

# The Fly Flat

Team Mod Squad  
Prairie View A&M University





# The Fly Flat

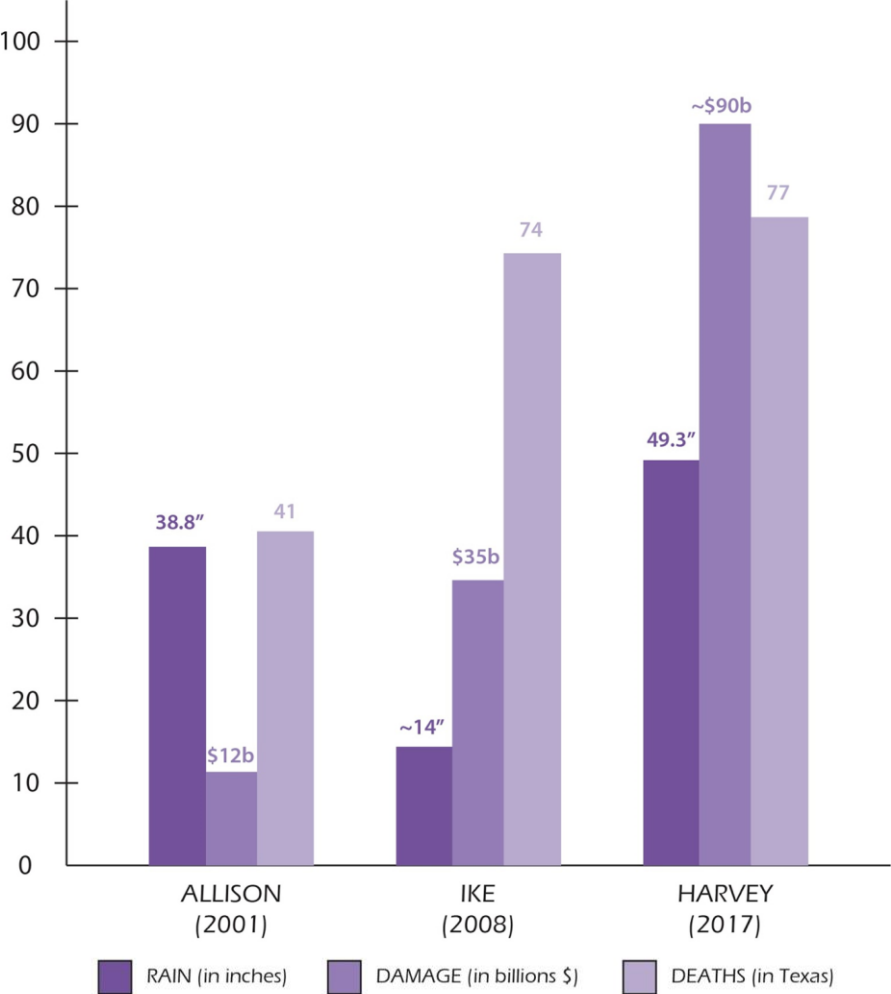
