GEODE

TM

Jefferson

Philadelphia University +
Thomas Jefferson University

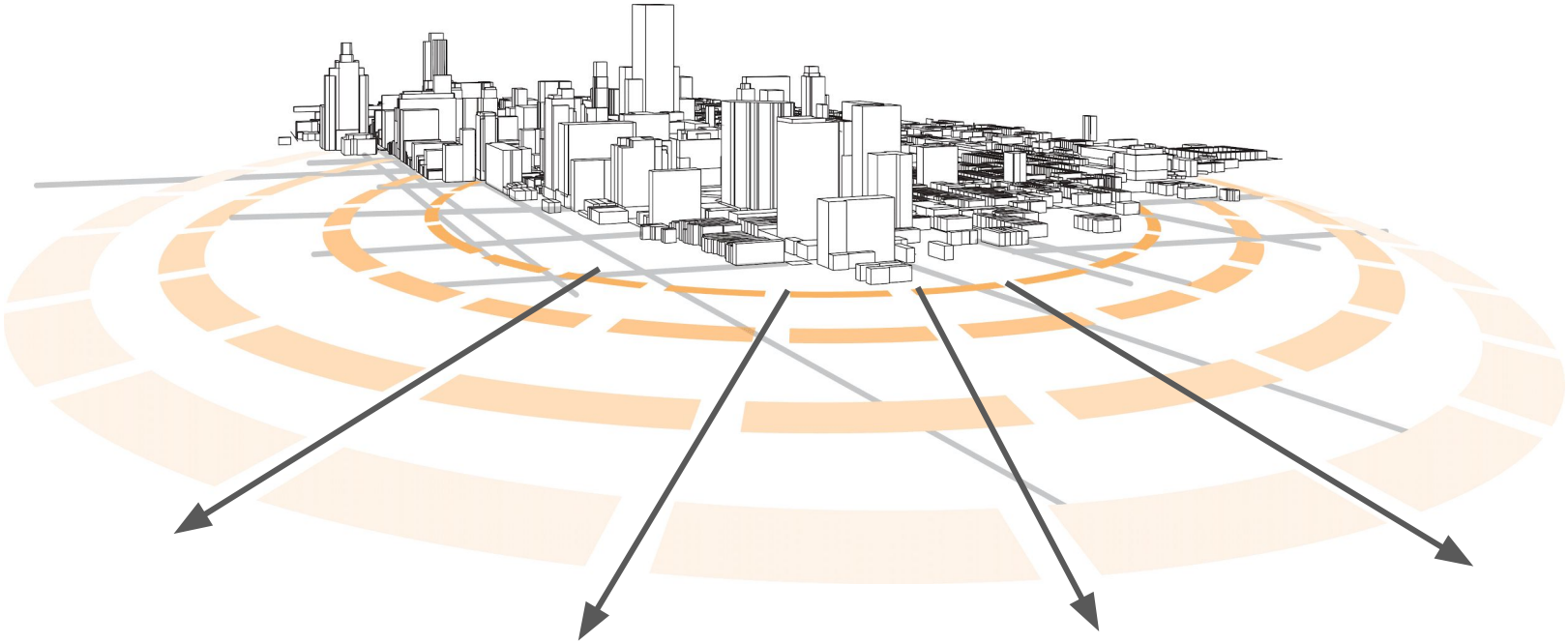
HOME OF SIDNEY KIMMEL MEDICAL COLLEGE

COLLEGE *of* ARCHITECTURE
and the BUILT ENVIRONMENT


INTEGRAL
GROUP


clear


BREWERYTOWN
SHARSWOOD
COMMUNITY CIVIC ASSOCIATION



ECONOMIC GROWTH HAS SPURRED RAPID DEVELOPMENT
RESULTING IN A WAVE OF **GENTRIFICATION**


CAFE

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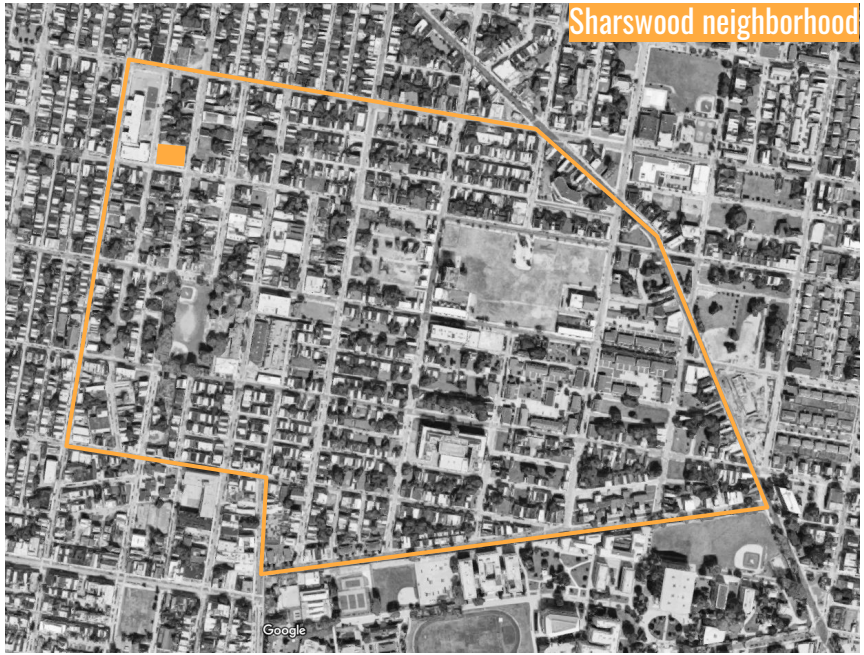
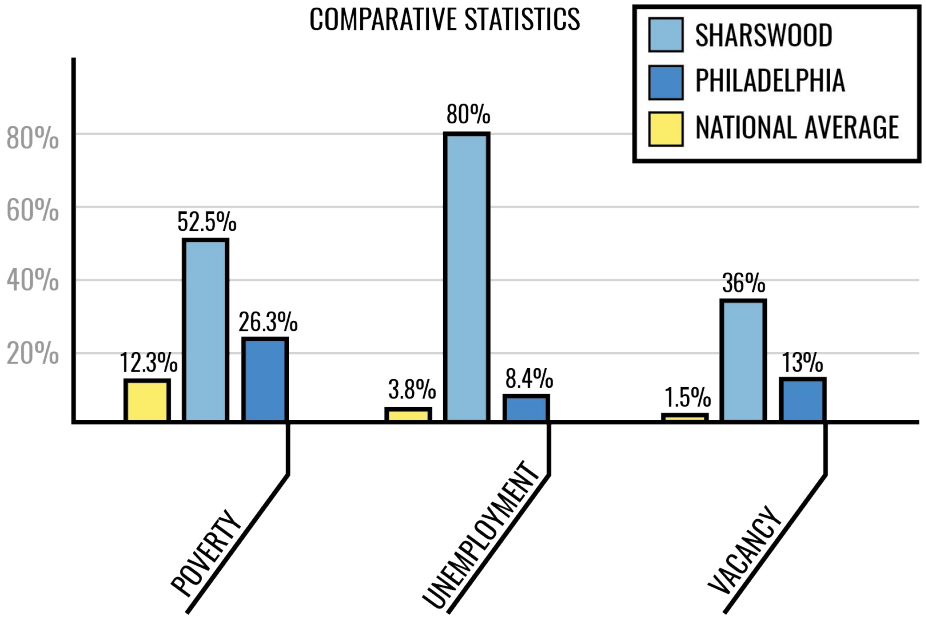
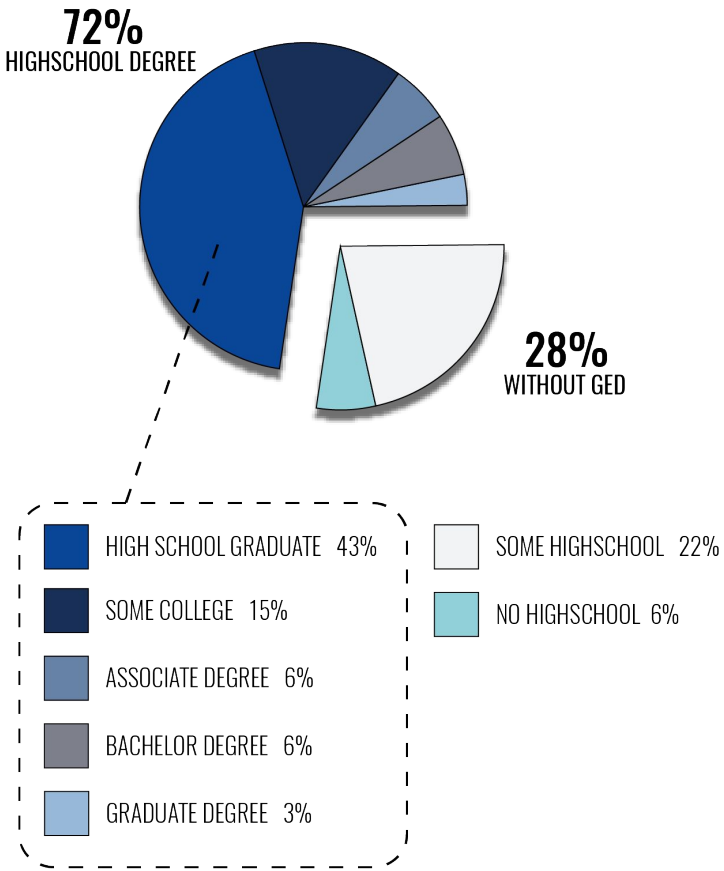
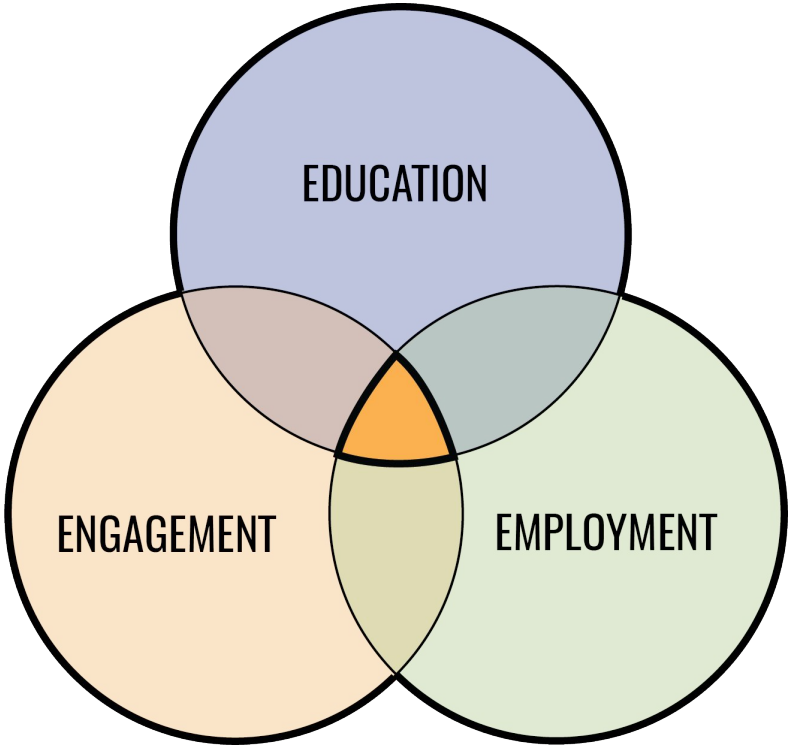


DEMOGRAPHICS





What if commercial development could help break the cycle of multi-generational displacement in gentrifying communities?

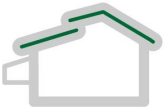

EDUCATION
ENGAGEMENT
EMPLOYMENT

SITE SELECTION

SITE SELECTION

COMMUNITY IMPACT

Social



Architecture

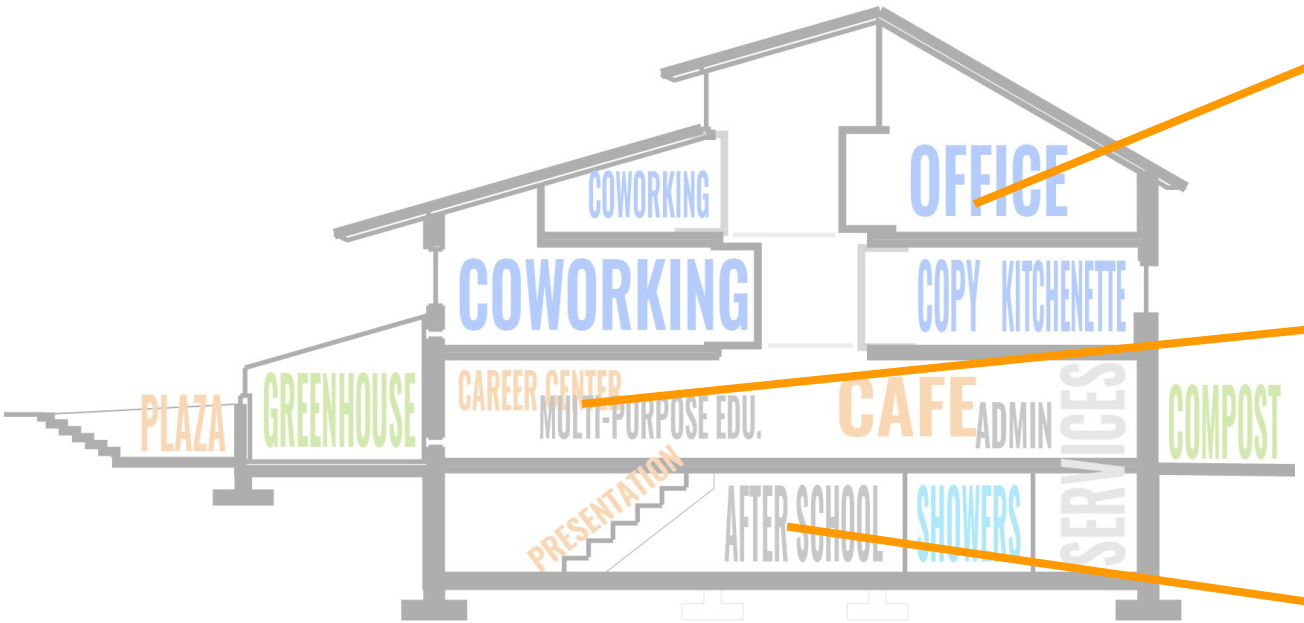
Environment

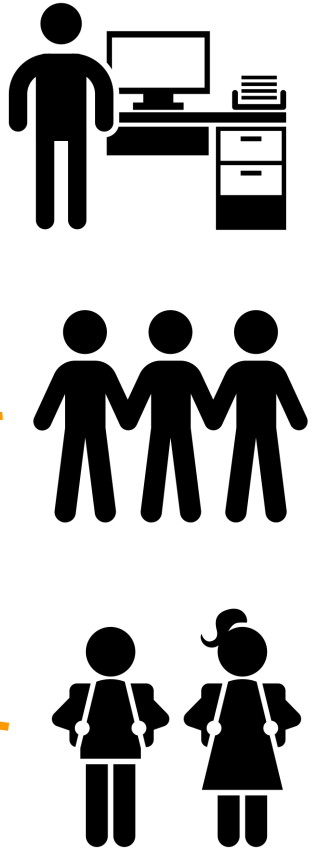
=

Healthy
Neighborhood

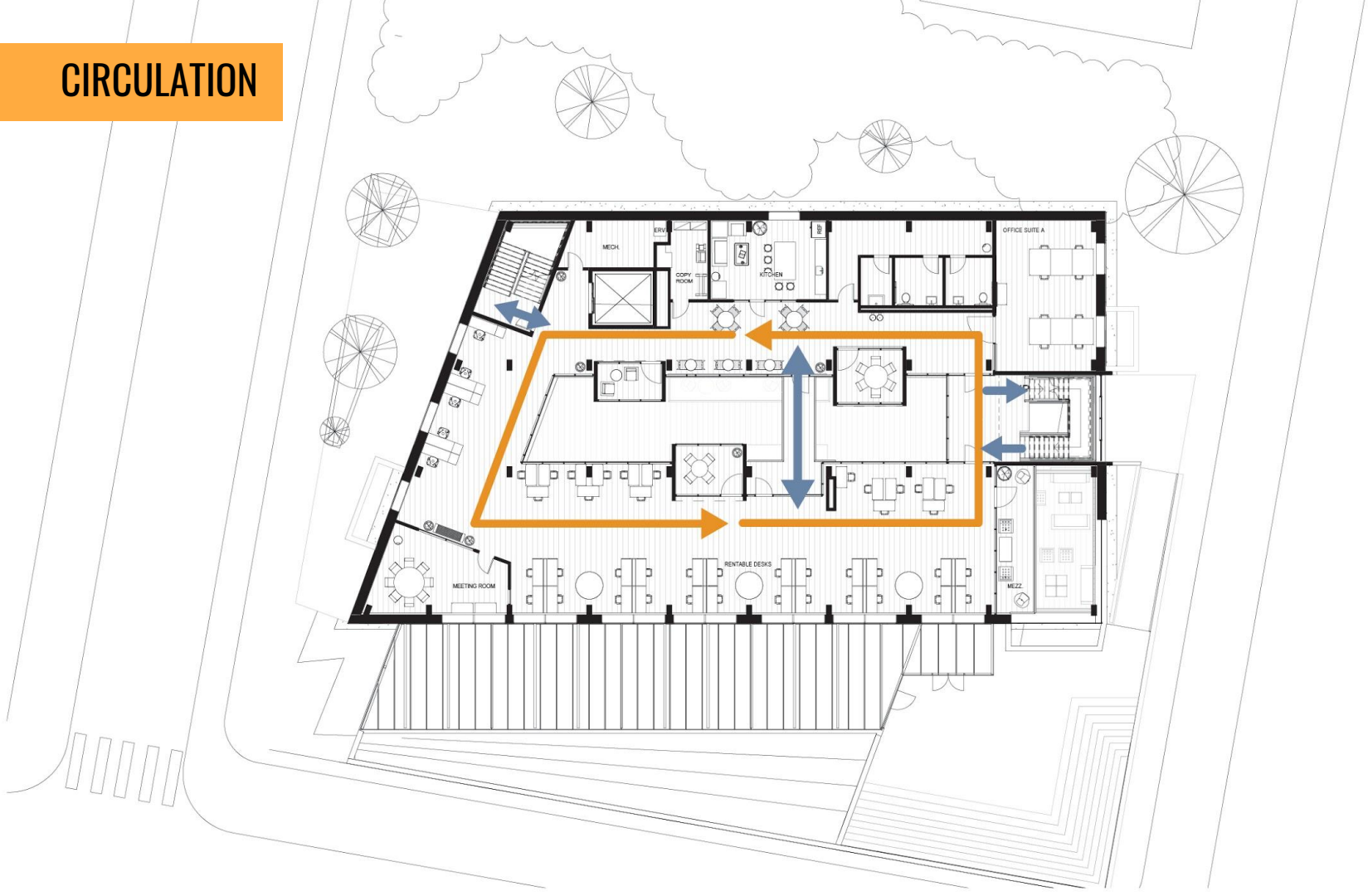
REDEFINING THE OFFICE TYPOLOGY

PROGRAM


COWORKING
OFFICE
COWORKING
COPY
KITCHENETTE
PLAZA
GREENHOUSE
CAREER CENTER
MULTI-PURPOSE EDU.
CAFE
ADMIN
SERVICES
COMPOST
PRESENTATION
AFTER SCHOOL
SHOWERS

