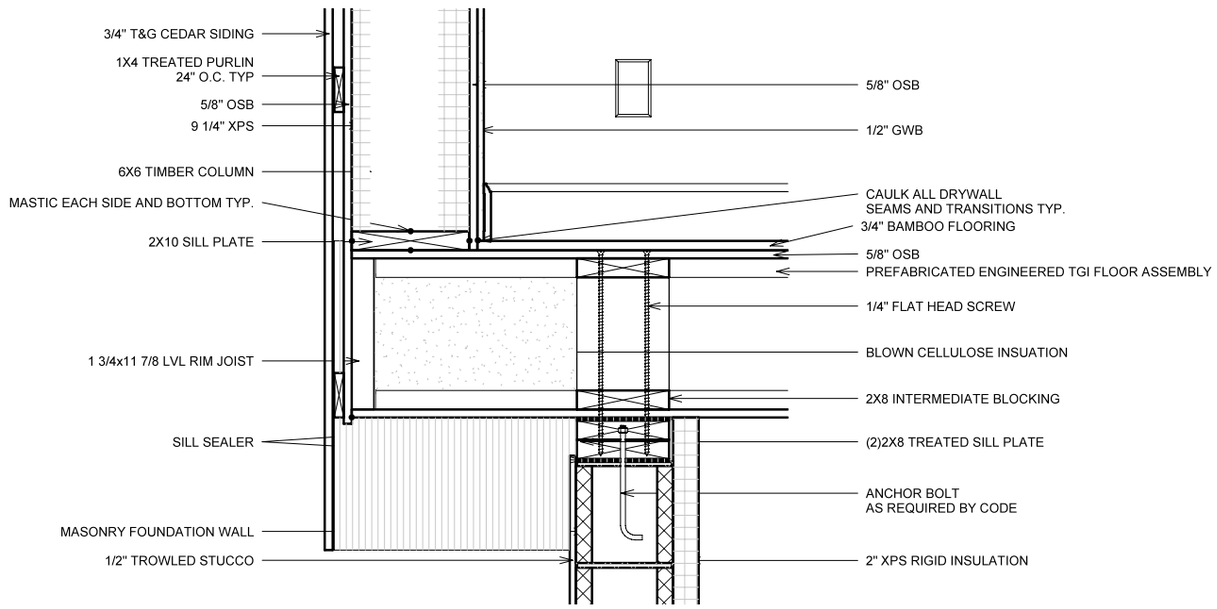


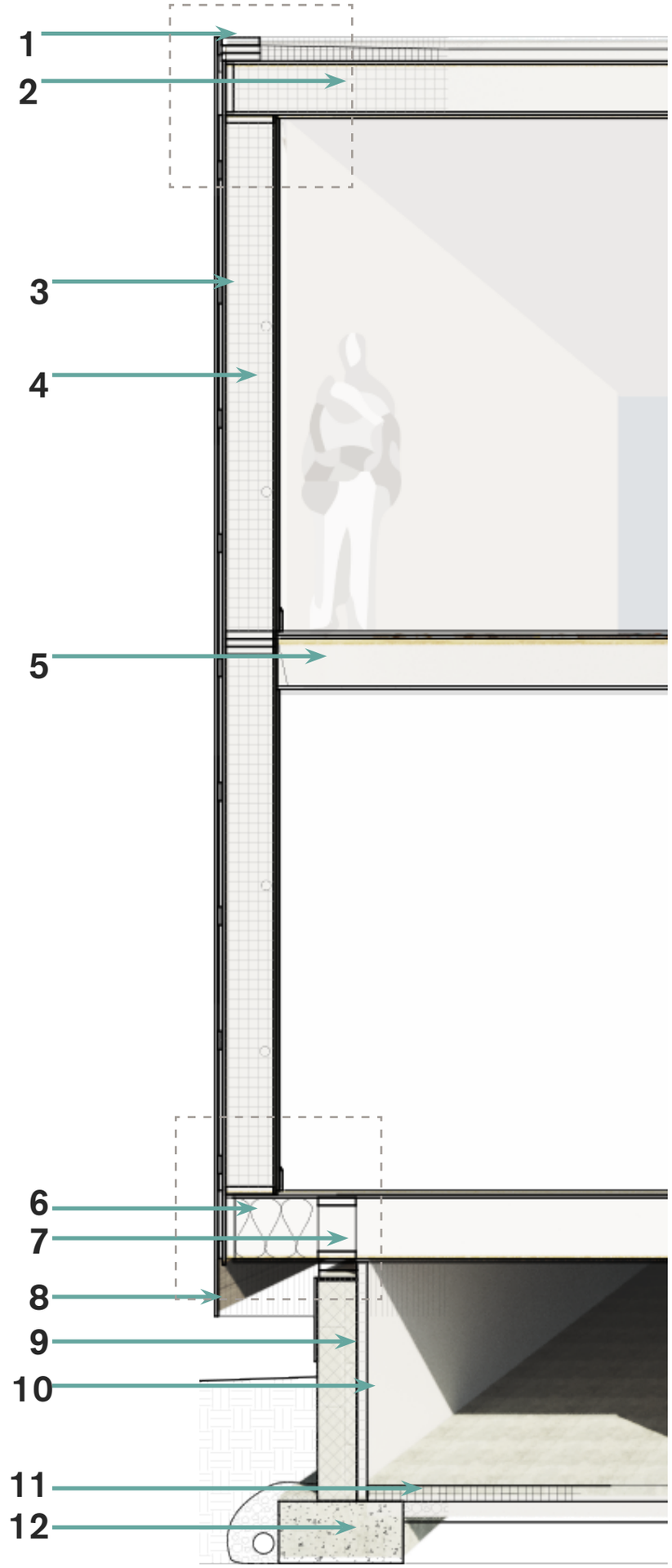
DETAILING

WALL SECTION

1. Built Up Parapet
2. 9 1/4" SIP Roof [R57]
3. 3/4" Air Gap
4. 9 1/4" SIP [R44]
5. 2 x 10 Floor Joist
6. 11" Blown Cellulose @ Edge [R36]
7. Engineered Floor / Blocking
8. 3/4" Cedar Siding
9. 8" CMU Foundation Wall [R13]
10. 2" XPS Continious
11. 4" Slab over 2" XPS, 4" Fill
12. 24 x 24" Concrete Footing