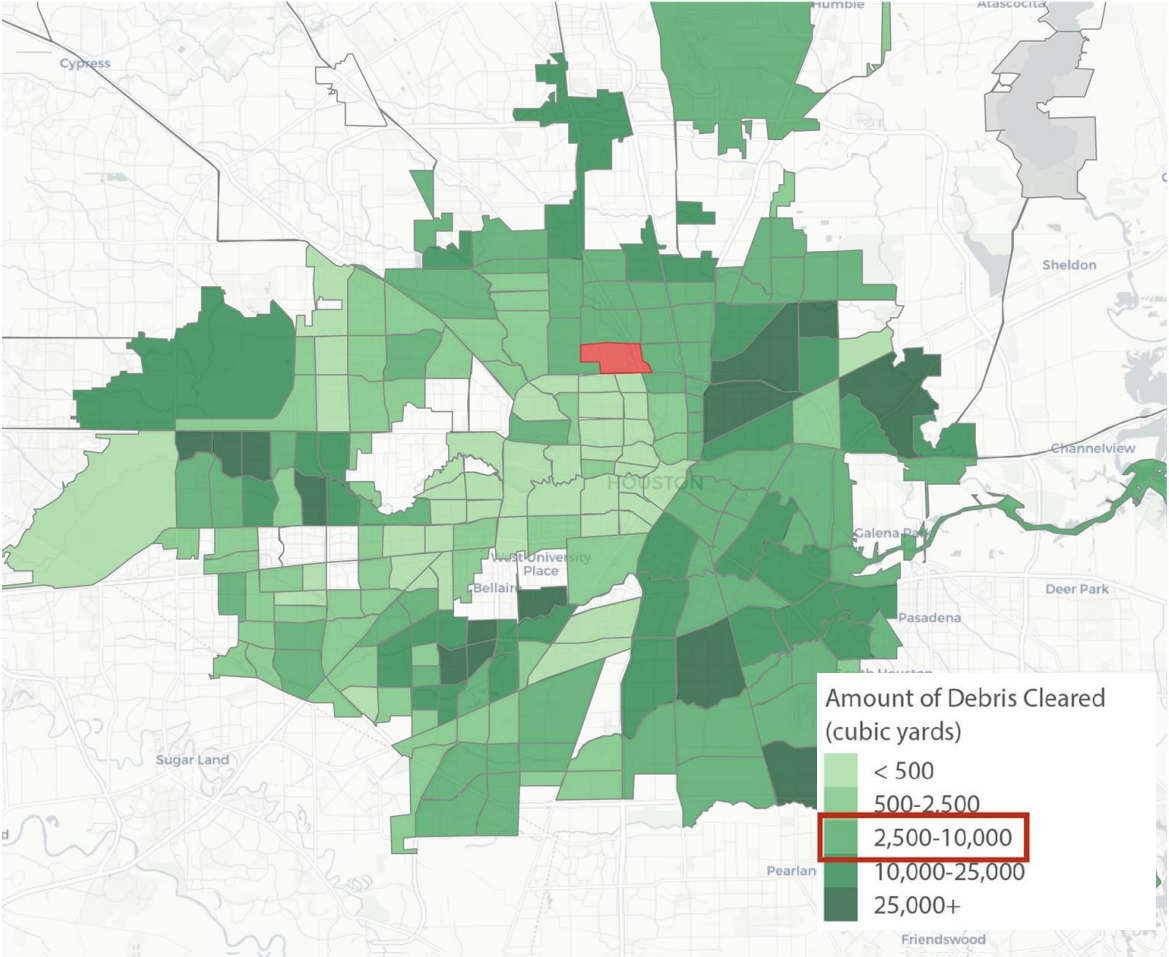
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Prairie View A&M University