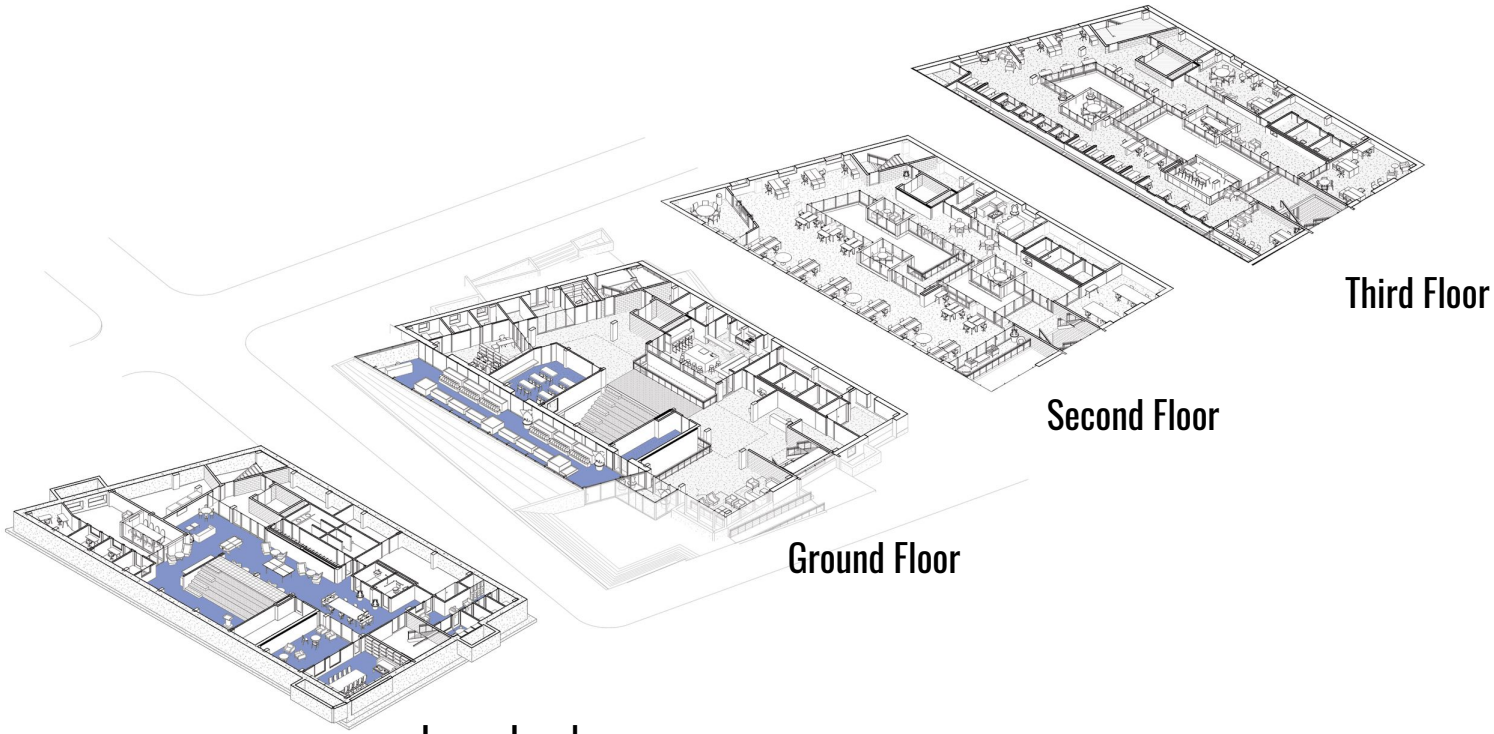


CIRCULATION



ENGAGEMENT

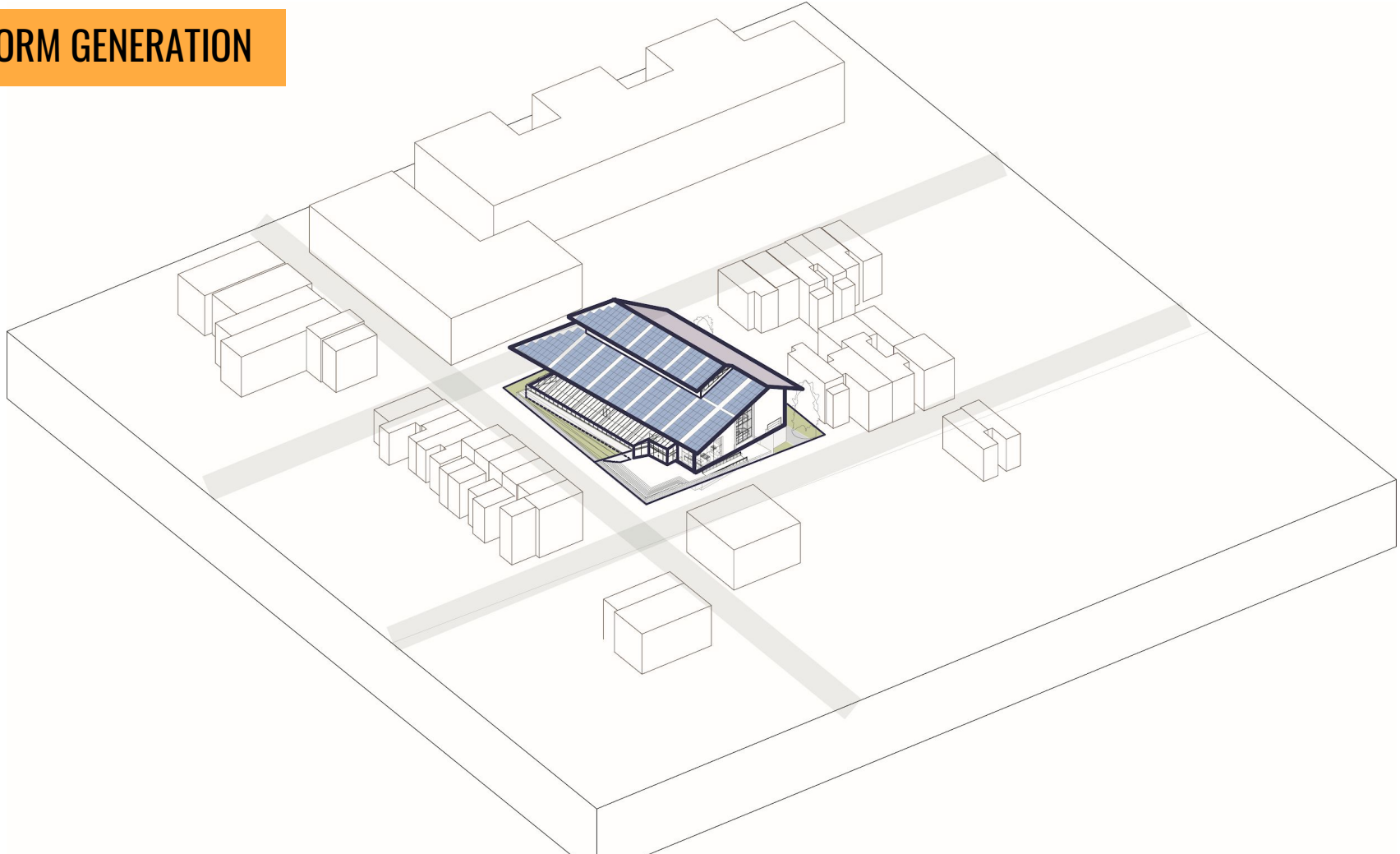
EDUCATION



EMPLOYMENT

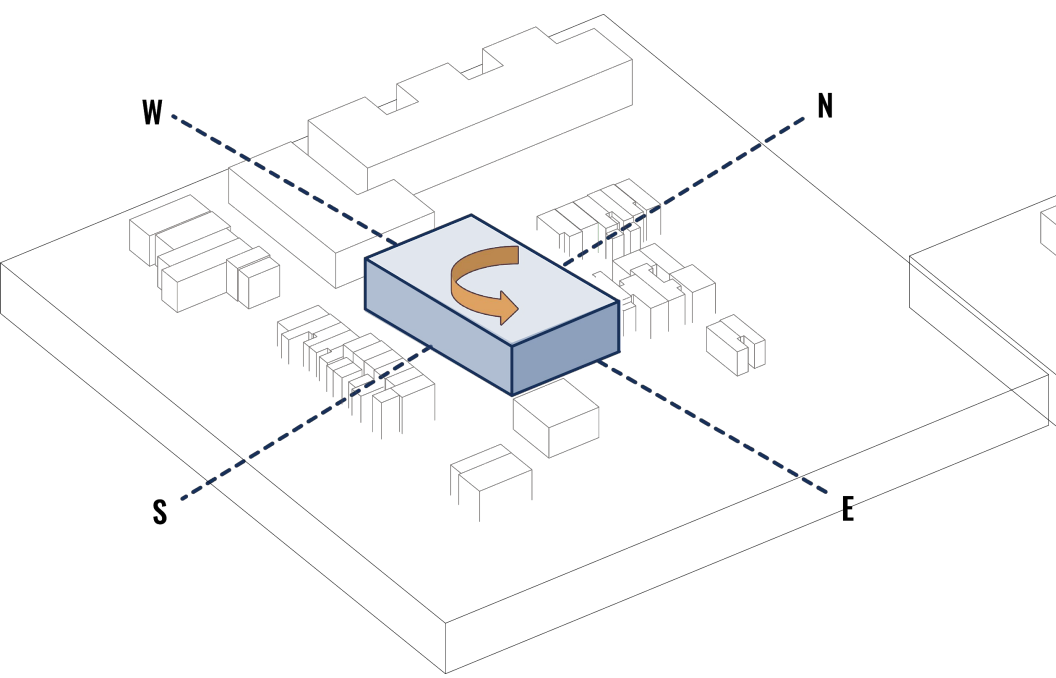
What if energy independence didn't have to be a privilege for those who need it the least?

FORM GENERATION

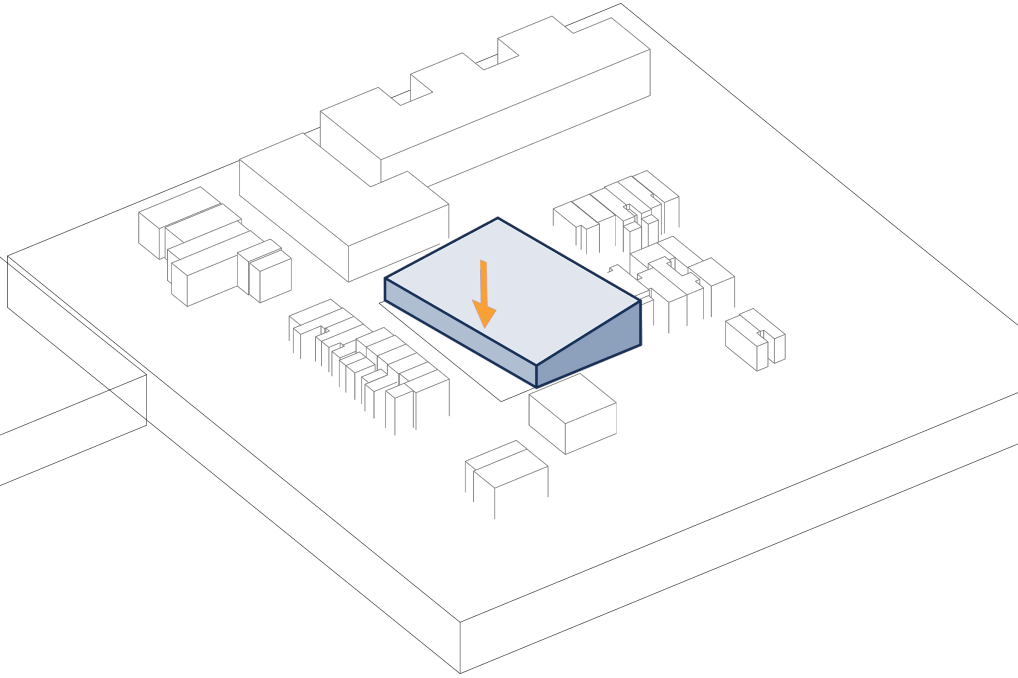


FORM GENERATION

SOLAR EXPOSURE



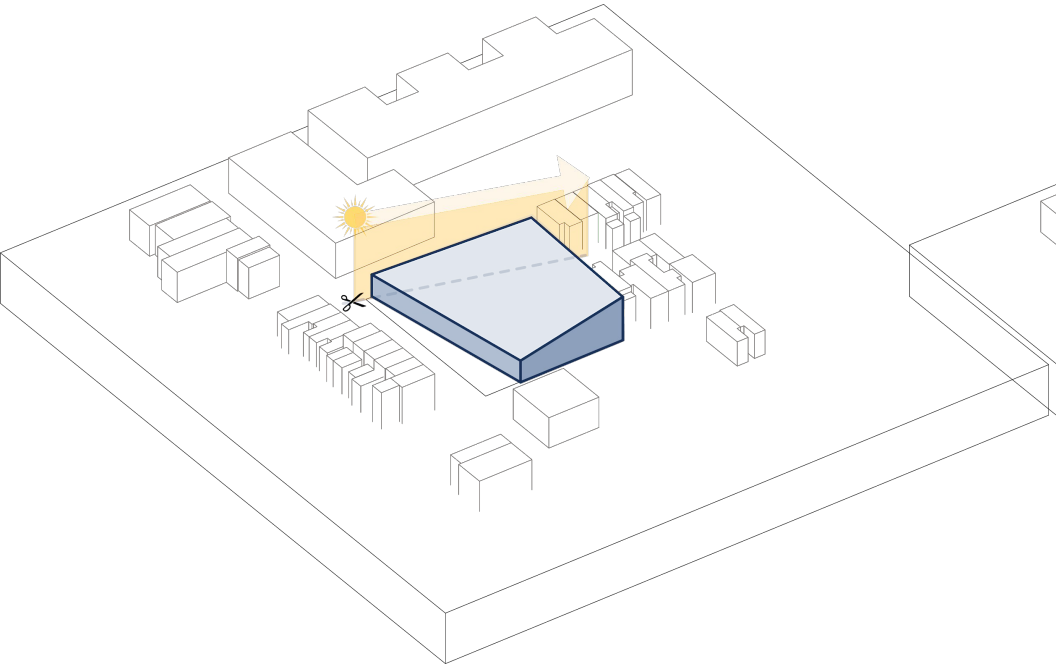
ROTATE DUE SOUTH



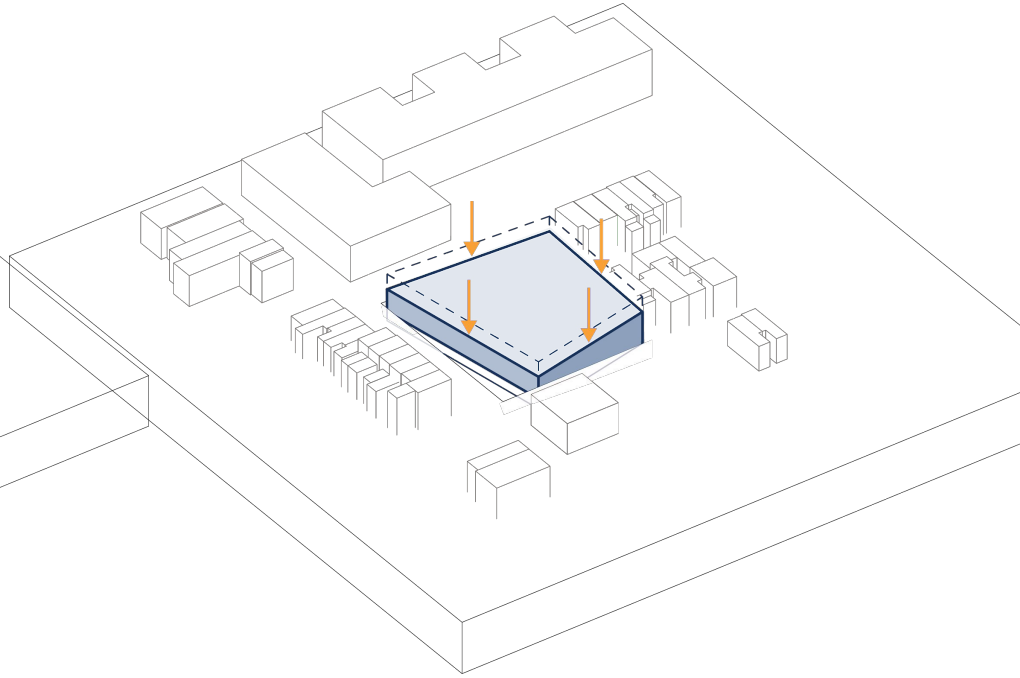
TILT FOR GREATER SOUTHERN EXPOSURE

FORM GENERATION

NEIGHBORHOOD CONTEXT

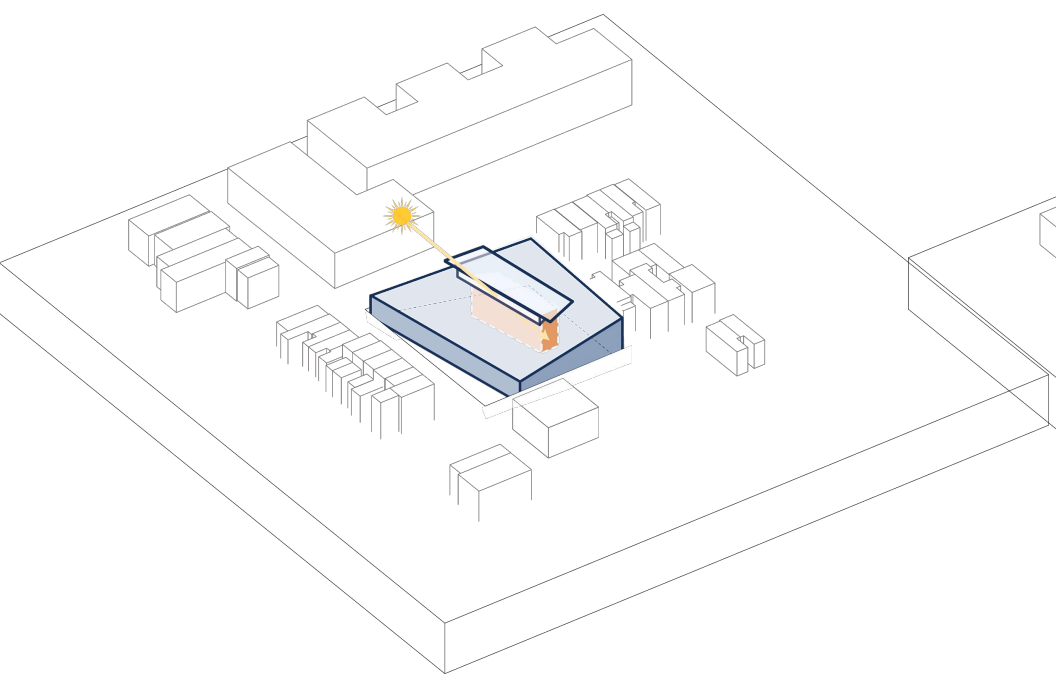


CUT GEOMETRY FOR NEIGHBORS



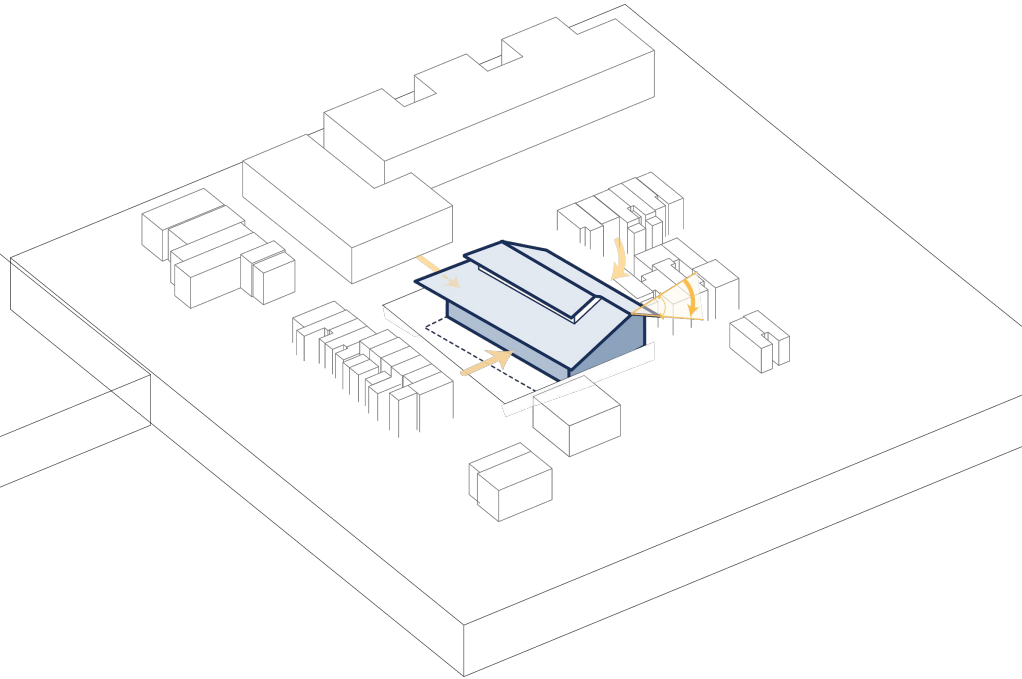
LOWER HEIGHT + GROUND COOLTH

FORM GENERATION



CUT SHAFT FOR INT. DAYLIGHTING

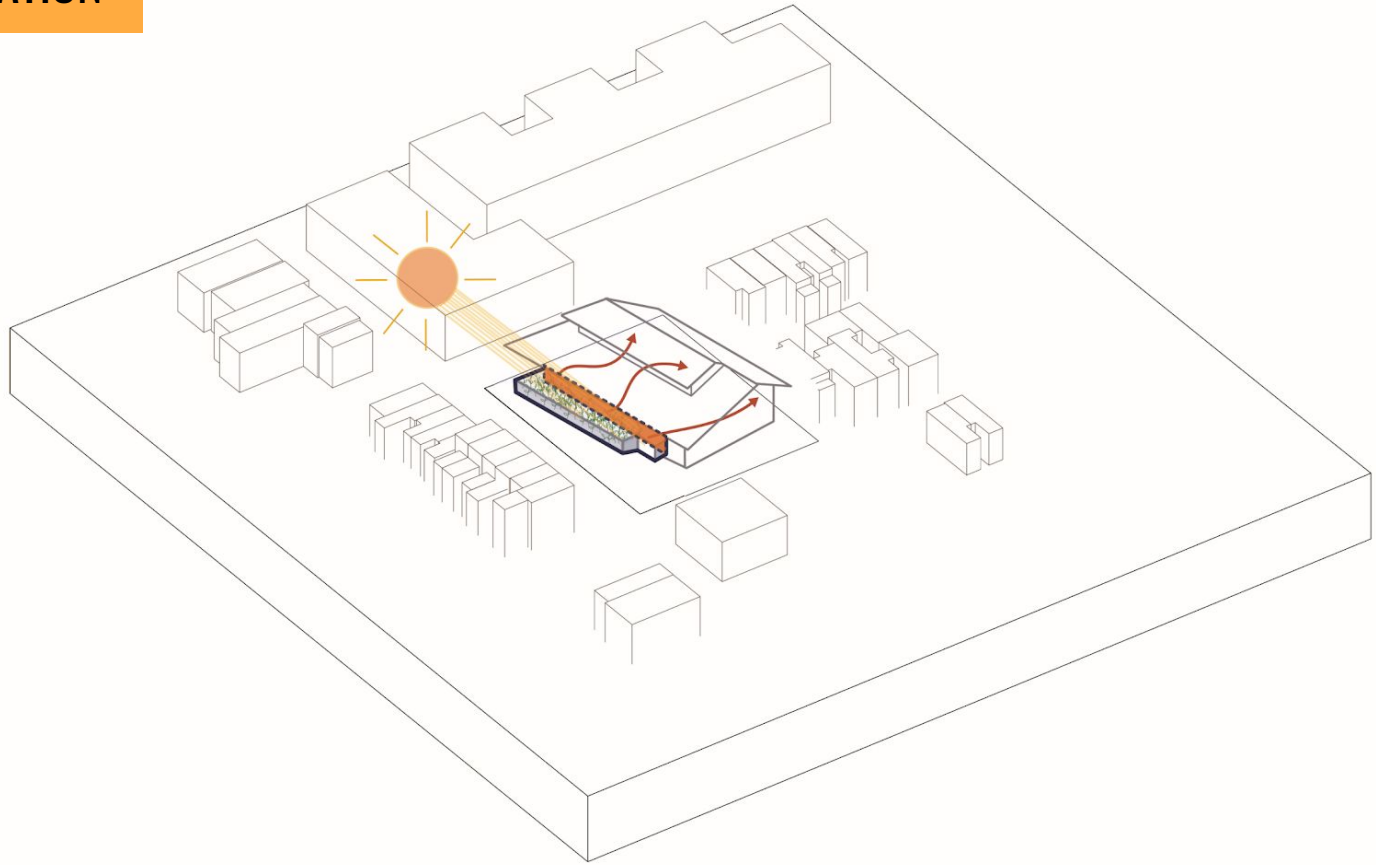
ATRIUM + CLERESTORY



ROOF ADJUSTMENTS & SETBACKS

SHADING + DRAINAGE

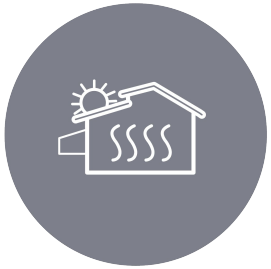
FORM GENERATION



To address user needs, we begin by linking tangible comfort to building solutions.