BALANCED SYSTEM

A STABLE INDOOR ENVIRONMENT

Low heating and cooling loads

Double height space acts as a mixing zone for heating and cooling

High efficiency, multi-zone heat pump allows for stable space conditioning

Two supply units for separate zones between public and private space

Each bathroom is outfitted with an Twin Fresh exhaust fan / ERV combination

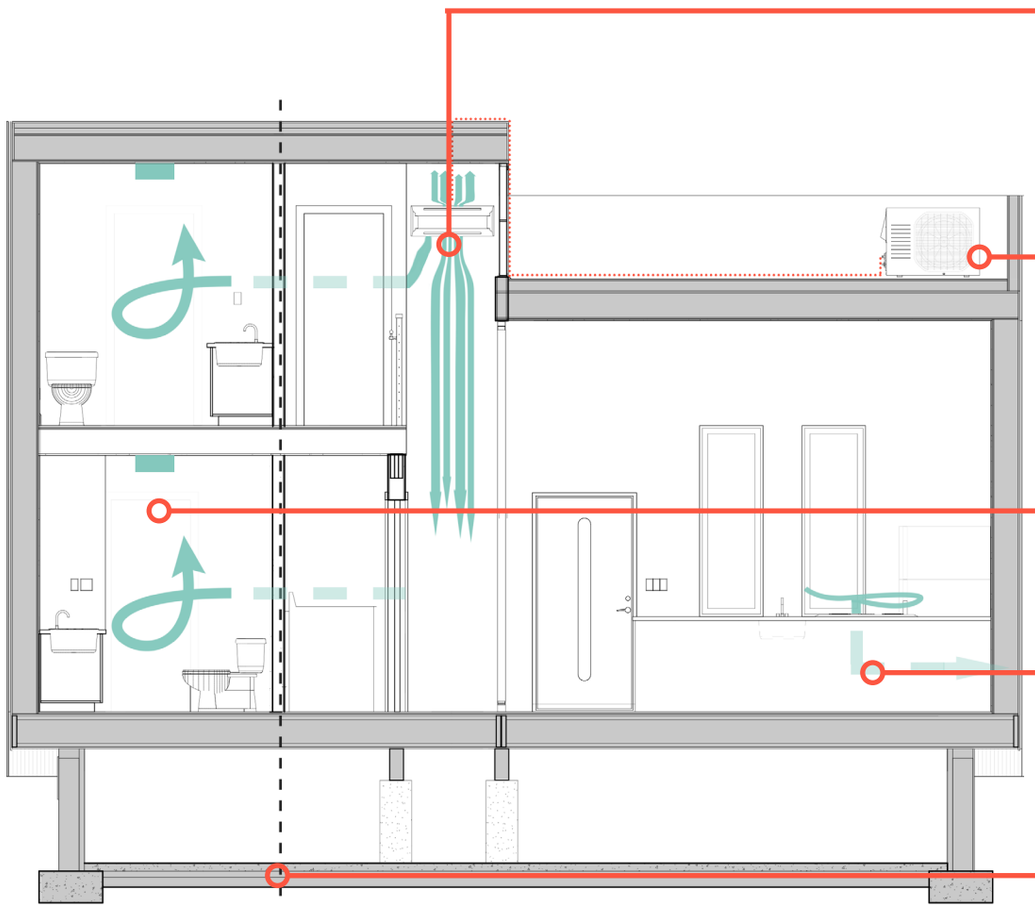
Exceeds ASHRAE 62.2 ventilation rate with two sensor controlled bath fans running at no less than 60 CFM