### Debris Removal Total debris collected by the City of Houston and contractors:



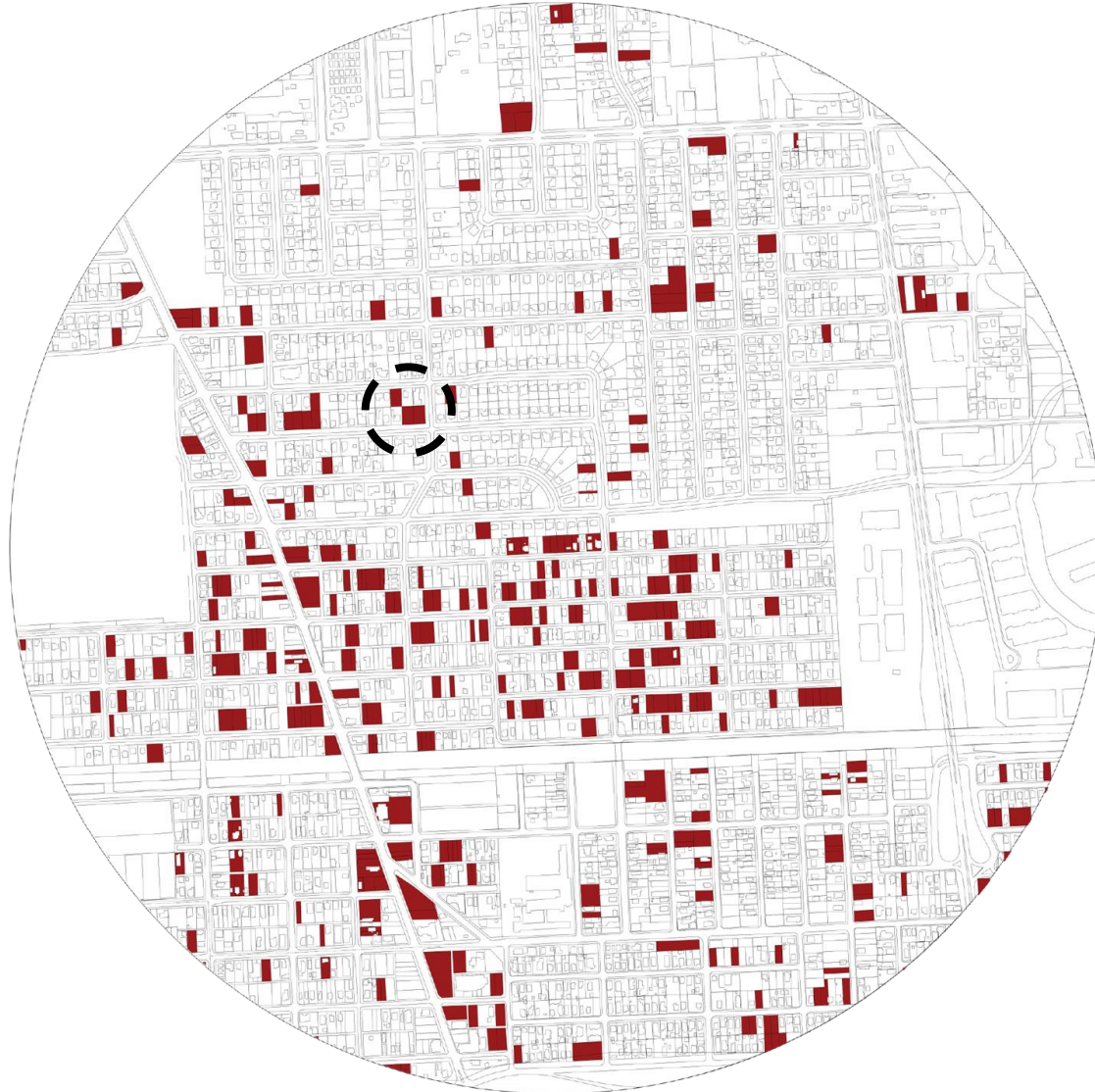
# Economic Conditions



Economic  
Resilience

Social  
Resilience

Environmental  
Resilience



Vacant Lots in Independence Heights, TX

Total Vacant Lots: 768  
Total Lot Values: \$202,306,218



Architecture

Constructability

Financial

Energy & Envelope

MEP & IAQ

Innovation

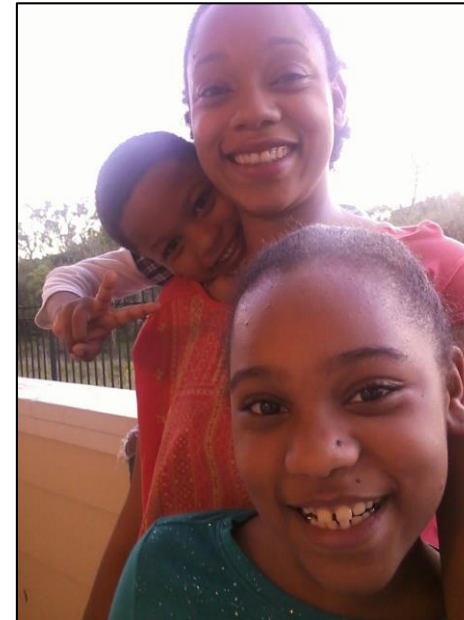




## Community Engagement

## Potential Residents

Independence Heights - Demographics	
Area	3,390 Sq. Mi.
Population	13,404
Population Density	3,954
Median Household Income	\$55,450
Male Population	6,590
Female Population	6,812
Male Median age	34.8
Female Median Age	36.4
Average Household Size	3.0 Persons
Percentage of Family Households	46.9%
Percentage of Married Couple Families	36.3%
Percentage of Single Mother Households	8.6%
Percentage of Never Married Females 15 yrs. and Older	16.3%
Average number of Cars or Other Vehicles Available in Houses/ Condos	1.7
Percentage of Population Below the Poverty Level	41.6%