SOLUTIONS

TANGIBLE COMFORT



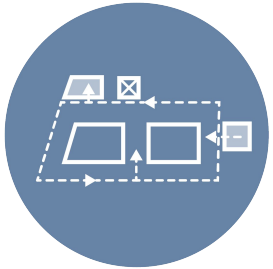
Thermal Control

Indoor Air Quality

Adaptable Program

Natural daylighting

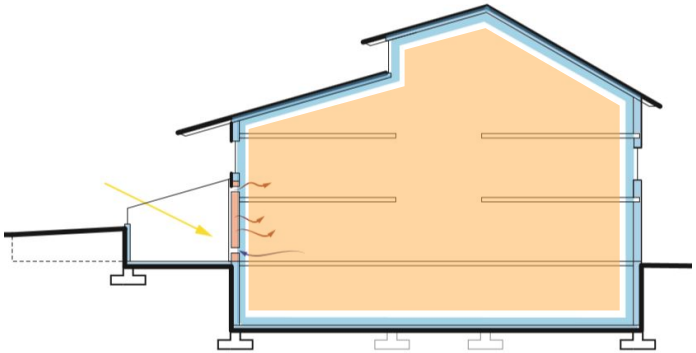
Biophilia



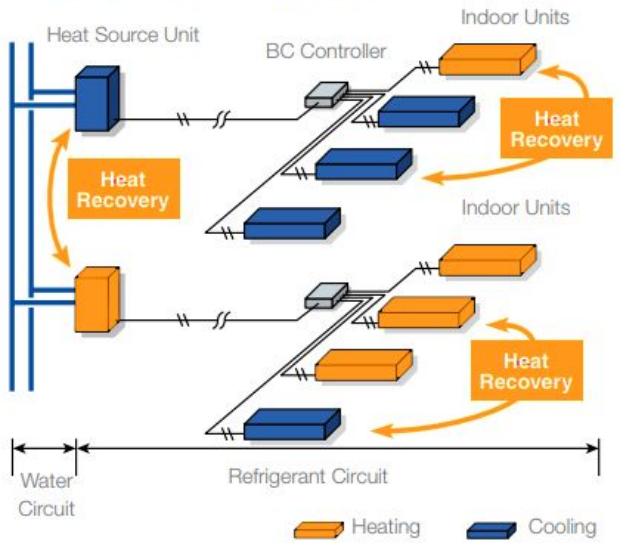
Convenient Circulation

THERMAL CONTROL

EFFICIENCY + COMFORT



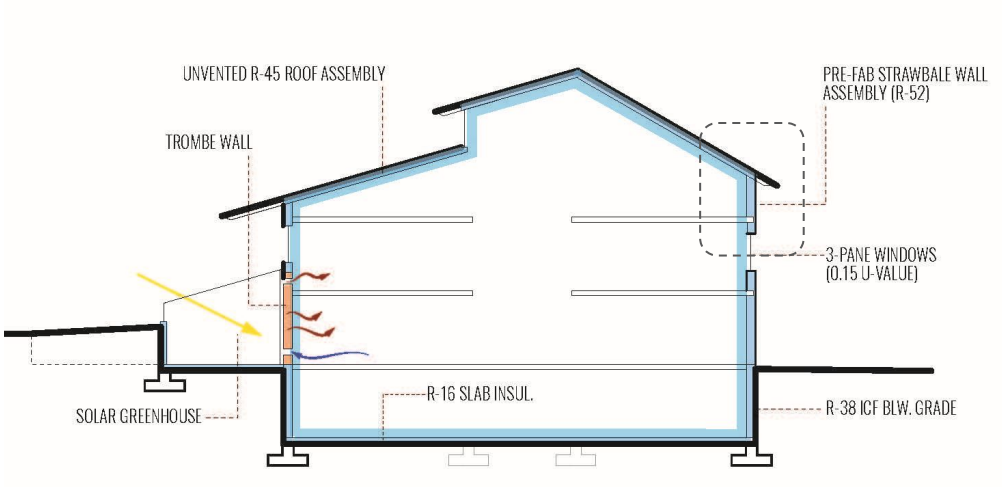
Super insulated airtight envelope



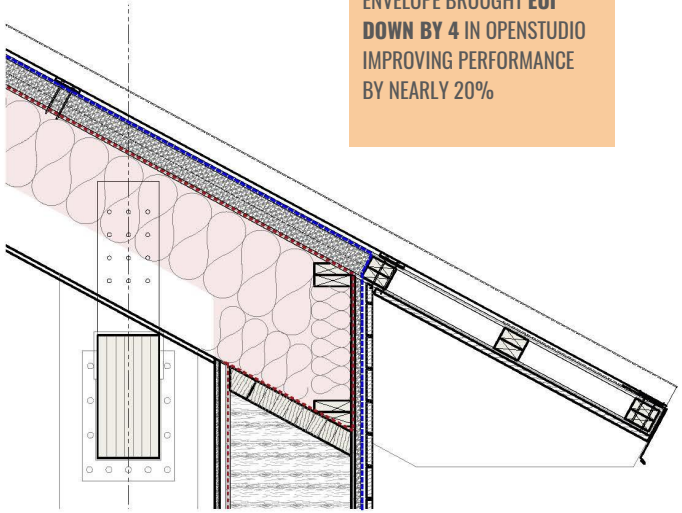
Efficient HVAC strategies

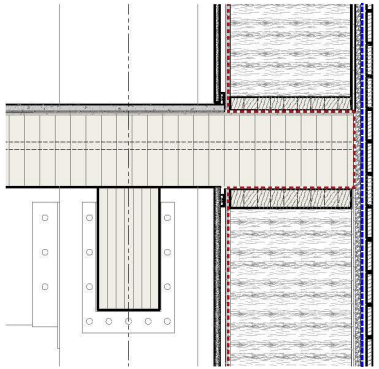
Image from mitsubishielectric.com.au

THERMAL CONTROL ENVELOPE



UPGRADING NREL STANDARD ENVELOPE BROUGHT **EUI DOWN BY 4** IN OPENSTUDIO IMPROVING PERFORMANCE BY NEARLY 20%





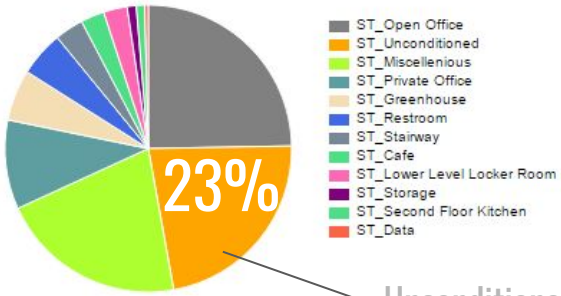
TECHNICAL INFORMATION

WALLS	R-52	Prefab. Straw bale wall system w./ cont. Wood fiber insul.
EXT. FLOORS	R-16	4” rigid stone wool insul.
FOUNDATION	R-38	Insulated concrete forms
ROOF	R-45	8” stone wool insul + 3” wood fiber insul.
WINDOWS	U-Value .15	Triple pane alum. clad wood windows

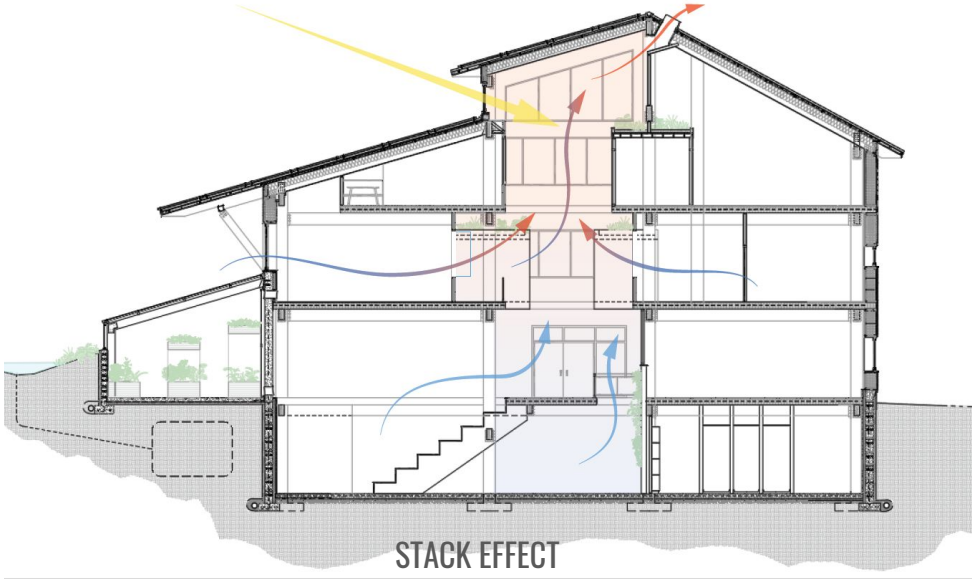
THERMAL CONTROL

ATRIUM

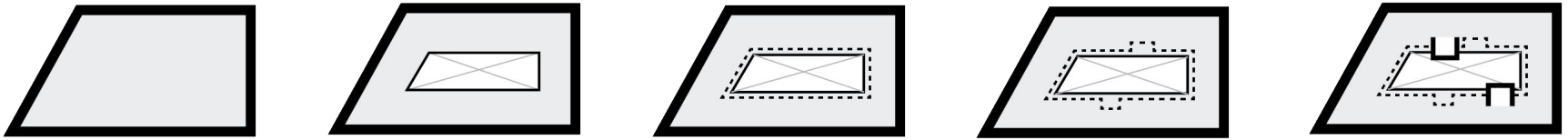
Space Type Breakdown - view table



Unconditioned Space



STACK EFFECT

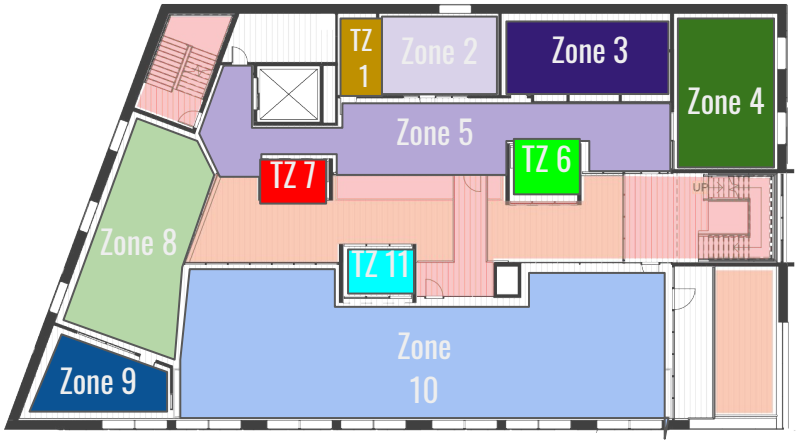


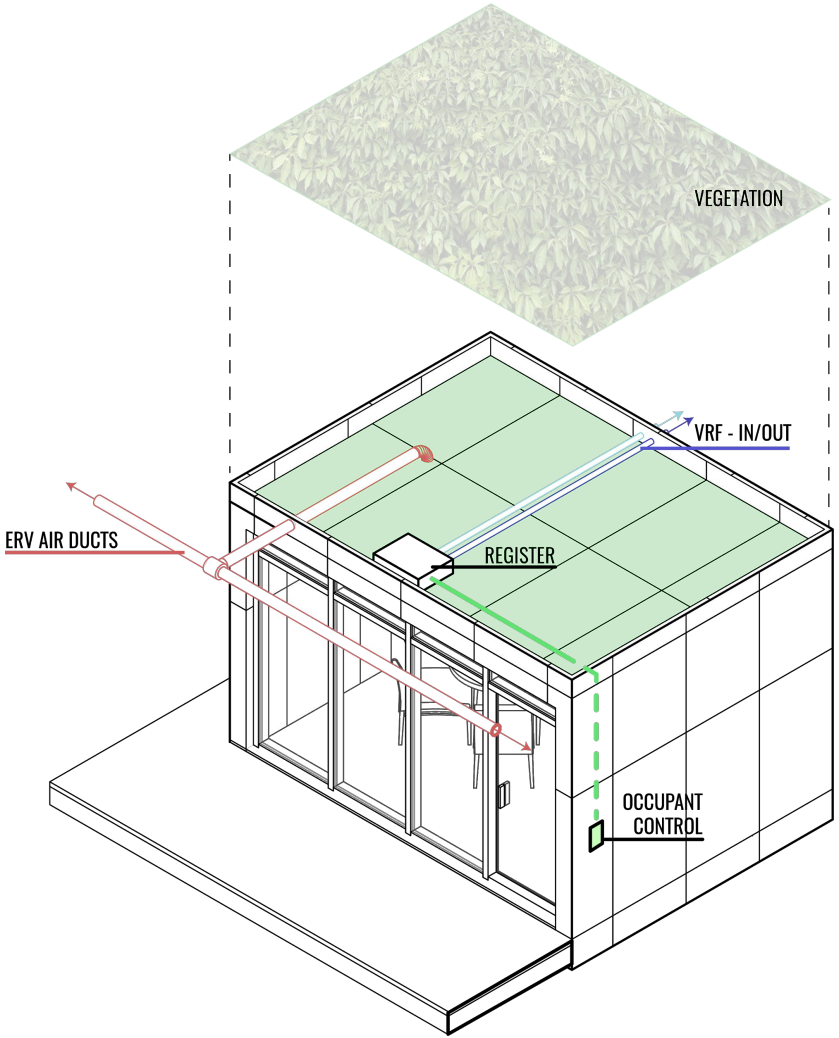
TYP. FLOOR | OPEN ATRIUM | ATRIUM ENCLOSURE | INT. MANIPULATION | PROGRAM EXTRUSIONS

THERMAL CONTROL

HVAC | VRF

= Unconditioned Zones





AIR QUALITY

IMPORTANCE

INDOOR AIR CONTAMINANTS

"Employers can improve workforce performance by up to 10% through improvements in the quality of indoor air."

Lawrence Berkeley National Laboratory

Poor indoor air hinders comfort, attention span and productivity, and OSHA estimates that poor indoor air costs employers **$15 billion annually** due to worker inefficiency and sick leave.

OSHA - Green Building Health in Schools

https://www.fsginspections.com/indoor-air-quality/
https://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=federal_register&p_id=13369
https://www.huffpost.com/entry/how-employee-productivity_n_5620941

AIR QUALITY

ELIMINATING VOCs

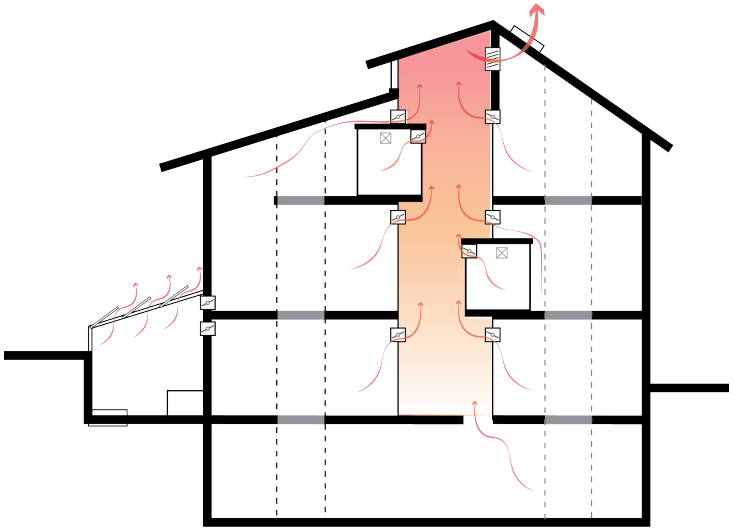
COPY ROOM EXHAUST TO OUTSIDE

“According to the EPA, the air inside buildings can be two to five times more polluted than the air outside.”

EPA - INDOOR AIR QUALITY

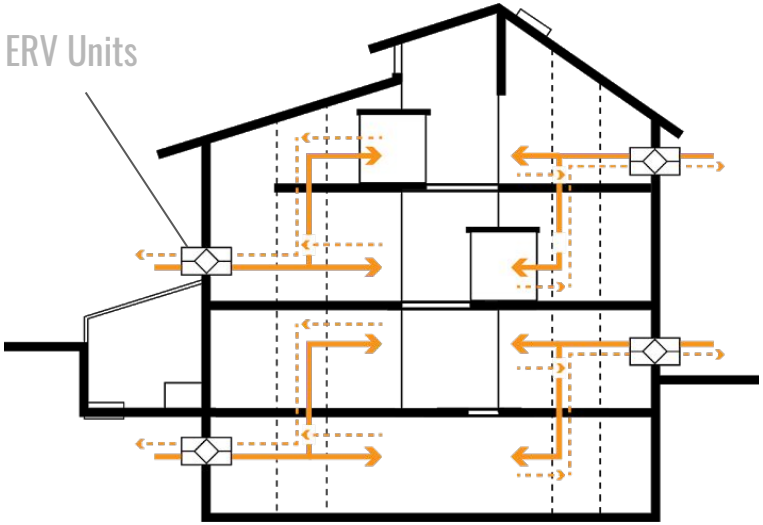
AIR QUALITY

FRESH AIR VENTILATION + ERV



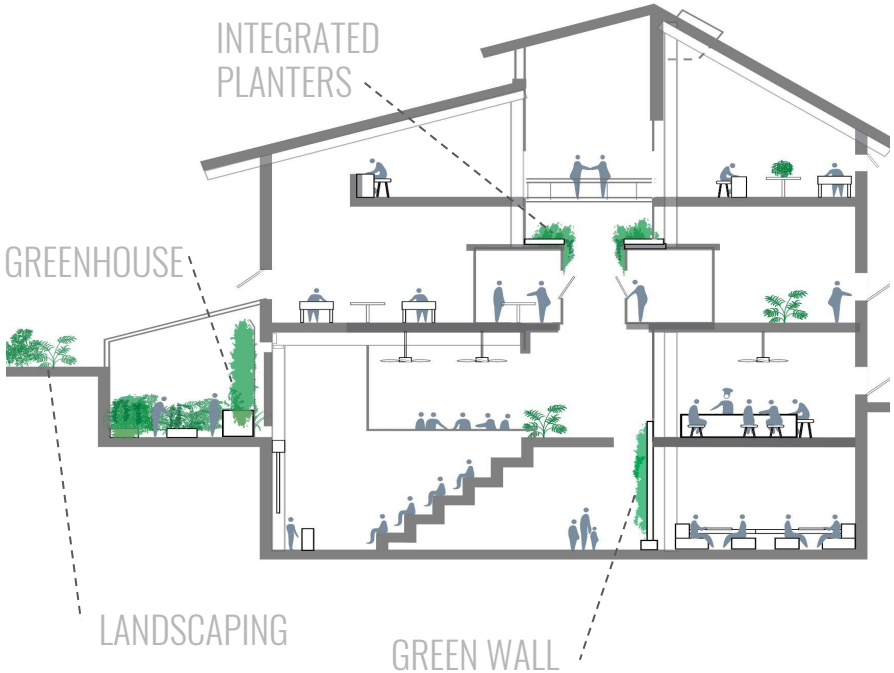
PASSIVE VENTILATION STRATEGIES

+

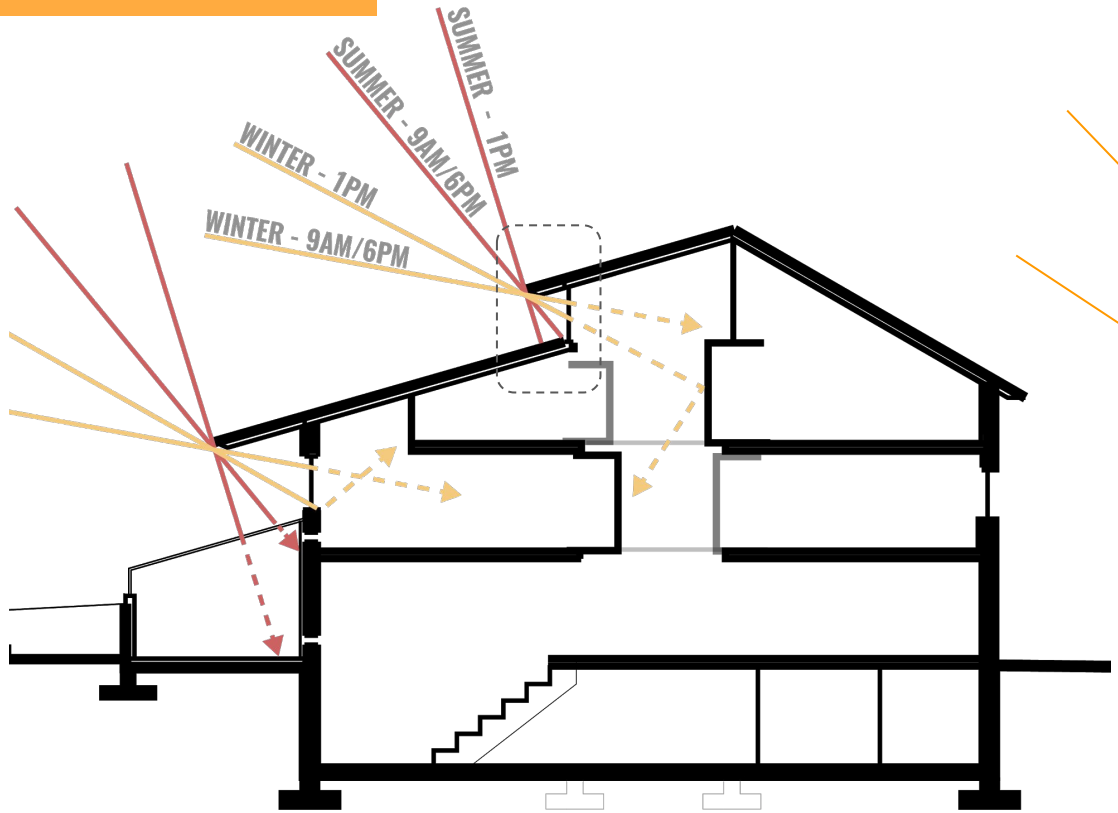


ENERGY RECOVERY VENTILATION

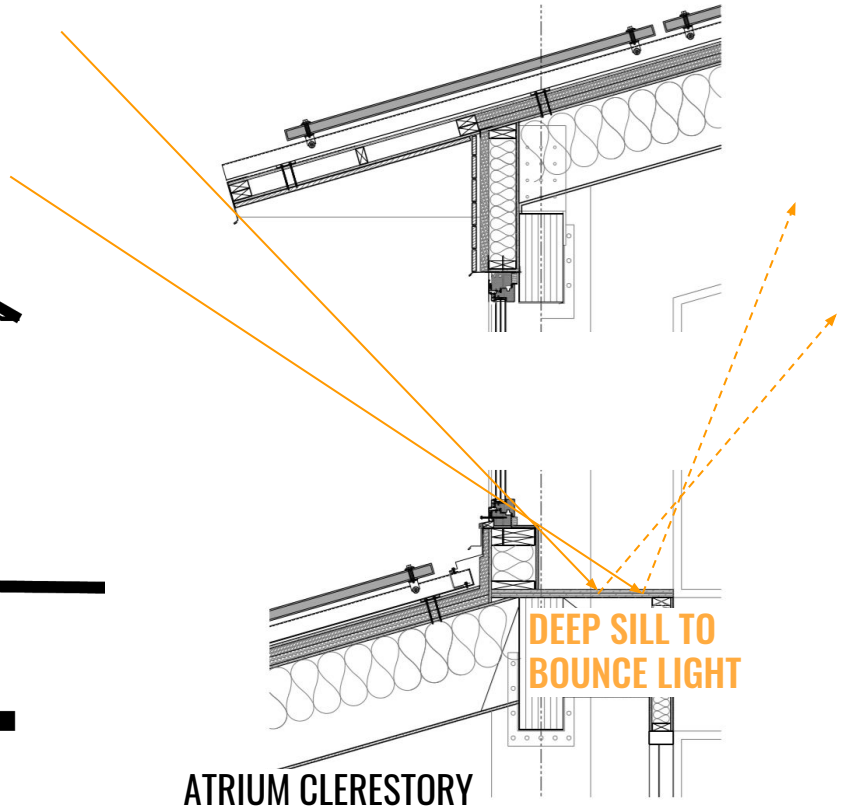
BIOPHILIA



NATURAL DAYLIGHTING



SEASONAL SOLAR ANGLES



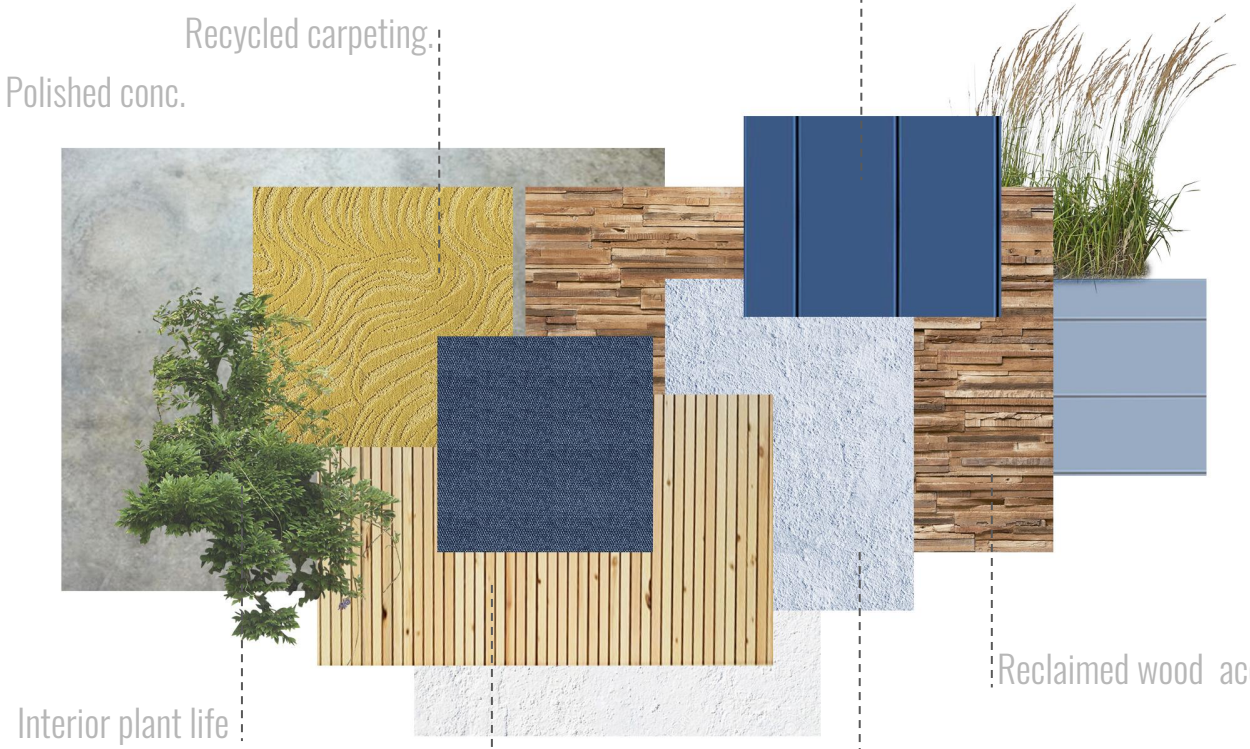
ATRIUM CLERESTORY

INTERIOR LIGHTING

REDUCTION STRATEGIES

1. Optimize natural daylight
2. High efficiency overhead lighting
3. Adaptable task lights
4. Motion sensors

INTERIOR DESIGN



STRUCTURE

MASS TIMBER

DLT - DOWEL LAMINATED TIMBER

✚

GLU-LAM - POST & BEAM STRUCT.