HEAT PUMP SPECIFICATIONS

	Energy-Star Requirement	Fujitsu AOU18RLXFZ
SEER	15	18
HSPF	9	9.3

DESIGN LOADS

	REM	(2)Fujitsu ASU7RLF1
HEATING	10,800	16,200 BTU/h
COOLING	10,300	14,000 BTU/h



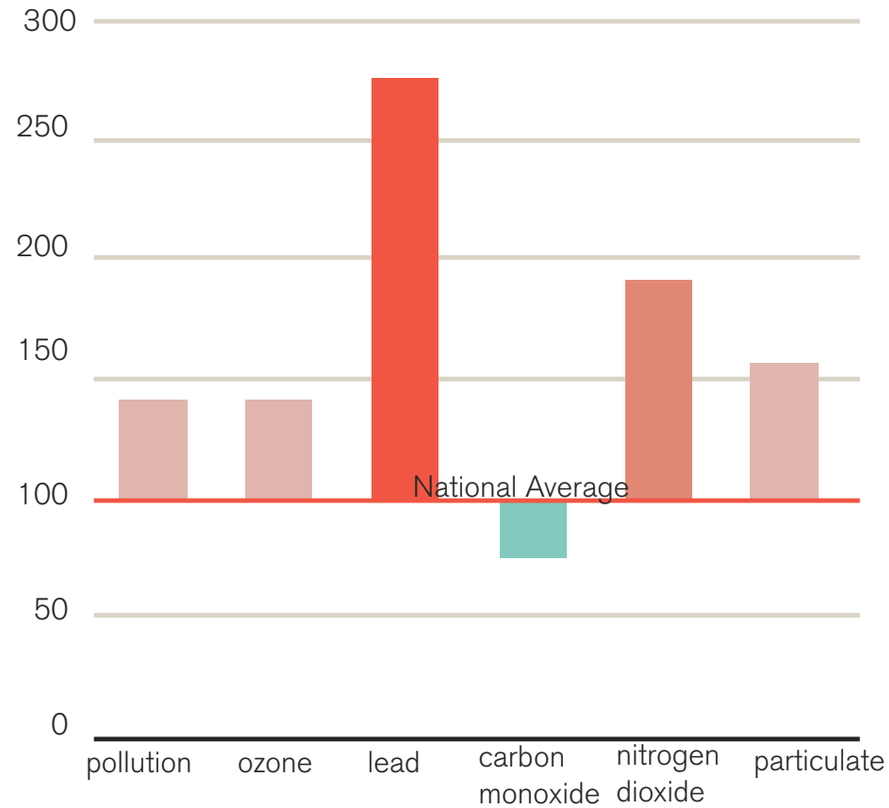
AIR

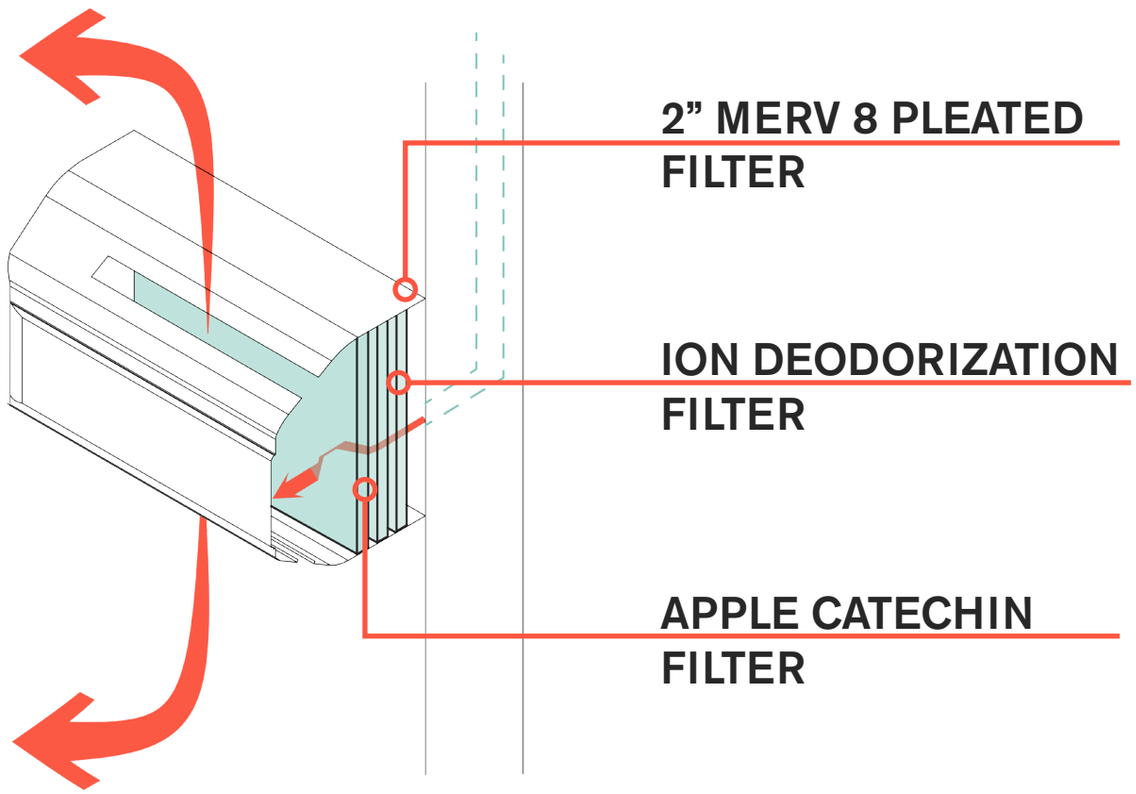
A HEALTHY PLACE TO GROW

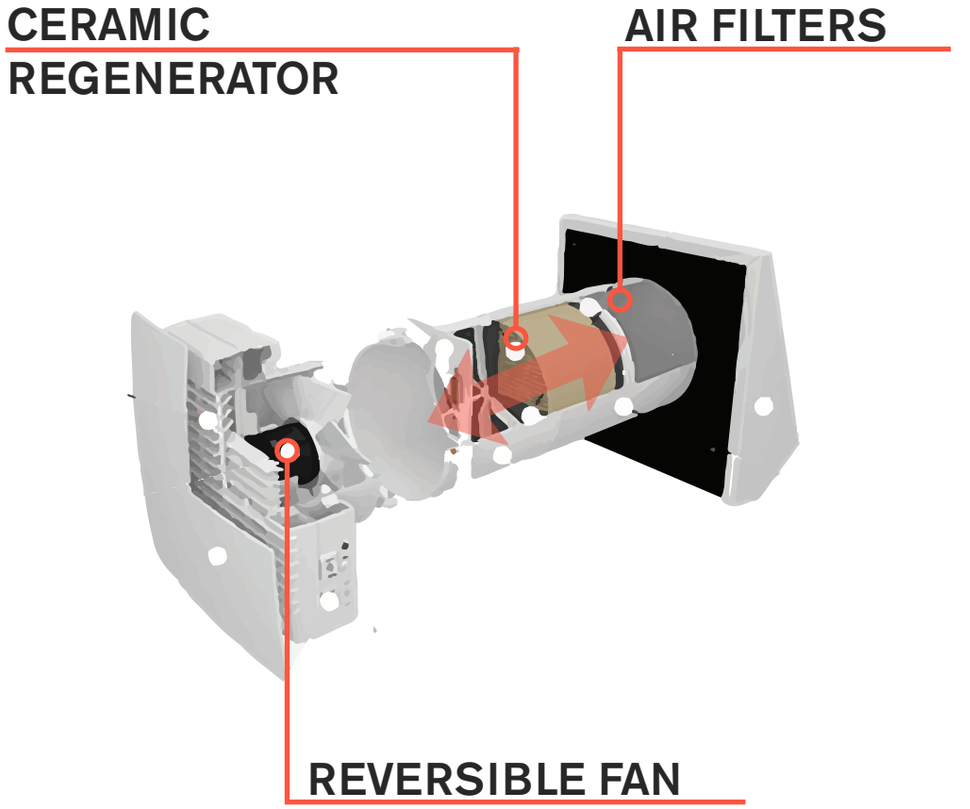
Guided by and fulfills EPA Indoor Air Quality Plus requirements

Triple filtration system in minisplit head

Exhaust / ERV filters recycled air







WATER

REDUCING WAIT TIMES AND WASTE

WaterSense certified

Centrally located wet fixtures

Single vertical plumbing chase

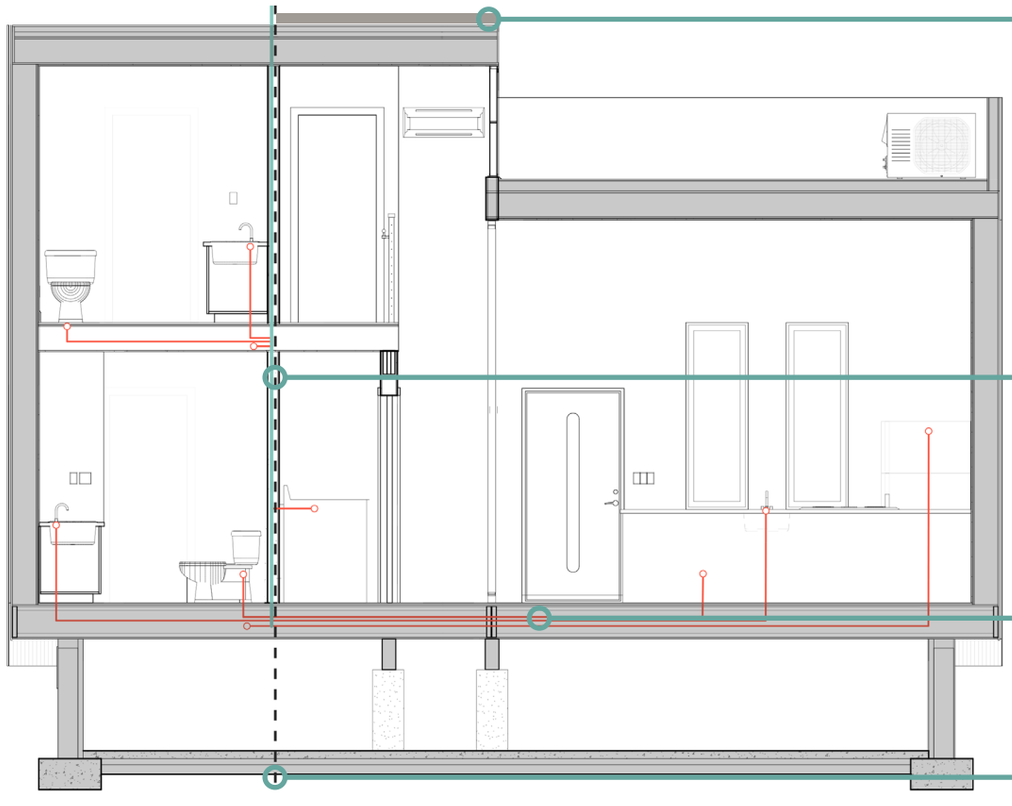
Manifold based PEX system

80 gal electric water heater with solar assist

Wait time to furthest fixture 4.9 seconds

WATER DELIVERY TIMES

Type	Demand (GPM)	Diameter Piping	Flow Velocity (FPS)	Distance FT	Wait Time
Faucet	1.5	3/8″	5.00	24.5	4.9
Toilet	1.28	3/8″	5.00	24.5	4.8
Faucet	1.5	3/8″	5.00	10.75	2.2
Faucet	1.5	3/8″	5.00	8.75	1.8
Toilet	1.28	3/8″	5.00	6.25	1.3
Shower	2.0	3/8″	6.67	2.5	0.2
Faucet	1.5	3/8″	5.00	9.5	1.9
Faucet	1.5	3/8″	5.00	11	2.2
Toilet	1.28	3/8″	5.00	14	2.8
Shower	2.0	3/8″	6.67	18	2.7
Faucet	1.8	3/8	5.00	17	2.5
Powder Room		Lower Bathroom		Master Bathroom	