<u>BENEFITS</u>

- Durability & lifespan

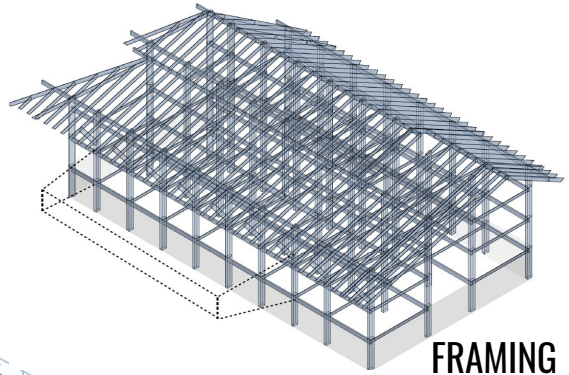
- Acoustic performance (with profiled slab and conc. topper

- Reduction in thermal bridging

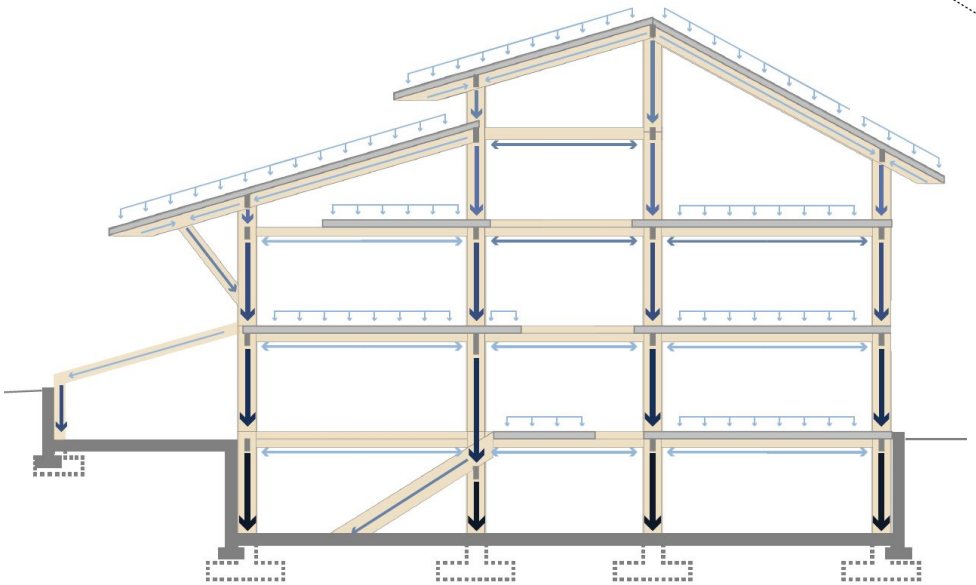
- Resistance to fire damage & seismic events

- Eliminates cost of ceiling finishes

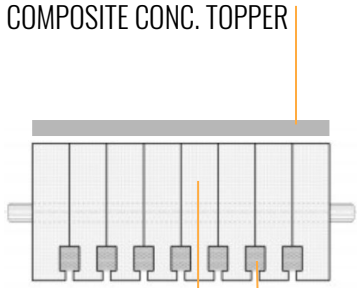
-Reduced building weight → decrease footing sizing



FRAMING



GLULAM - LOAD PATH

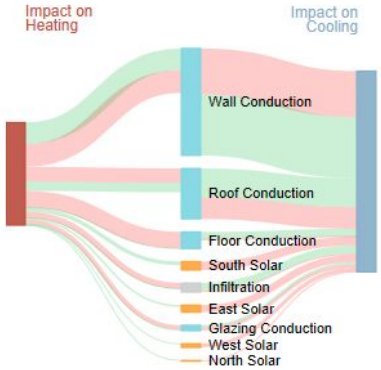


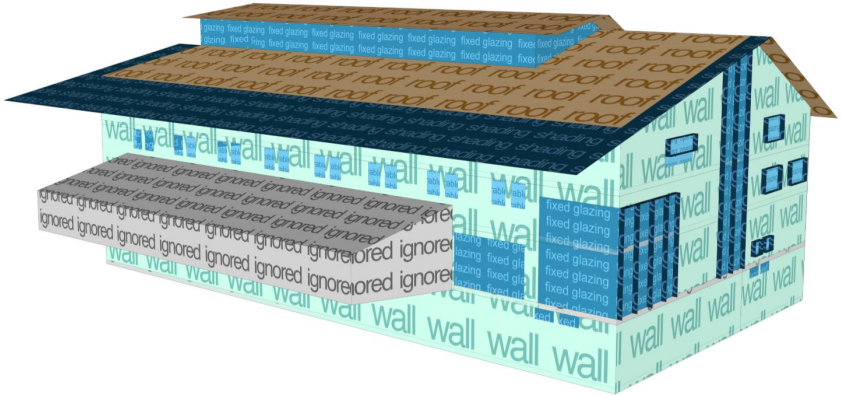
PERFORMANCE BASED ANALYSIS

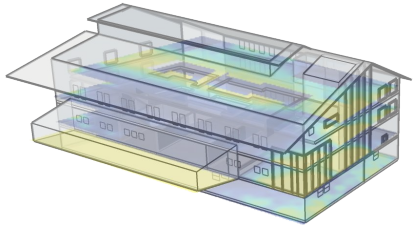
To achieve net zero, the first step is to reduce energy consumption.

PERFORMANCE

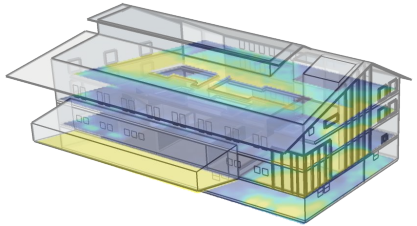
DESIGN ITERATION IN SEFAIRA



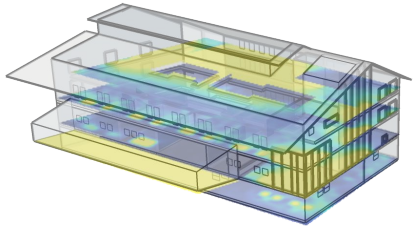




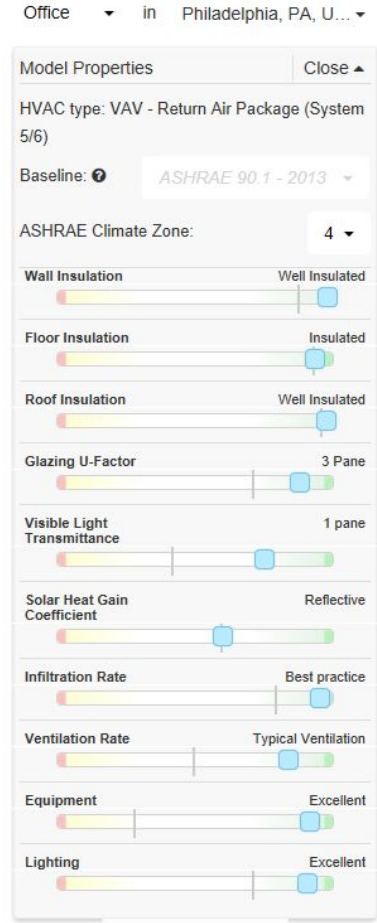
MARCH 21 12PM



JUNE 21 12PM



DECEMBER 21 12PM



PERFORMANCE

ENVELOPE STRATEGIES

NORTH MINIMAL APERTURES, MAXIMIZE CONT. SURFACE AREA

SOUTH THERMAL RETENTION, SHADED OPERABLE GLAZING W/ 1½ STORY TROMBE WALL

EAST MORNING SUN - VERT. SHADE
30% WINDOW TO WALL RATIO

WEST AFTERNOON SUN - ROOF OVERHANG
FACADE TO ENGAGE SCHOOL ENTRY
30% WINDOW TO WALL RATIO

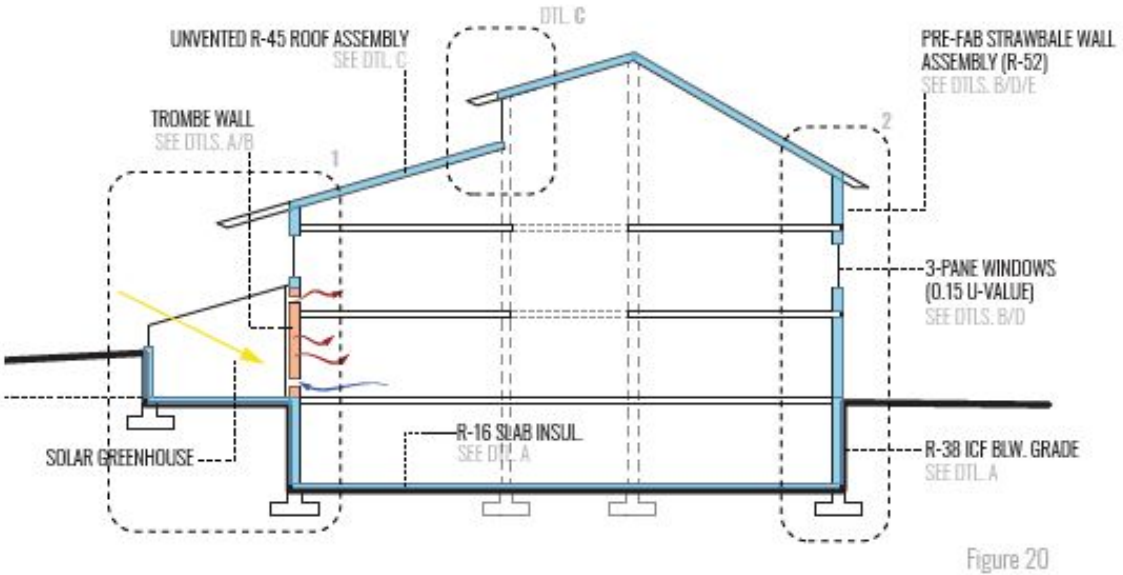


Figure 20

PERFORMANCE

WALL ASSEMBLY

modcell® straw technology

FEATURES

Natural, **low carbon materials** (wood based products + straw bale)

Balances extreme thermal efficiency w/ cost

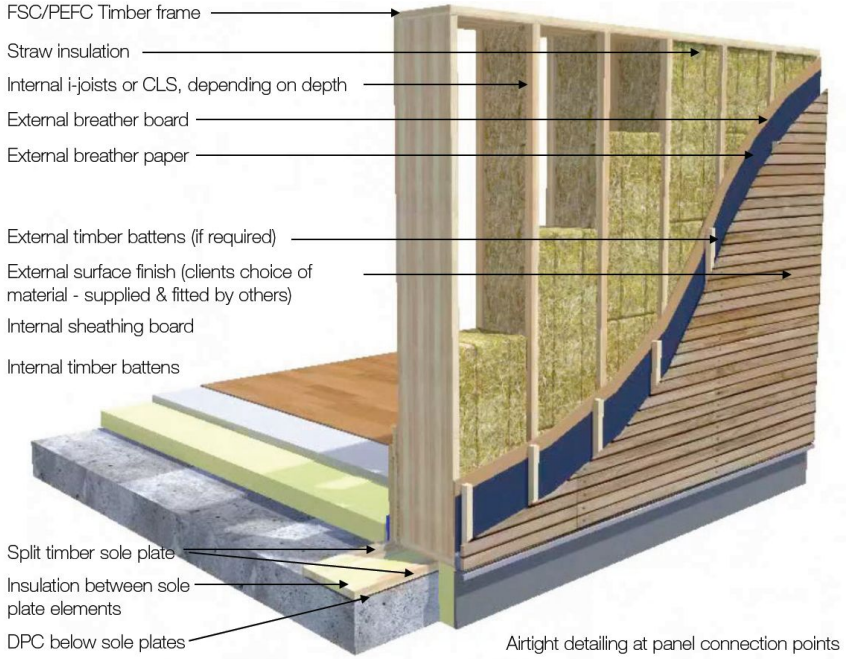
Airtight detailing to Passivhaus standards

Speed of construction (**pre-fabrication** near site)

Provides **acoustic** sound dampening (-50db)

Can achieve up to 2hr **fire rating** (1hr standard)

Constructed in "flying factories," near site, utilizing **locally sourced materials and labor** to reduce carbon footprint

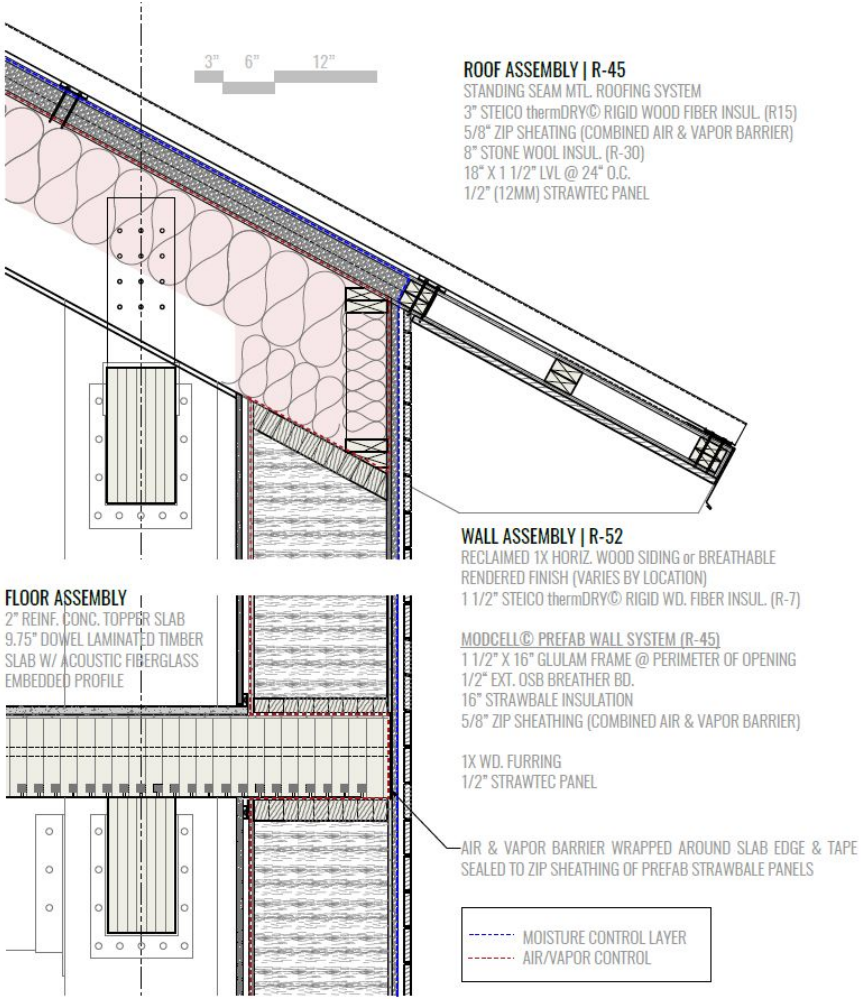


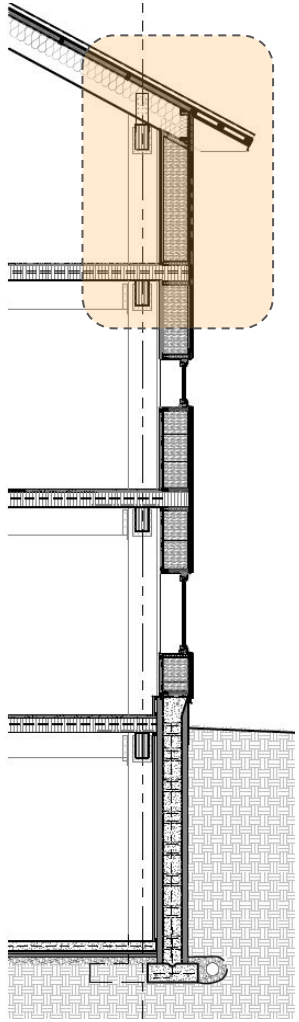
Airtight detailing at panel connection points

* Graphic by MODCELL®

PERFORMANCE

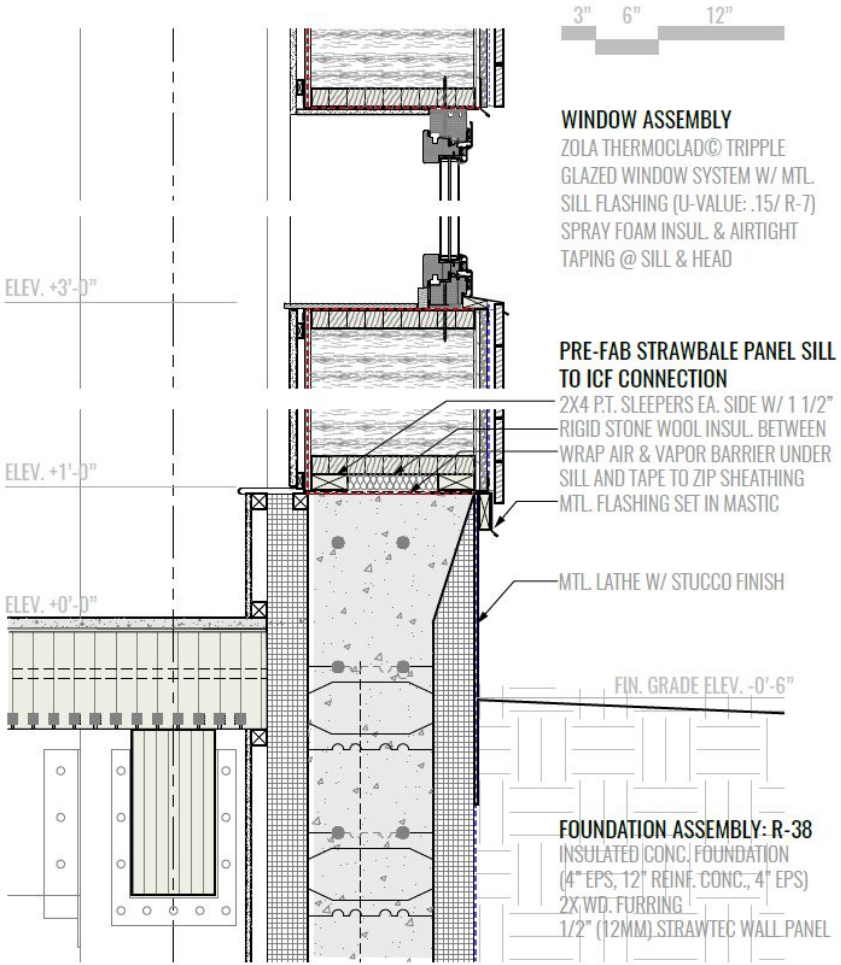
NORTH WALL ASSEMBLY

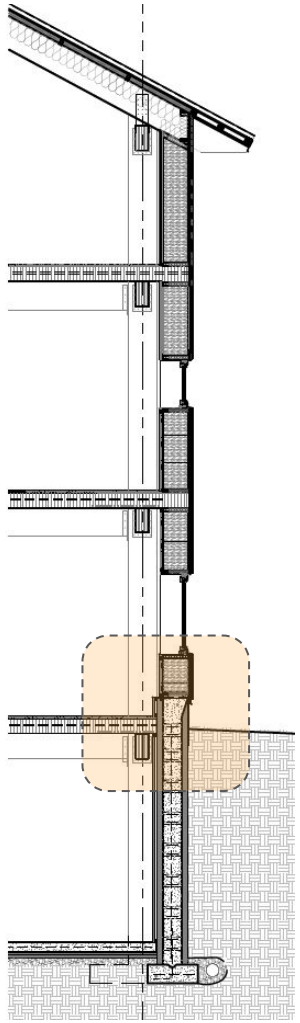




PERFORMANCE

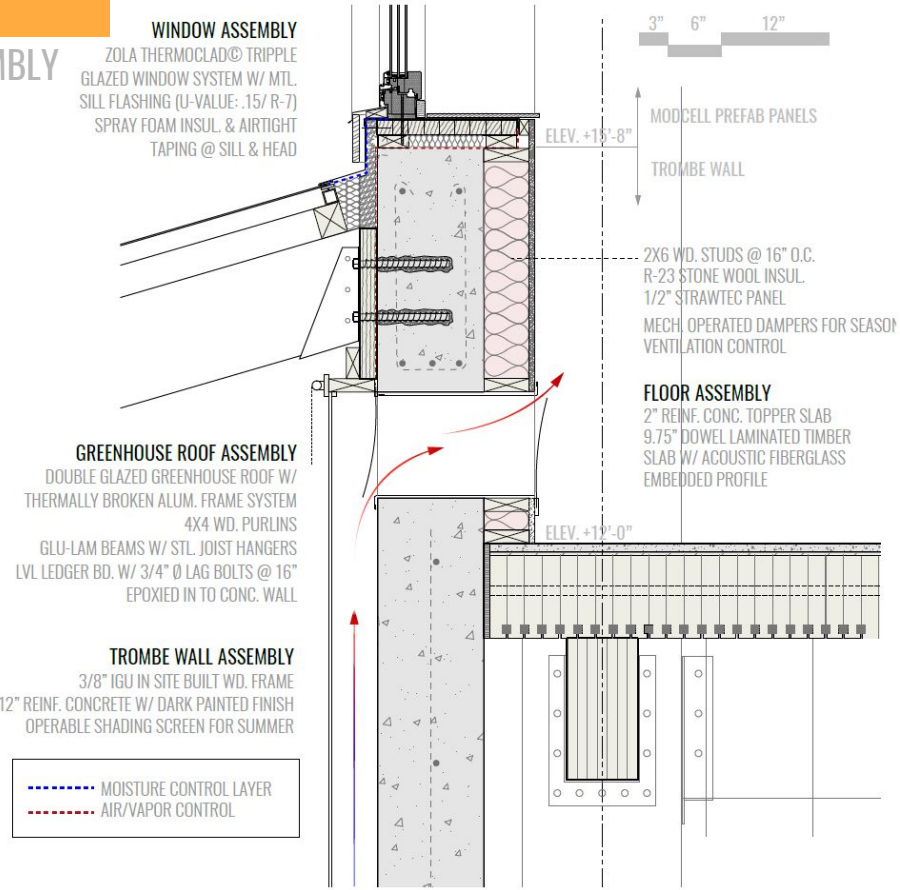
NORTH WALL ASSEMBLY

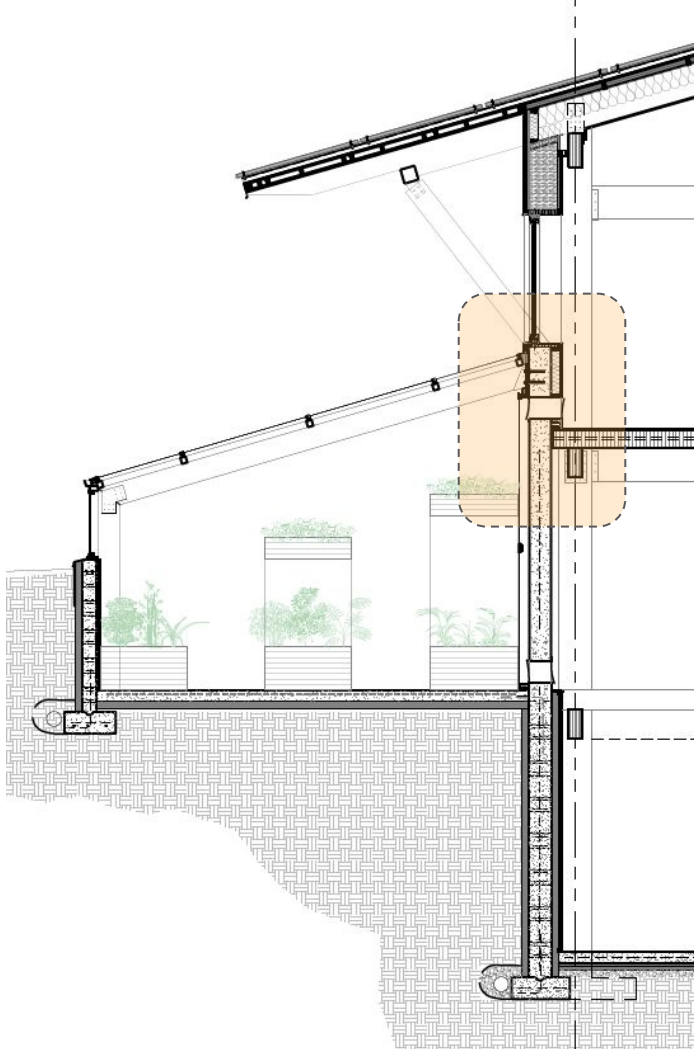




PERFORMANCE

SOUTH WALL ASSEMBLY

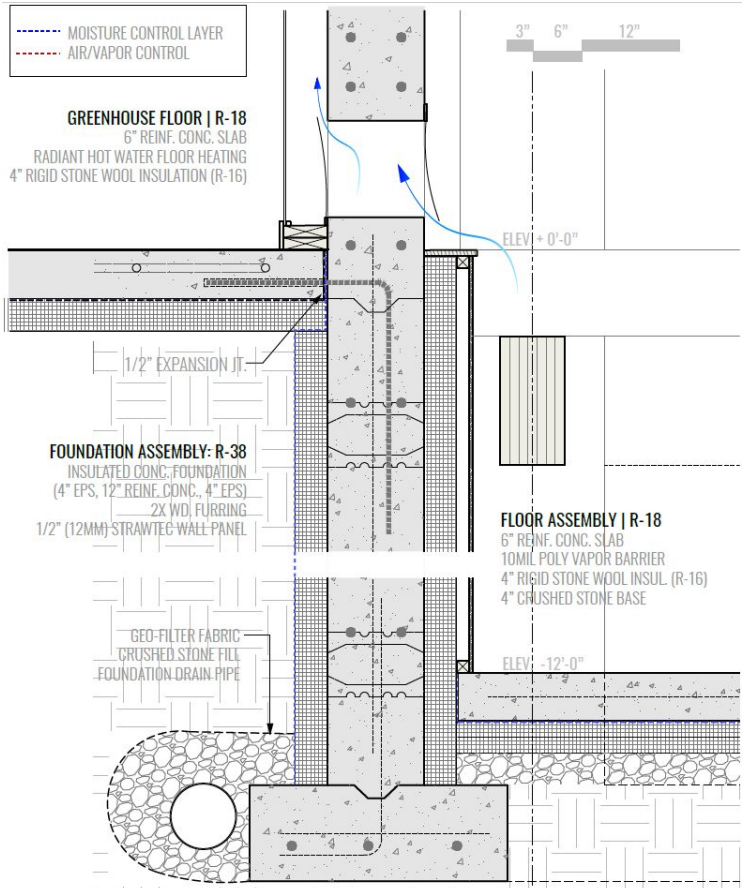


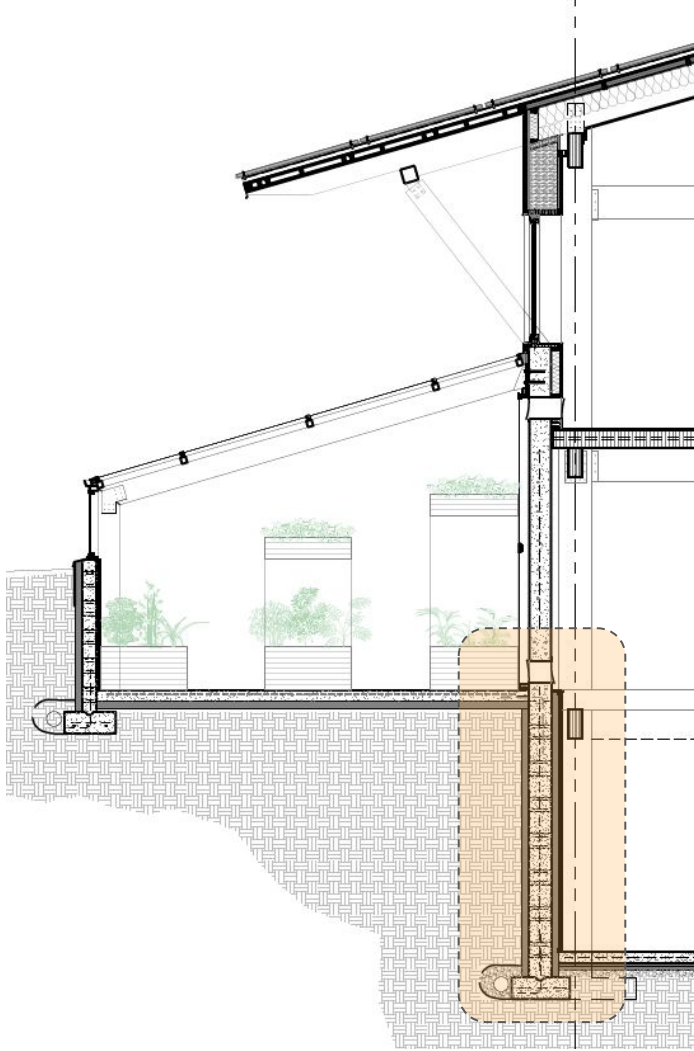


PERFORMANCE

SOUTH WALL ASSEMBLY

GREENHOUSE + TROMBE WALL





HEATING & COOLING

VRF + ERV

Energy Recovery Ventilation (ERV)

ERV Supply

ERV Return

VRF Register

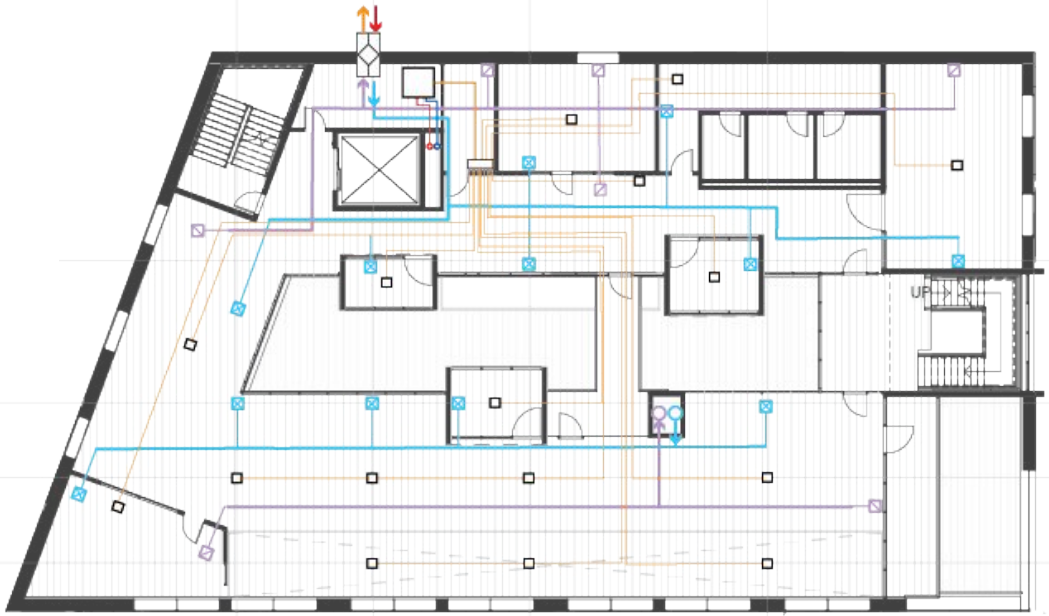
VRF Refrigerant Flow

Stale Cool Air

Outdoor Air (cold)

Stale Warm Air

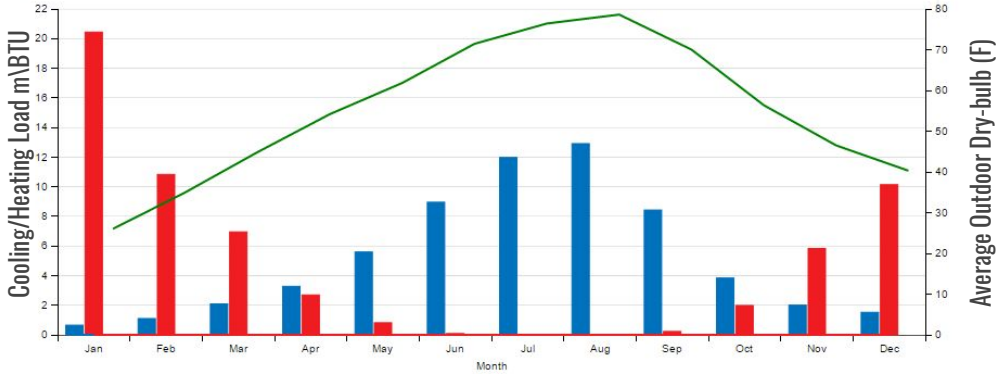
Outdoor Air (warm)



Typical Office Floor

HVAC Load Profiles

Monthly Load Profiles - view table



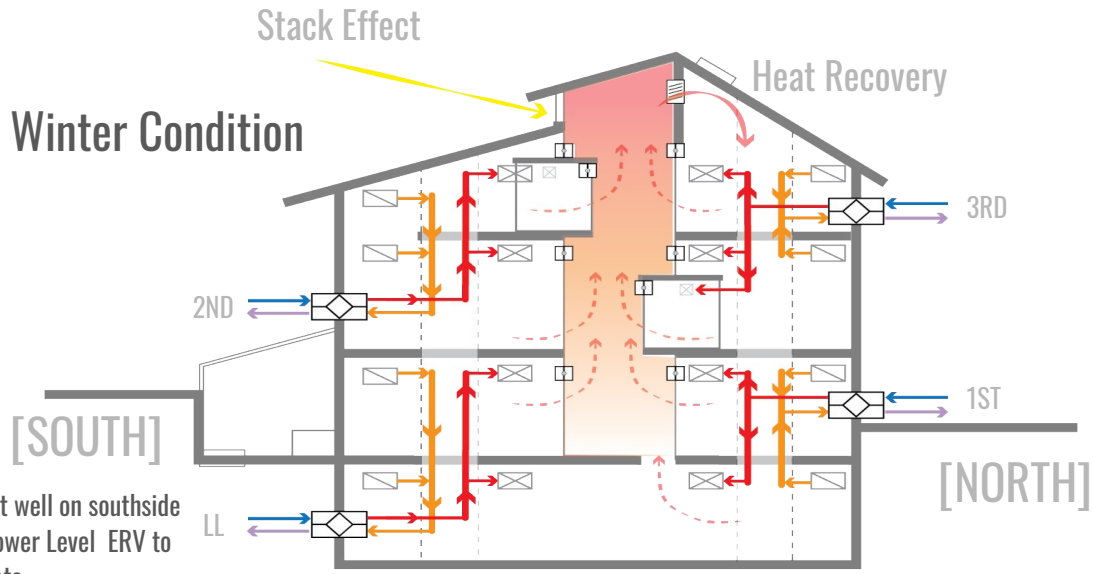
Cooling Loads

Heating Loads

Outdoor Temperature

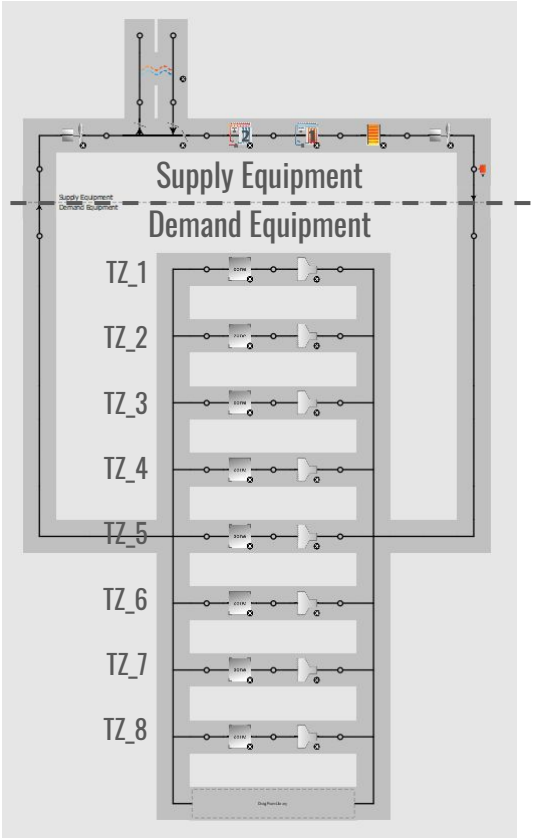
HEATING & COOLING

ERV Strategy



*Light well on southside for Lower Level ERV to operate

- Stale Cool Air
- Outdoor Air (cold)
- Stale Warm Air
- Outdoor Air (warm)
- Exhaust/Recovery Damper
- Open Damper
- Closed Damper
- Energy Recovery Ventilation Unit(ERV)
- Supply
- Return

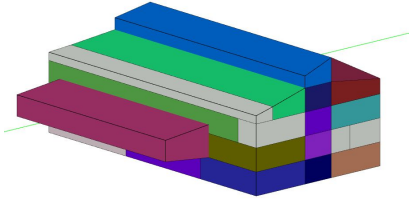


Air Loop for Single ERV

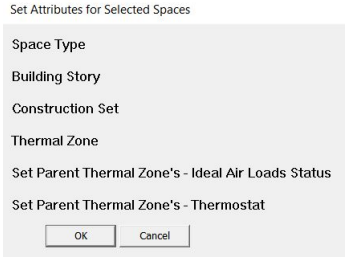
[Openstudio]

ENERGY ANALYSIS

OPENSTUDIO PROCESS

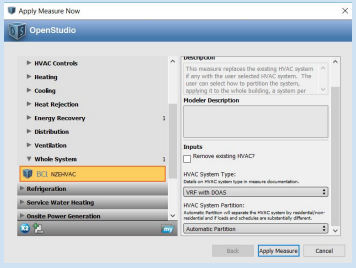


Model thermal zones in SketchUp



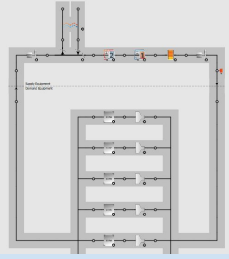
Set attributes: space type & thermal zones

HVAC



Apply measure NZEHVAC: VRF with DOAS

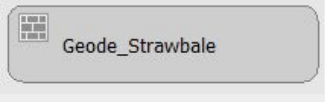
NEW EUI: 21



Air Loop and VRF automatically produced - we adjusted

ENVELOPE

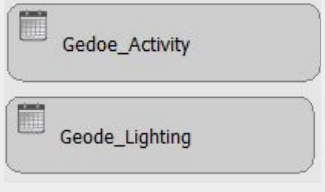
NEW EUI: 17



R Value (ft^2*h*R/Btu)
51.05

Model high performance envelope: strawbale walls, roof + windows

NEW EUI: 16



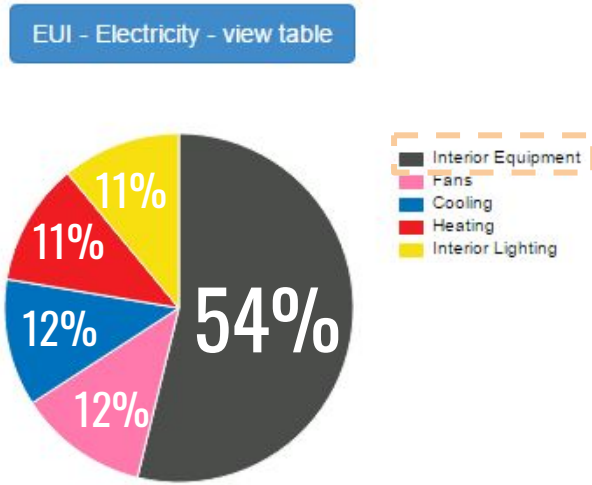
Adjust occupancy schedules and lighting loads

FINAL EUI: 16

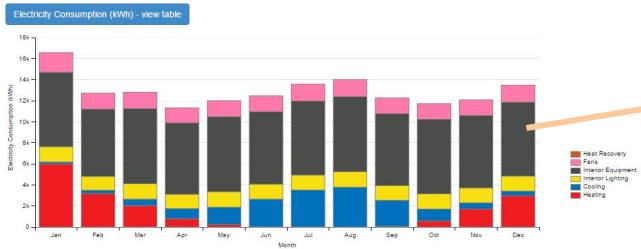
Total Site Energy	529,015 kBtu
Total Building Area	32,575 ft^2
Total Site EUI	16.24 kBtu/ft^2

ELECTRICAL USAGE

INTERIOR EQUIPMENT & PLUG LOADS



Monthly Overview



Screenshots from OpenStudio

Plug Loads Summary

Open Office (7,770 sq. ft.) = 15,000 kwh

Private Office (3,273 sq. ft.) = 7,385 kwh

Second Floor Kitchen (309 sq. ft.) = 11,754 kwh

Cafe (870 sq. ft.) = 34,396 kwh

Second Floor Copy Room (126 sq. ft.) = 4,419 kwh

Educational Programs (885 sq. ft.) = 3,862 kwh

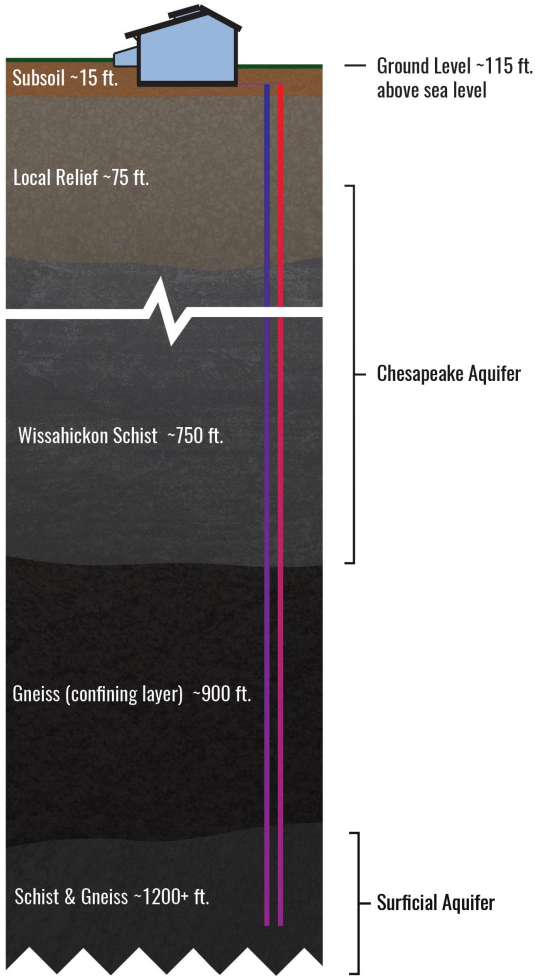
GEOTHERMAL

For every 50 ft of bore, 1 tonne of energy is gained towards mechanical systems.