WATER

STORM-WATER MANAGEMENT

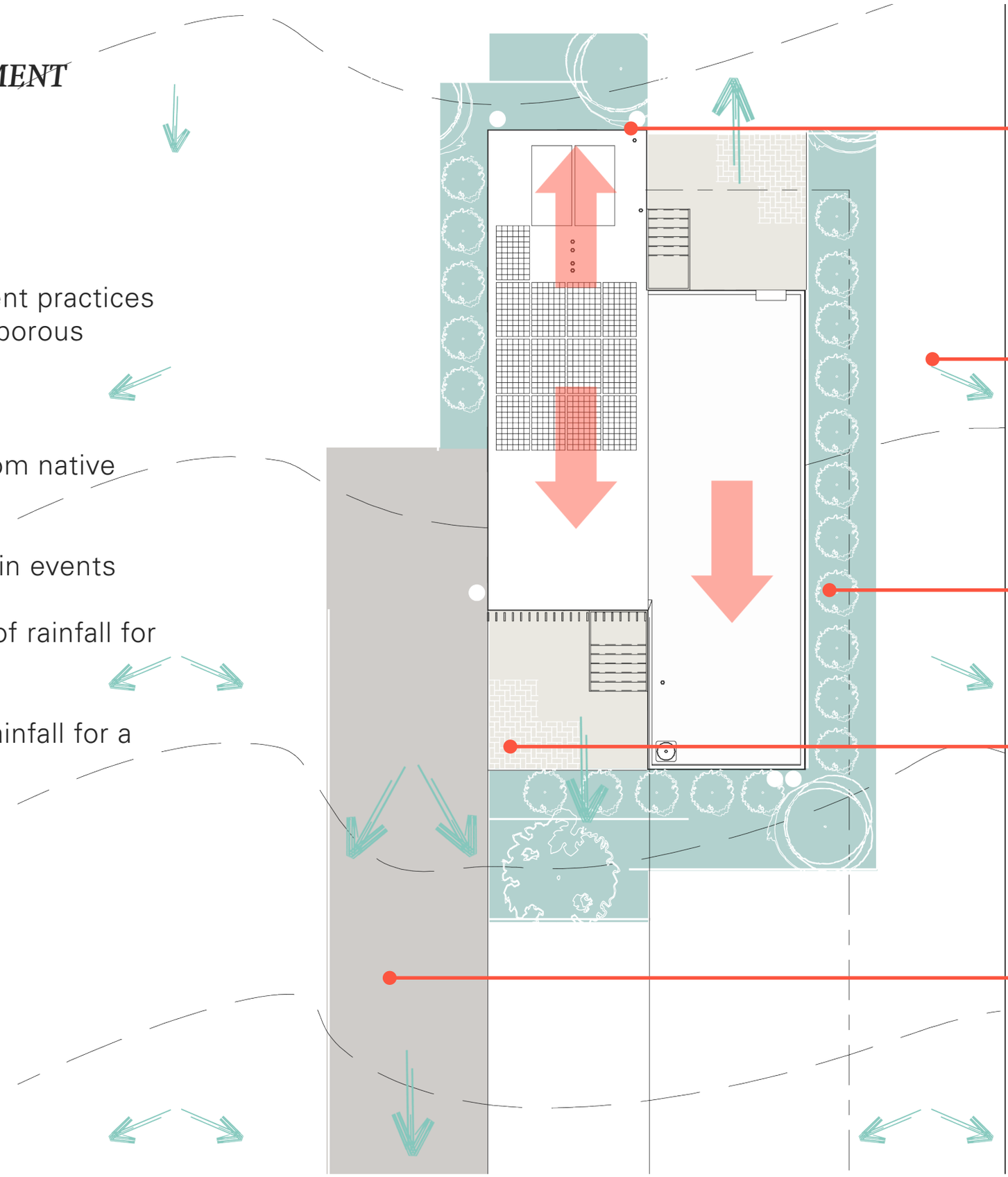
Storm-water best management practices including permeable pavers, porous asphalt, and rain gardens

42% of total site drainage from native vegetation and lawn on site

Zero runoff during average rain events

Retains the first 15 minutes of rainfall for a 25 year storm

Retains the first 7 hours of rainfall for a yearly storm



RAIN BARRELS
40 gal capacity x 5 barrels

OPEN LAWN
Stores 2,452 cu. ft.

CATCHMENT AREAS
Stores 1,435 cu. ft.

INTERLOCKING PAVERS
Stores 512 cu. ft.

POROUS ASPHALT
Stores 1,104 cu. ft.