4:1

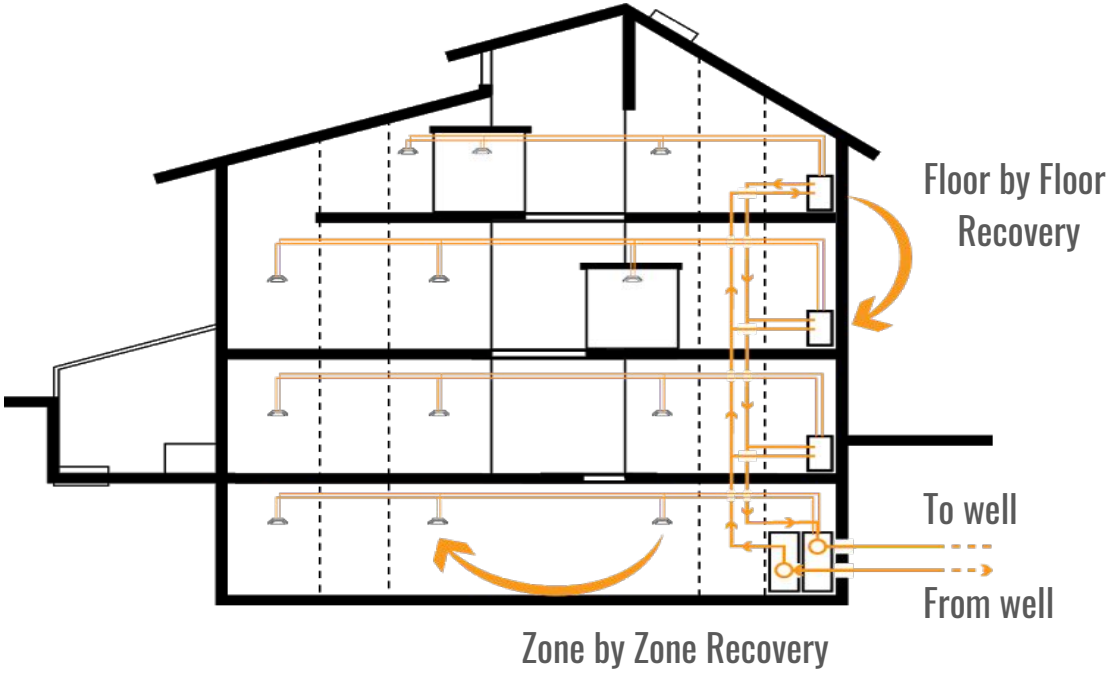
PRODUCTION : CONSUMPTION

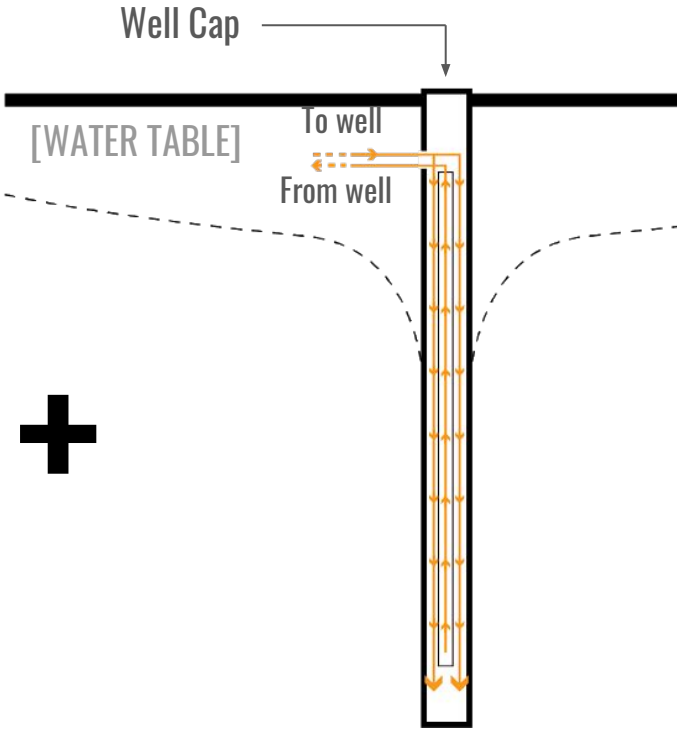
REPLACES THE NEED FOR ROOFTOP PACKAGE UNIT/OUTDOOR CONDENSER



SYSTEM SYNTHESIS

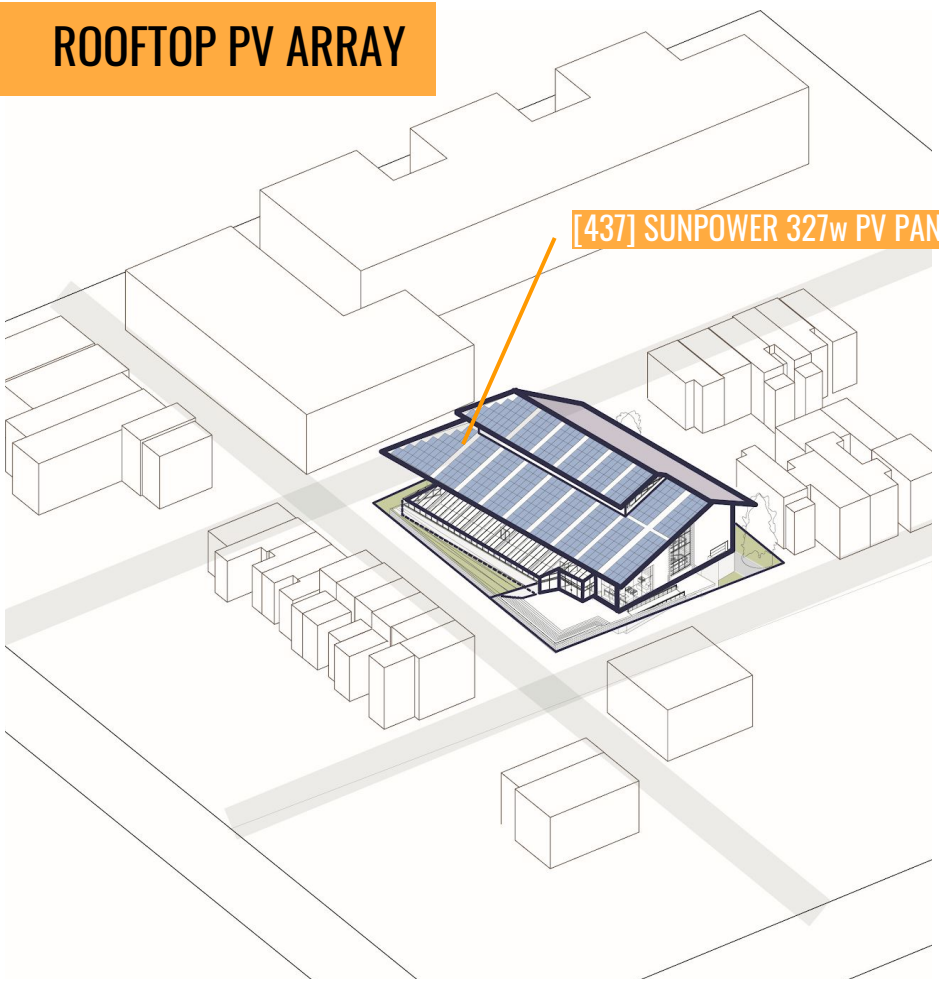
[VRF + ERV + GEO]

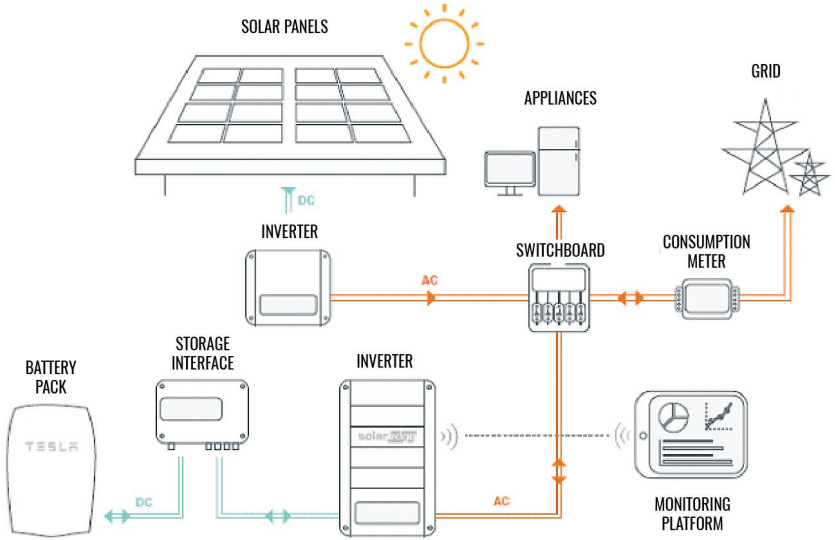




ENERGY GENERATION

ROOFTOP PV ARRAY





20.1% EFFICIENCY

327W / 1000 = .327kW

.327kW x 3.607 hr x 365 days = 430.51 kWh / panel per year

430.51 x 437 panels = 188,134.4 kWh per year

CONSUMPTION

Interior Equipment: 77,903 kWh/yr. + HVAC Systems: 50,312 kWh/yr. + Lighting: 34,082 kWh/yr. = Total Consumption: 162,297 kWh/yr.

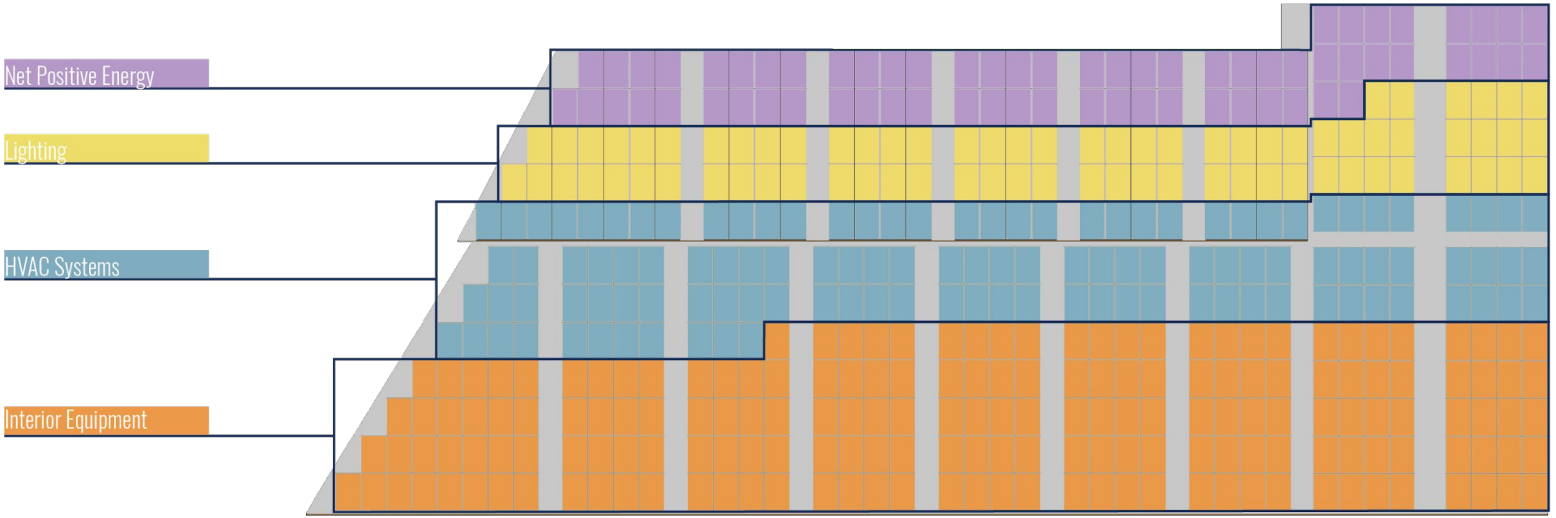
$$\frac{(162{,}297\ \text{kWh/yr.}) \times (3.142)}{31{,}400\ \text{ft.}^2} = 16.24\ \text{EUI}$$

(Pre-renewables)

Energy Production: 188,134 kWh/yr. − Total Consumption: 162,297 kWh/yr. = Net Energy Production: 25,837 kWh/yr.

-3 EUI

(Post-renewables)



SCHOOL CONNECTION

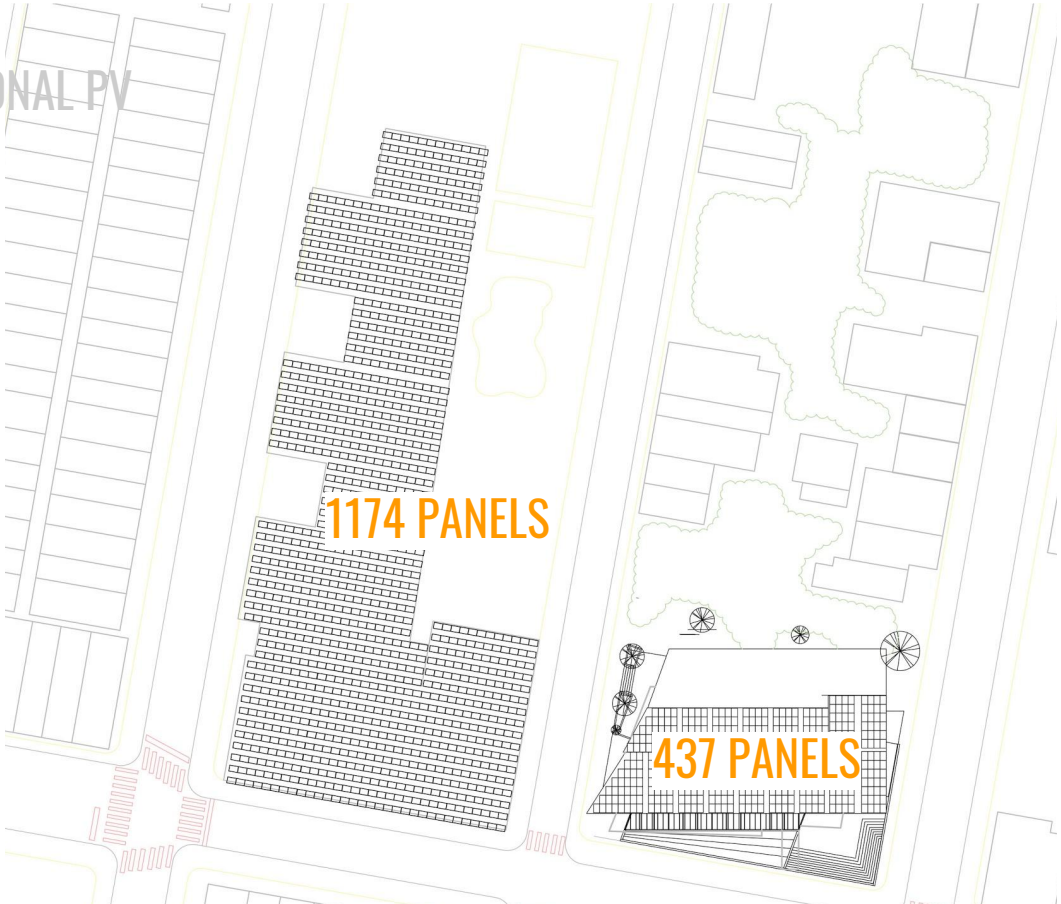
POTENTIAL ADDITIONAL PV

OFFICE BUILDING

430.51 x 437 panels = 188,134.4 kWh per year

WILLIAM D. KELLEY

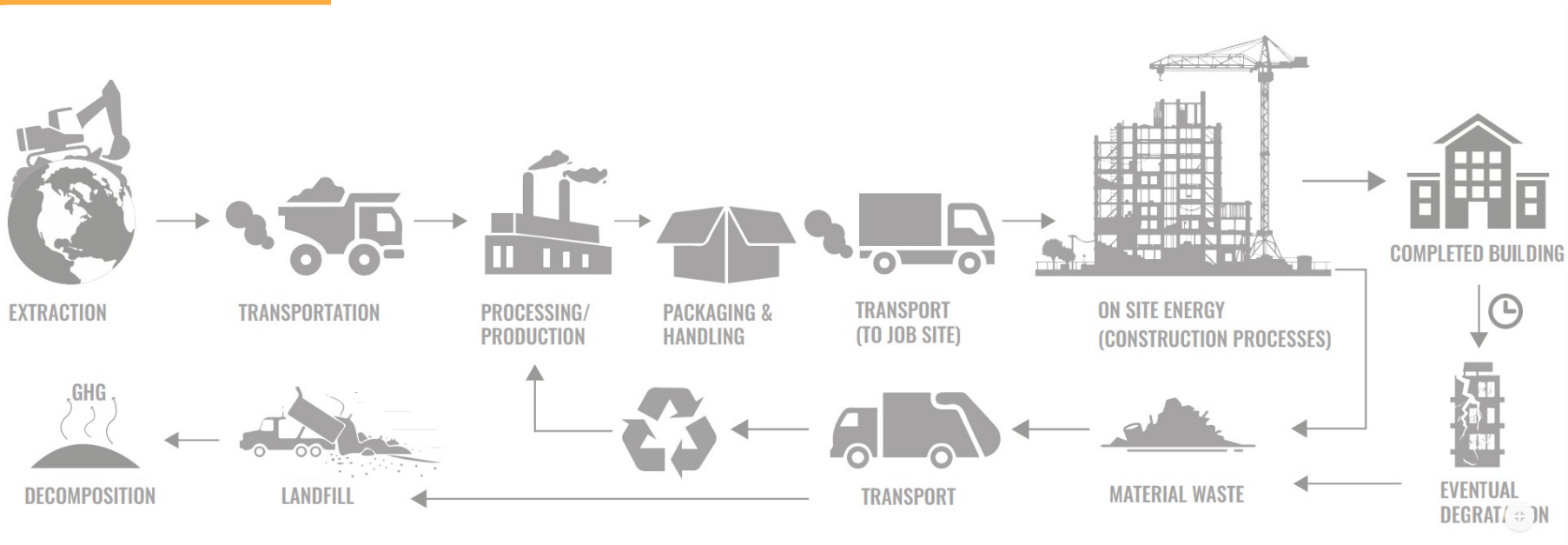
430.51 x 1174 panels = 505,418.74 kWh per year



SITE PLAN - PROPOSED SCHOOL ARRAY

BEYOND NET-ZERO

LOW CARBON



STRATEGIES

ELIMINATE OPERATIONAL ENERGY MASS TIMBER STRUCTURE STRAW BALE WALL ASSEMBLY ALTERNATE INSULATIONS

MINIMIZE ON SITE CONSTRUCTION ENERGY MINIMAL FINISHES ON SITE WATER MGMT.