LIGHTS & APPLIANCES

ANALYSIS BASED DESIGN

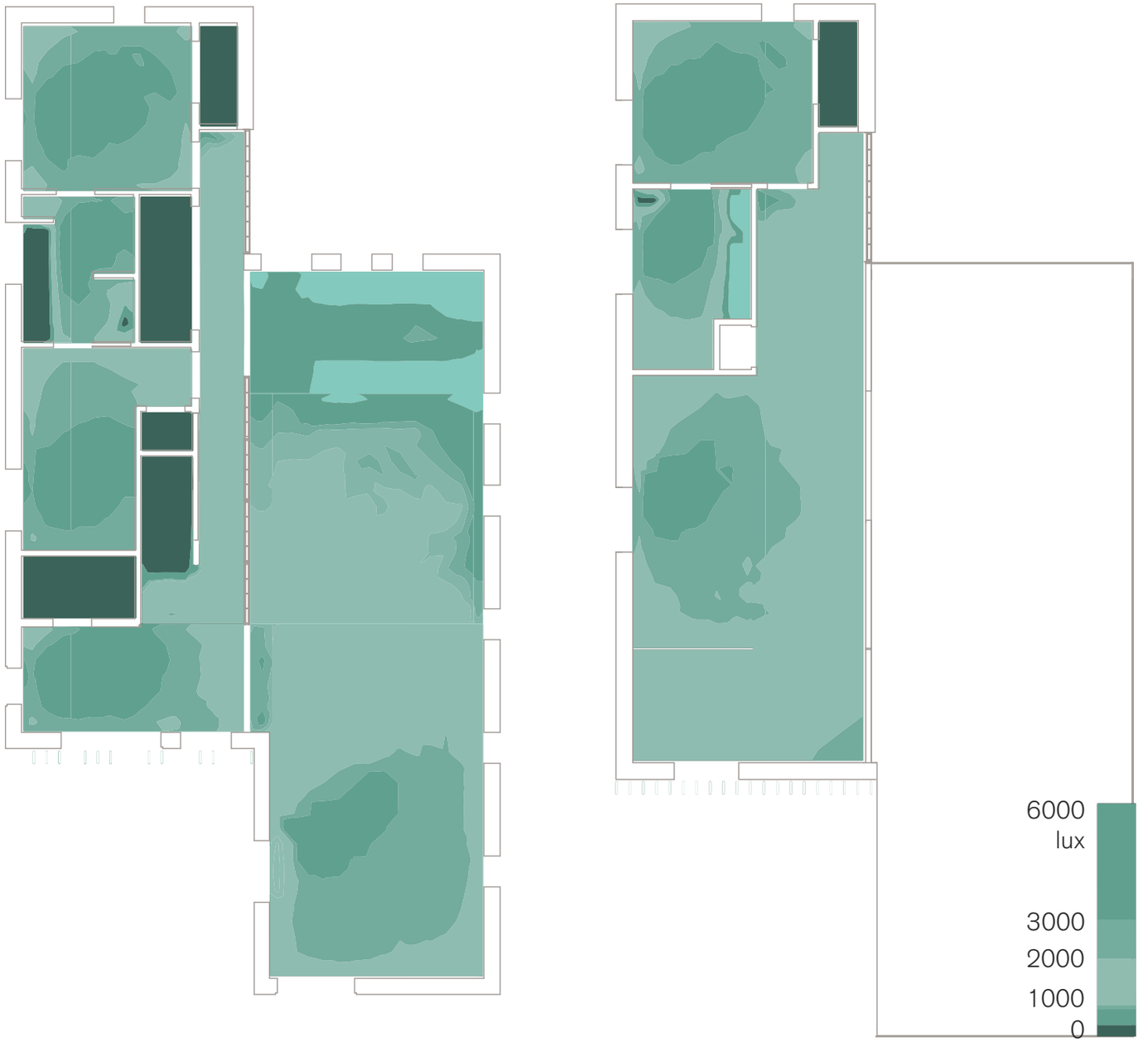
SELECTION CRITERIA

Only energy-star approved fixtures and appliances

Emphasis on selecting durable products with a long lifespan

LIGHTING ANALYSIS

Based on occupant habits, room use and time of day



Manufacturer	Model	Placement	Lamp	Watts
Cooper	QD9	Recessed	CFL	20
Cooper	420	Ceiling	CFL	25
Delray	6300	Pendant	LED	27
Delray	SW MR	Rail	LED	3.3
Lumenpulse	LOGi120	Wall	LED	34
Holtktter	C-8420	Pendant	LED	5

A NEW PARADIGM FOR SUBURBAN ARCHITECTURE