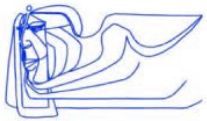
LBC

33% OPEN SPACE

WITH NATIVE PLANTING

100% WATER RETENTION

WITH ADDITIONAL REUSE



BEAUTY

VISUALLY COMPELLING - ENCOURAGES COMMUNITY TO CARE AND UTILIZE BUILDING

SURPLUS ENERGY

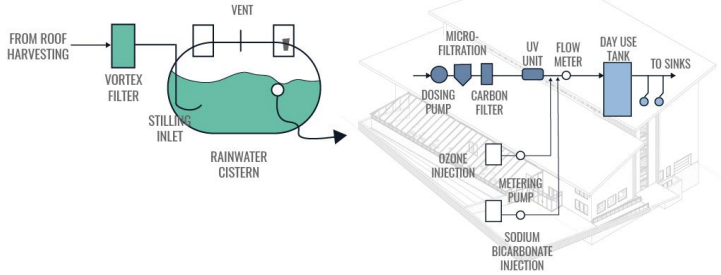
SOLD BACK TO GRID

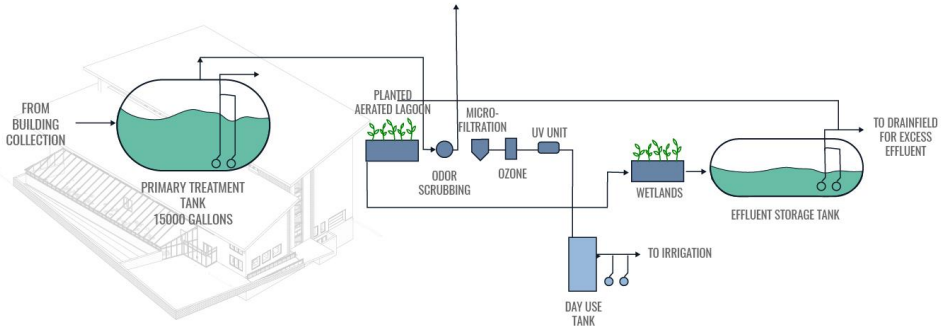
COMMUNITY PROGRAMMING

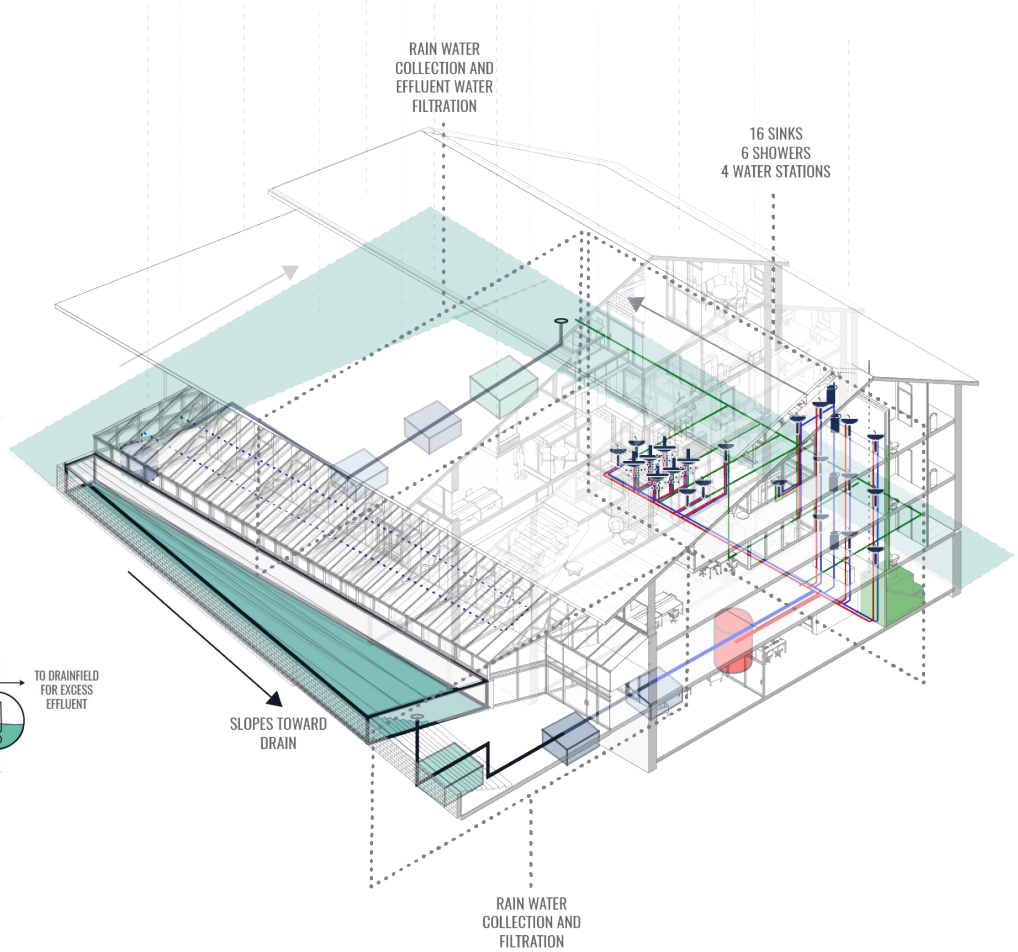
SOCIAL EQUITY

ZERO VOC MATERIALS

WATER MANAGEMENT

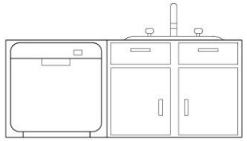






WATER CALCS

TOTAL OCCUPANT USAGE



DISHWASHER KITCHEN SINK

SHOWER REFILLABLE WATER STATION BATHROOM SINK

185,237 gallons per year

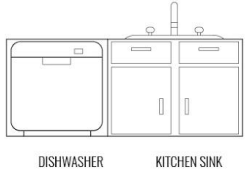
\+

TOTAL GREENHOUSE USAGE

32,000 gallons per year

\+

TOTAL CAFE USAGE



DISHWASHER KITCHEN SINK

292,000 gallons per year

AVERAGE ANNUAL RAINWATER **+562,256** gallons per year

TOTAL WATER USAGE IN BUILDING: **511,237** gallons per year

ESTIMATED POTABLE CISTERN SIZE: **10,000** gallons

FILTRATION CISTERN SIZE: **50,000** gallons

LEED V4 GOING PLATINUM

YES: 81

LIKELY: 17

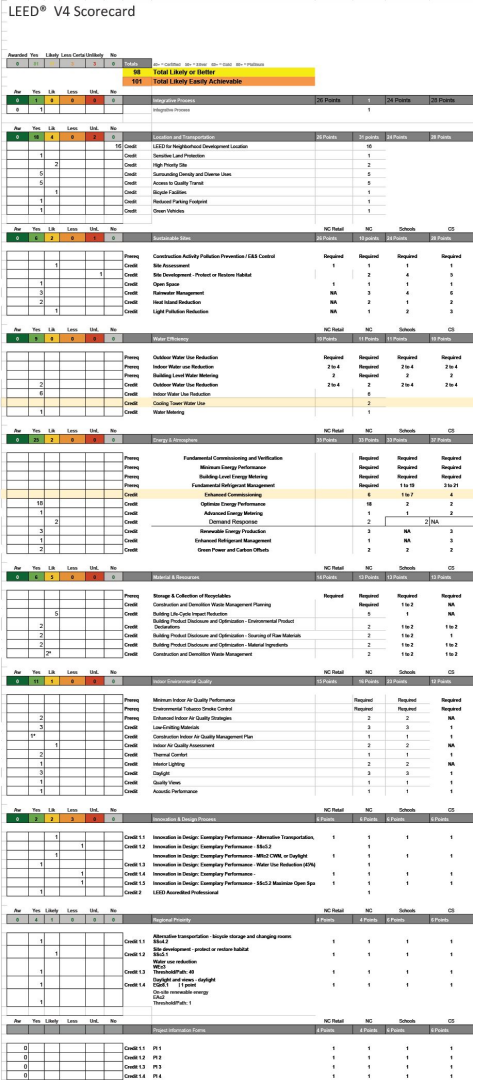
LESS CERTAIN: 3

UNLIKELY: 3

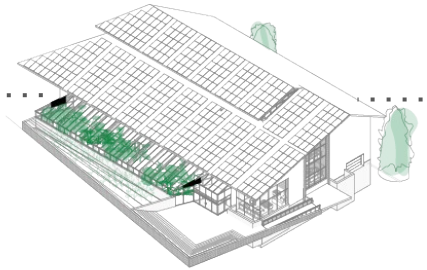
SCORECARD TOTAL: 98 LIKELY OR BETTER

SCORECARD TOTAL: 101 TOTAL LIKELY EASILY ACHIEVABLE

LEED SCORECARD



COMMUNITY IMPACT



Farming Initiatives

Home Ownership

Education Outreach

Job Fairs

CONCLUSIONS

COST ANALYSIS

Foundation: $775,000

Structure: $2,100,250

Interior Finish: $700,000

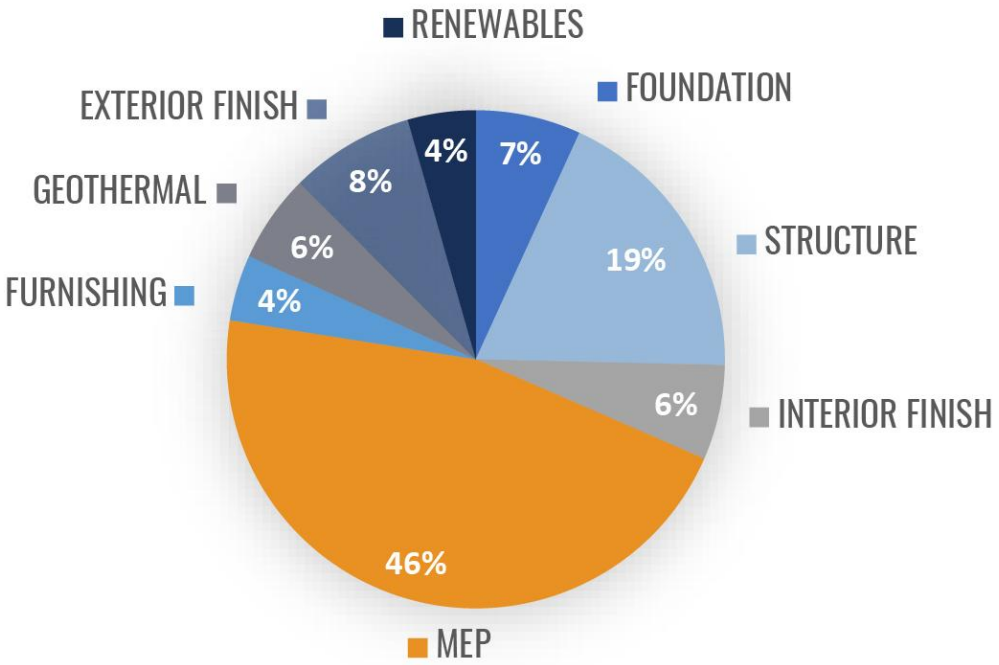
MEP: $5,212,000

Furnishing: $485,000

Geothermal: $650,550

Exterior Finish: $913,000

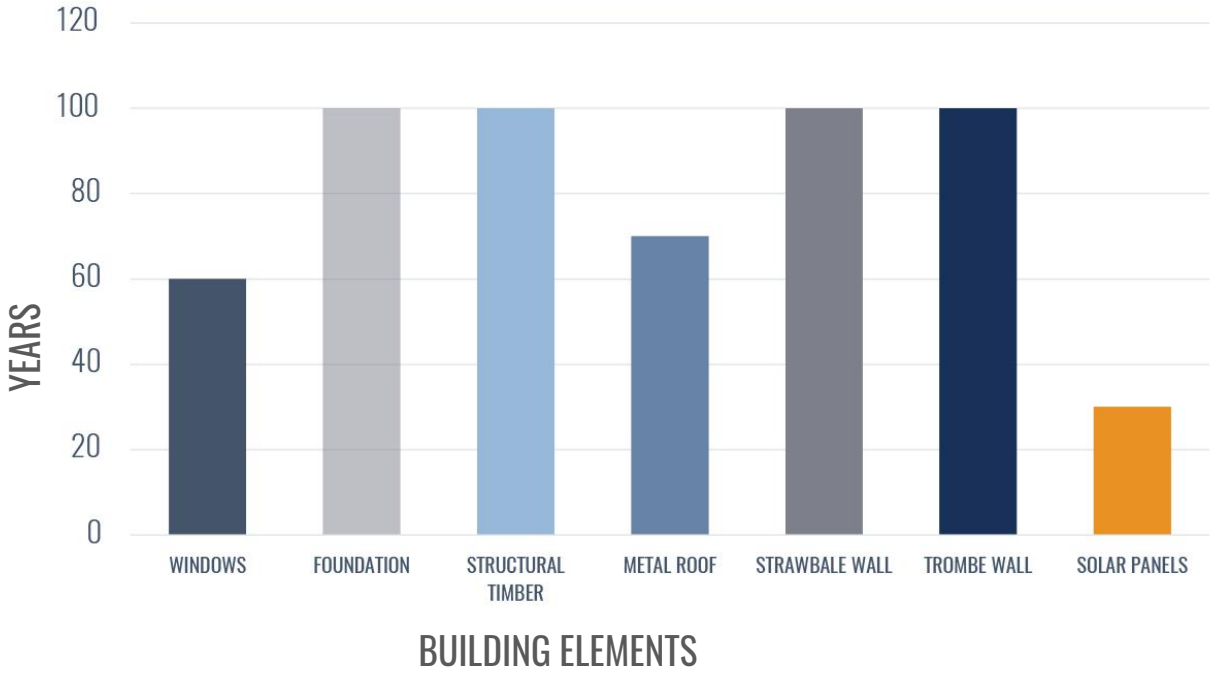
Renewables (PV Panels): $500,000



TOTAL CONSTRUCTION COST: $11,335,800

RESILIENCE

MATERIAL DURABILITY & LIFESPAN



HEALTHY + BEAUTIFUL BUILDING

MARKET POTENTIAL

FUNDING SOURCES

NEW MARKET TAX CREDITS:	$ 2,680,000
RACP:	$ 4,000,000
PRIVATE DONORS:	$ 2,800,000
CITY OF PHILADELPHIA:	$ 500,000
TOTAL	$ 9,980,000

CONSTRUCTION COST:
$11,335,800

FUNDING GAP:
$ 1,355,800

Operational Building Expenses (annually)

Power Utilities-	$0
Grounds upkeep -	$3,000
Building Admin -	$65,700
Pest Control -	$3,000
Waste removal -	$8,000
Building Security (personnel & systems)-	$60,000
TeleCom & WIFI-	$3,000
Cleaning -	$31,400
Insurance -	$9,420

Total Expenses - $182,820

Building Revenue (annually)

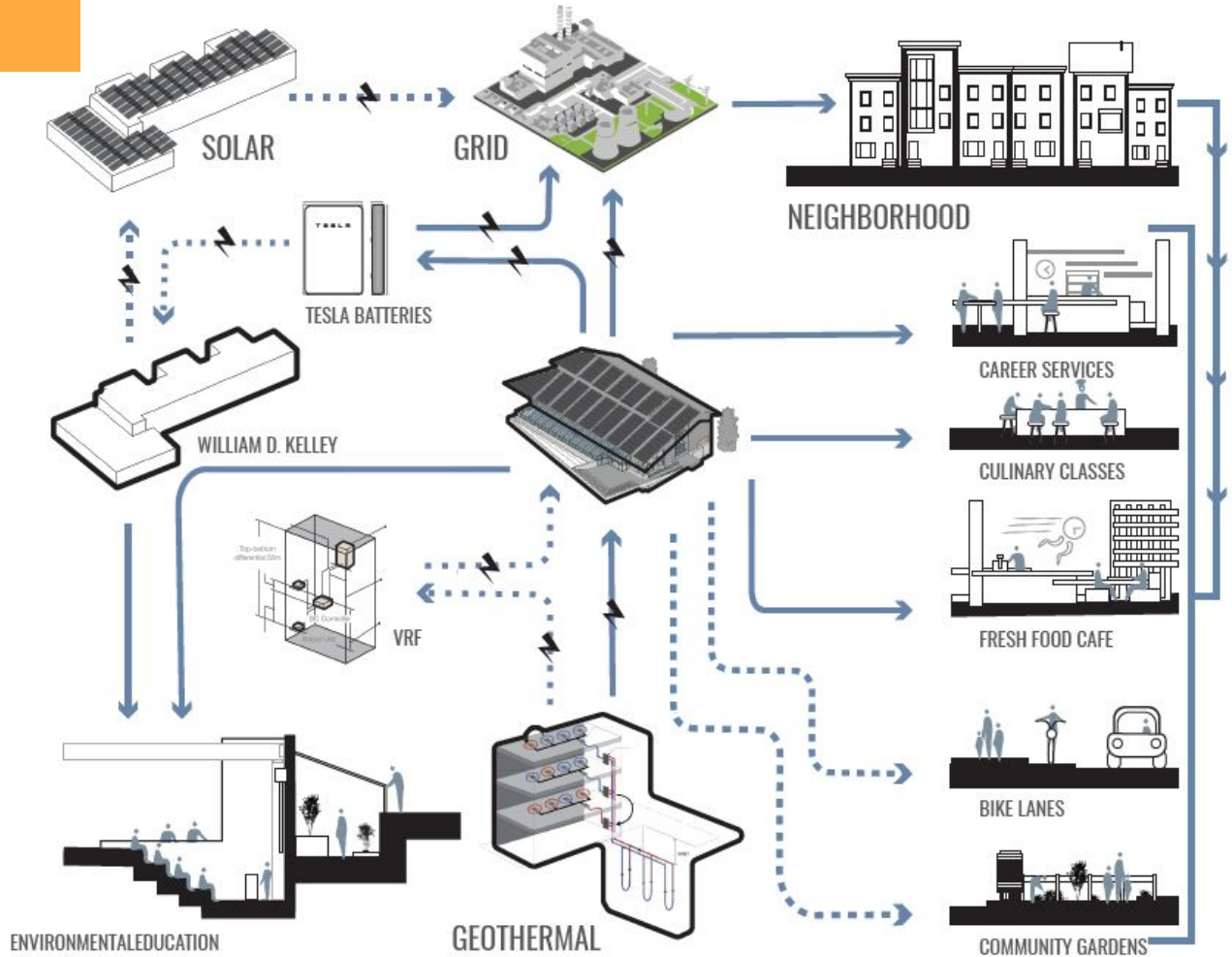
Greenhouse - 2,000 SF x $20 = $40,000

Office Space (Shared & Private)
36 shared desks x $300/month/desk = $129,600
8 private offices x $900/month/office = $86,400

Cafe - 700 SF x $25/sf/month = $210,000
Total Revenue - $466,000.00

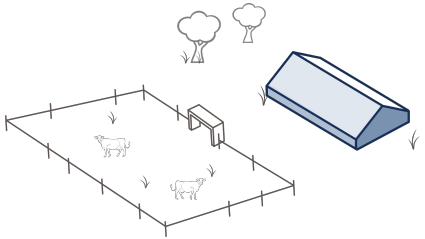
Net Annual Revenue: $283,180

THE MODEL


SOLAR
GRID
NEIGHBORHOOD
TESLA BATTERIES
CAREER SERVICES
WILLIAM D. KELLEY
CULINARY CLASSES
VRF
FRESH FOOD CAFE
BIKE LANES
ENVIRONMENTALEDUCATION
GEOTHERMAL
COMMUNITY GARDENS

THE MODEL

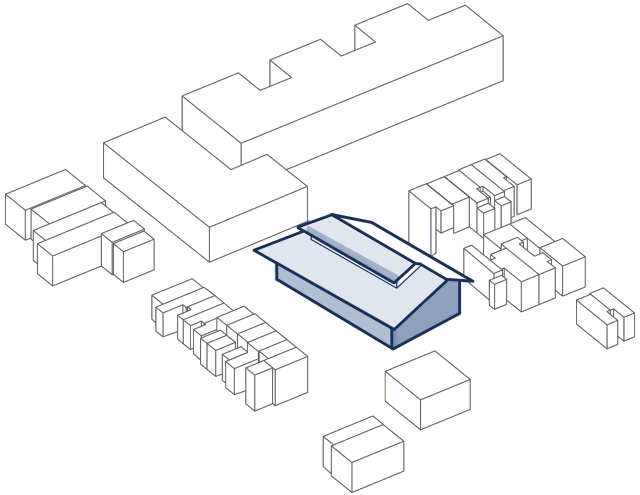
SCALING THE MODEL



SMALL SCALE CONTEXT

5:1

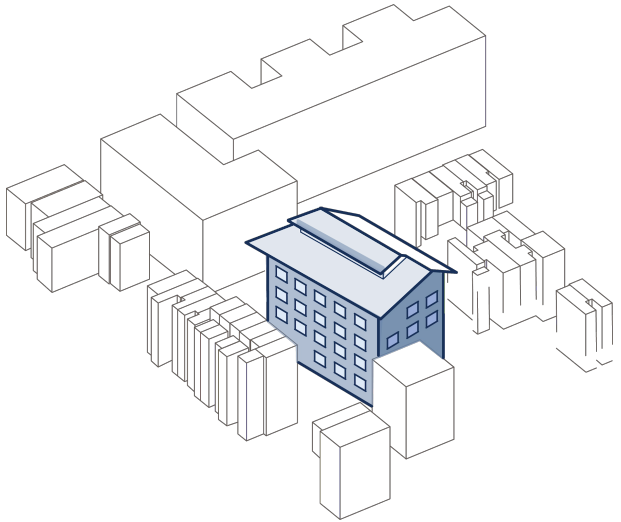
PRODUCTION TO USAGE



OPTIMUM CONTEXT SCALE

1:1.5

PRODUCTION TO USAGE



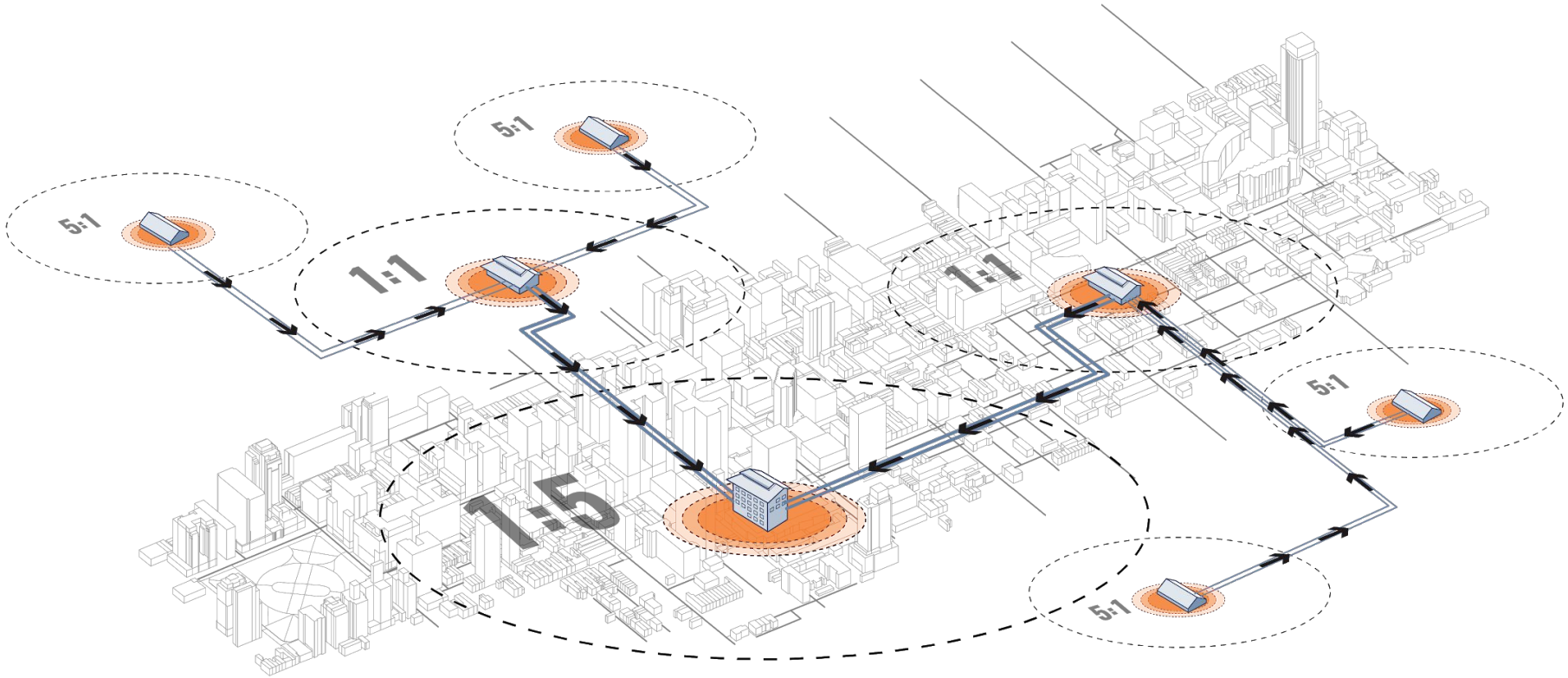
DENSE URBAN CONTEXT

1:5

PRODUCTION TO USAGE

EXPAND THE MODEL

COUPLING THE CITY GRID



THANK YOU

Supplemental Materials

CASE STUDIES

MODCELL WALL ASSEMBLY

INSPIRE BRADFORD BUSINESS PARK

LOCATION: Bradford, UK

TYPOLOGY: Office

COMPLETED: 2019

SIZE: 30,000sqft.

Highlights:

Largest straw bale development in Europe

Houses 14 serviced offices and 14 managed work spaces

Utilizes 260 thermally efficient, prefabricated ModCell® straw bale wall panels assembled at the nearby Flying Factory™

Funding provided by a variety of local, federal, and EU funding sources as well as by non-profits

CASE STUDIES

MODCELL WALL ASSEMBLY

YORK ECO DEPOT

LOCATION: York, UK

TYPOLOGY: Office

COMPLETED: 2007

SIZE: 14,000 sqft.

Highlights:

- Utilizes 78 large scale MODCELL panels

- The structure combines a thermally massive floor deck and a laminated timber frame

- Integrated with an entirely passive natural ventilation system

ModCell® Core - Manufacturing and install process

A

Straw bales are chopped to predetermined size and act as the insulation material.

B

Engineered timber arrives 'flat packed' to flying factory minimising the embodied carbon resulting from transportation.

C

Panel frames are assembled in a flying factory.

D

Panel frames are assembled.

E

Panel assembled and closed to one side prior to being flipped over to have straw installed

F

Straw is installed into panel

G

Panels are closed and uniquely marked as part of ISO 9001 2017 quality management system

H

Panel are delivered to site ready for installation

I

Panels are located onto a sole plate. This also assists when creating an air-tight seal between the base of the panel

J

Panels are joined together to create an air-tight detail and maximise the integrity of the overall structure.

K

Panel now installed and await final internal and external finish surfaces.

L

Panels can act structurally or connected to other structural elements, depending on the clients

CASE STUDIES

Standing Column Geo

Friends Center Philadelphia

LOCATION: 1501 Cherry Street,
Center City Philadelphia

TYPOLOGY: Multi-Use,
Religious Institution

COMPLETED: 2009

SIZE: 56,000 sqft.

Highlights:

Friends Center seeks to be a place that nurtures awareness of the presence of God, enlivens work for peace and justice, and invites the highest aspirations of the human spirit.

Closed Loop Vertical Well Field

Standing Column Geothermal Wells

Vertical Geothermal = 40 bore holes @ ~500 ft
Standing Column = 2 bore holes @ ~1200 ft

Viability + Potential

To determine the viability for geothermal in our region, we identified a successful application of the system within a 3 mile radius of our site. **The Friends School** uses a standing column geothermal with 6 bore holes penetrating between 1000-1500 ft into the earth. 80% of all geothermal on the east coast consists of standing column because it is the most viable option for a heating dominated climate zone. (source 2) Despite going deep into the ground, the standing column requires far less bore holes:

1: https://www.friendscentercorp.org/?page_id=657
2: http://northeastgeo.com/standing-columns/
3: https://www.builditsolar.com/Projects/Cooling/EarthTemperatures.htm
4: https://www.researchgate.net/publication/303413357_Standing_column_wells/figures?lo=1

CASE STUDIES

Geothermal

Fedigan Hall, Villanova Campus

LOCATION: 800 E. Lancaster Ave,
Villanova, PA 19085

TYPOLOGY: Dormitory, Student Housing

COMPLETED: 2013

SIZE: ~12,000 sqft.

Highlights:

Villanova installed a geothermal system in Fedegan Hall to help reduce the building's dependency on electrically-generated heating and cooling. Geothermal systems use the constant temperature of the earth's crust to cool air in the summer-time, and warm air in the winter time.

https://www1.villanova.edu/villanova/sustainability/CampusSustainabilityBuildingsGroundsStormwaterDiningRecycling/EnergyClimateSustainability.html

CASE STUDIES

Water-Source VRF + Geothermal

Judge William Lewis House, Strawberry Mansion

LOCATION: 2450 Strawberry Mansion Dr,
Philadelphia, PA 19132

TYPOLOGY: Residential,
Fairmount Park Services

COMPLETED: 1789, 2009

SIZE: 10,000 sqft.

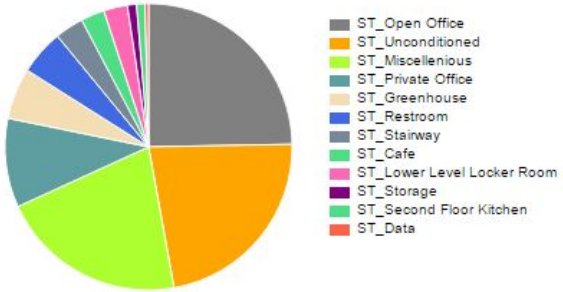
Highlights:
A 2-pipe water-source VRF zoning system tied into the mansion's existing geothermal well field and saved $50,000 up front on installation costs when compared to a 4-pipe system.

http://www.mitsubishicomfort.com/sites/default/files/case-study/strawberry_mansion_case_study.pdf

OPENSTUDIO OUTPUTS

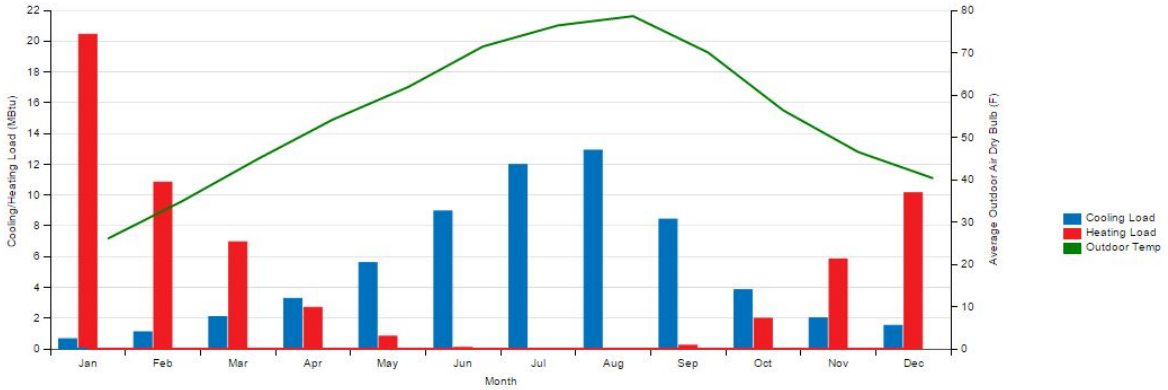
Space Type Breakdown

Space Type Breakdown - view table

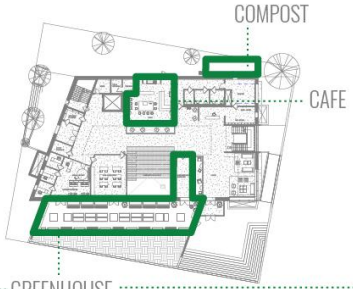


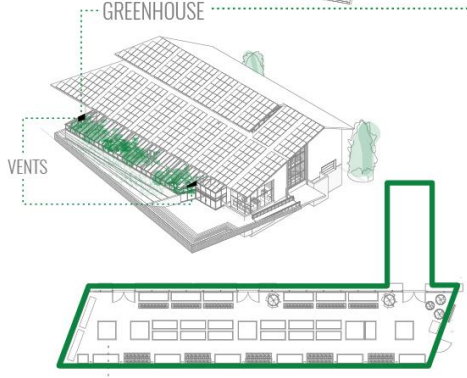
HVAC Load Profiles

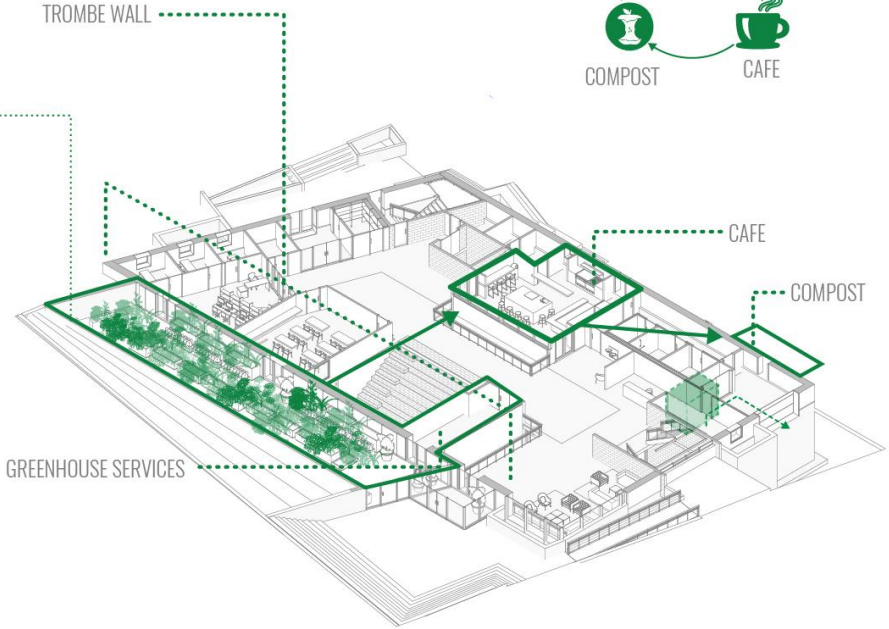
Monthly Load Profiles - view table

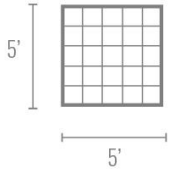


GREENHOUSE









PLANT	SEEDS PER FT²
BEANS:	8
BEATS:	9
CUCUMBERS:	2
SPINACH:	9
PEPPERS:	1
PARSNIPS:	16
ONIONS:	16
LEEKS:	4
COLLARD GREENS:	1
TOMATOES:	1 PLANT PER 4FT²

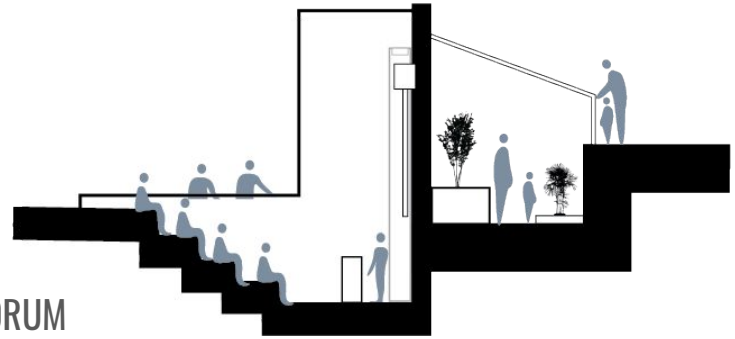
OPTIMAL TEMP: 60 TO 65 DEGREES F
(NOTHING ABOVE 80, NOTHING BELOW 50)

2000 FT² - 500 FT² = 1500FT² PLANTABLE AREA

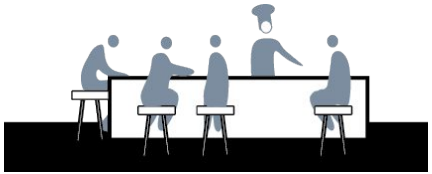
IF WE PLANTED ONLY TOMATOES IN OUR GREENHOUSE, WE COULD ROUGHLY PRODUCE **15,000** LBS OF JUST TOMATOES

ADAPTABLE PROGRAM

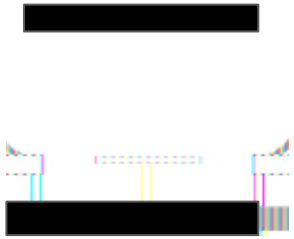
SHARED SPACE



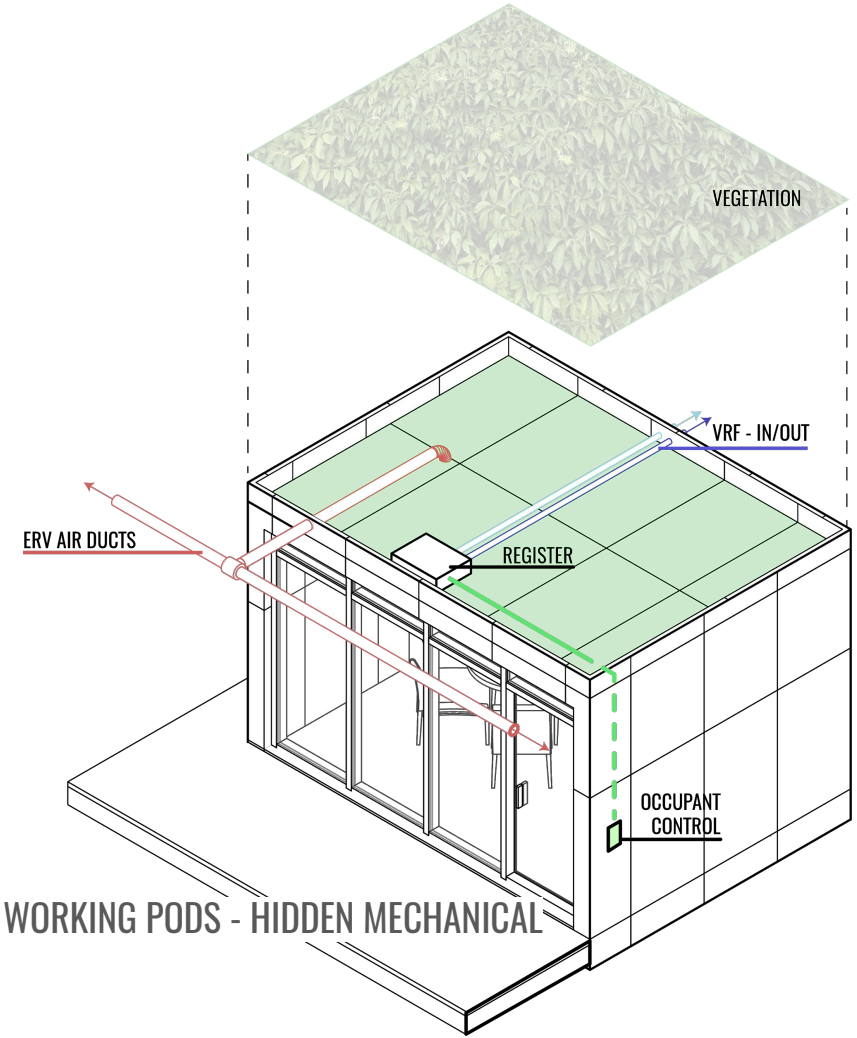
PUBLIC FORUM



DEMONSTRATION KITCHEN

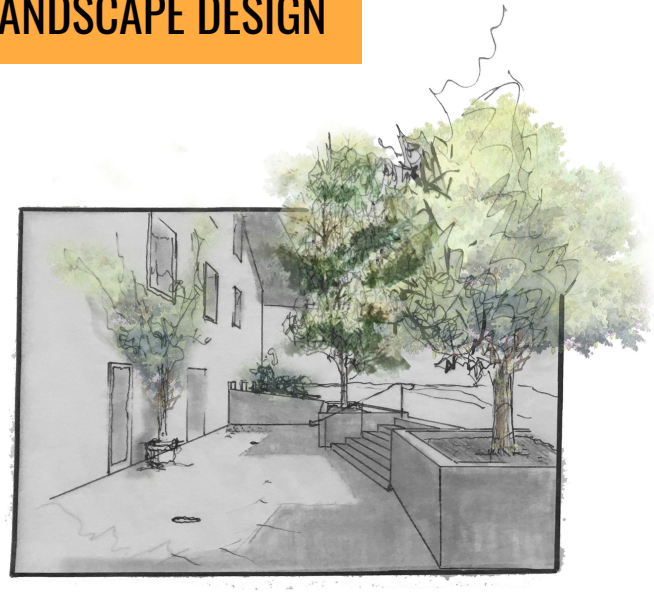


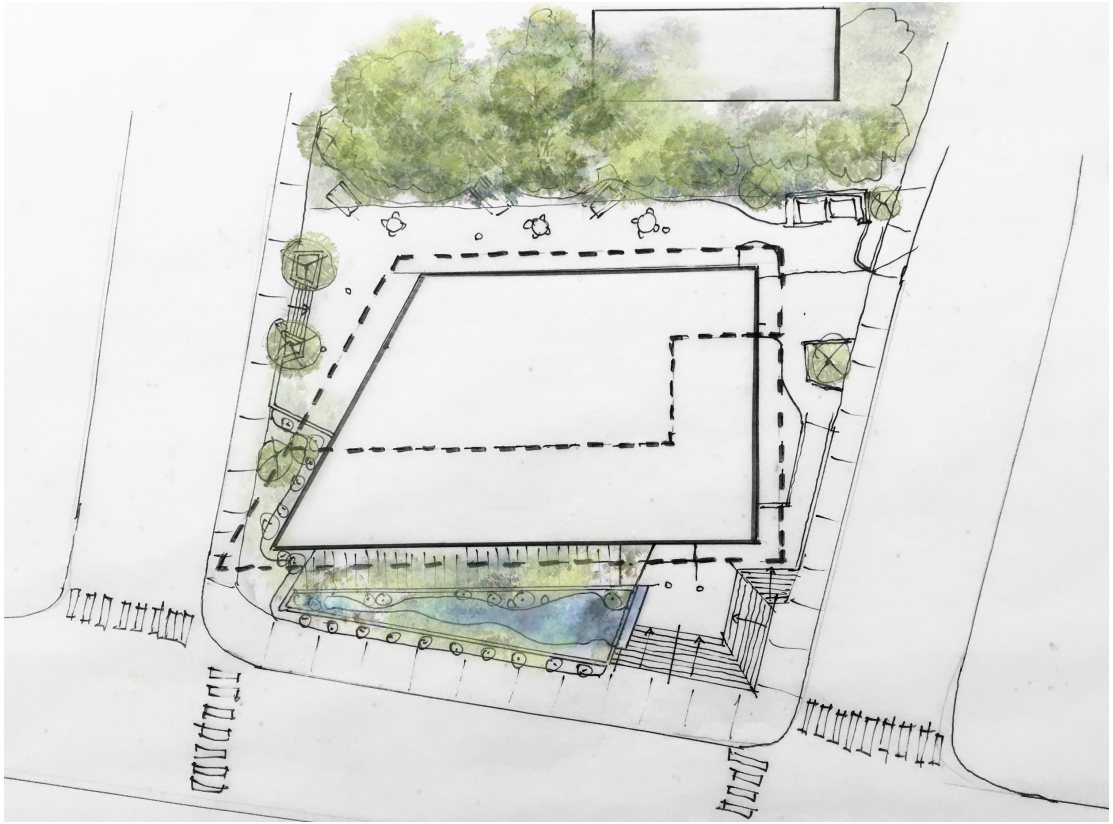
SHARED WORK PODS



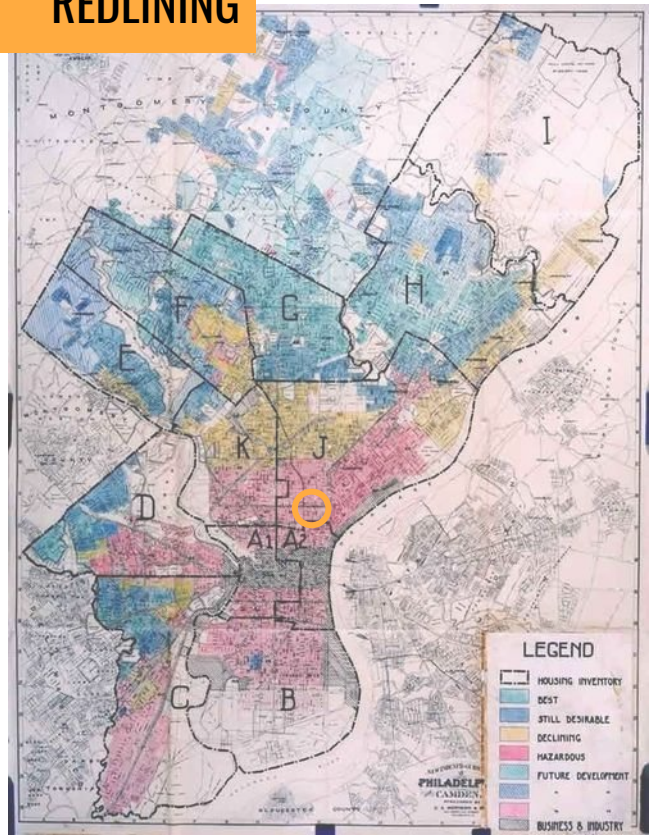
WORKING PODS - HIDDEN MECHANICAL

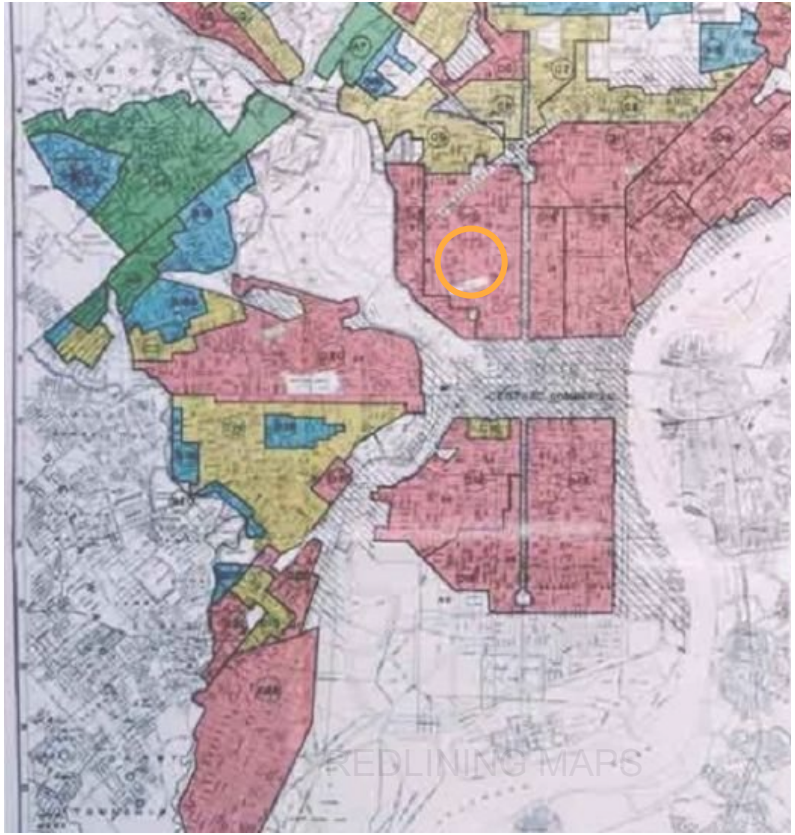
LANDSCAPE DESIGN





REDLINING

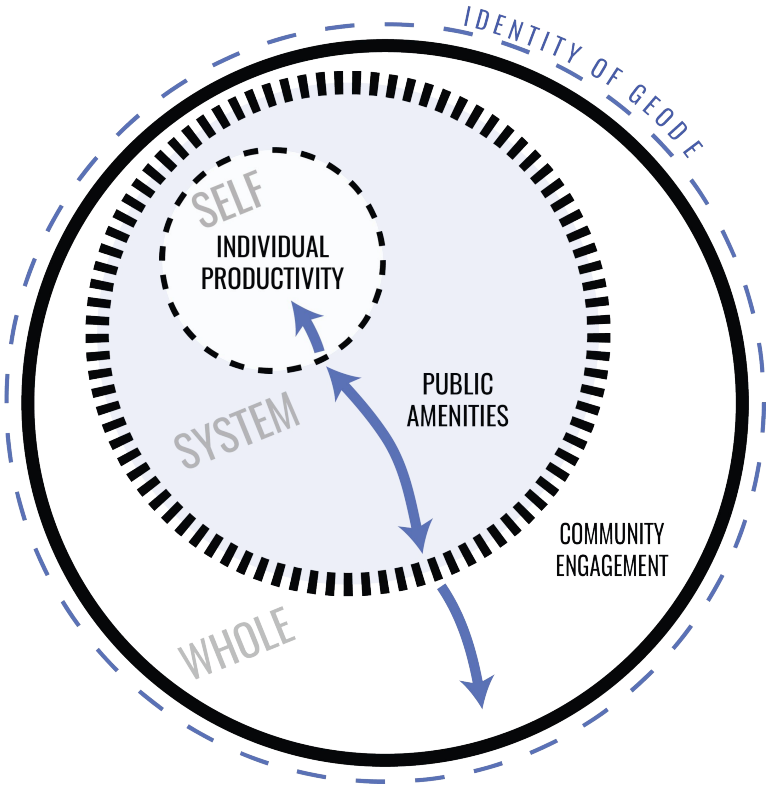

I
H
G
F
E
K
J
D
A1
A2
C
B
LEGEND
HOUSING INVENTORY
BEST
STILL DESIRABLE
DECLINING
HAZARDOUS
FUTURE DEVELOPMENT
BUSINESS & INDUSTRY


REDLINING MAPS

COWORKING

The flexibility of the typical office floor plate enables optimal productivity and functionality

SOCIAL ENGAGEMENT



USER CIRCULATION

SOURCES

https://thenounproject.com/search/?q=job&i=1551321

https://www.huffpost.com/entry/how-employee-productivity_n_5620941

https://newscience.ul.com/indoorairquality

http://www.modcell.com/technical/

https://www.osha.gov/Publications/3430indoor-air-quality-sm.pdf

https://pvwatts.nrel.gov