Economic Resilience

Social Resilience

Environmental Resilience





## Economic

- Affordability
- Ownership
- Address vacancy
- Economically healthy neighborhood

## Environmental

- Address flooding
- Surviving hurricanes and flooding events with minimal damage
- Man/Nature Connection
- Health
- Net zero residence

## Social

- Social Agency
- Community connectivity/relationship development
- Health

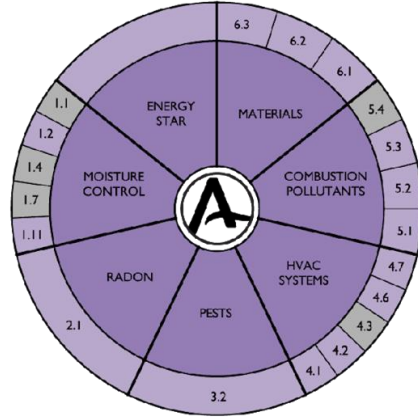


# Resilience Methods

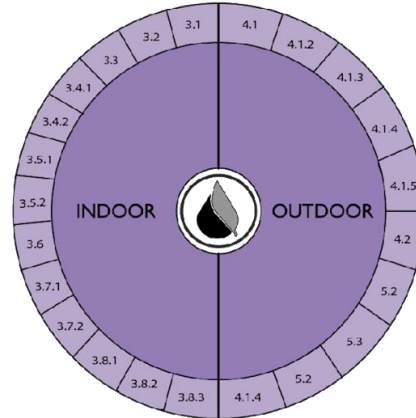


Economic Resilience  
Social Resilience  
Environmental Resilience

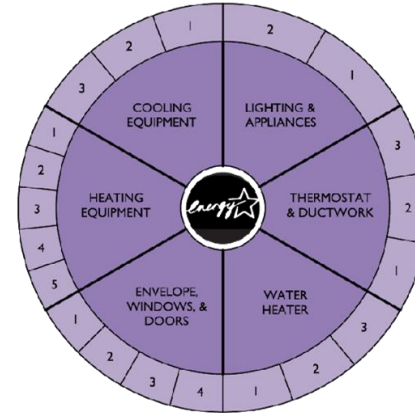
INDOOR airPLUS



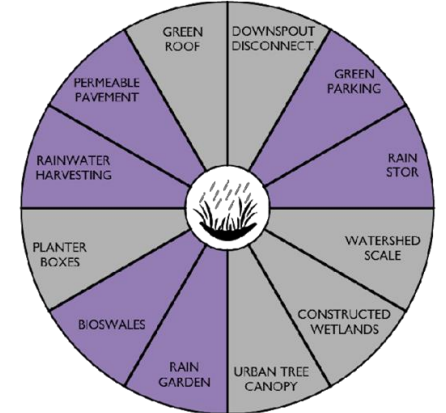
WATERSENSE



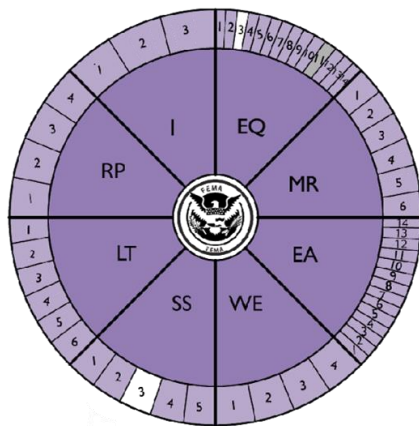
ENERGY STAR



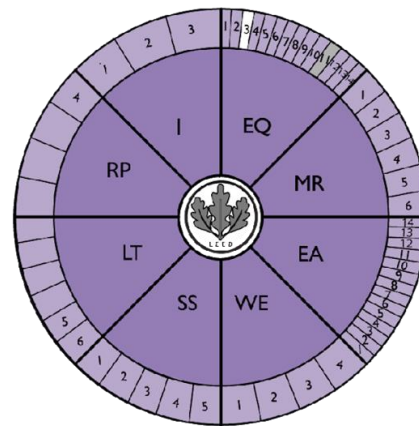
LOW IMPACT DEVELOPMENT



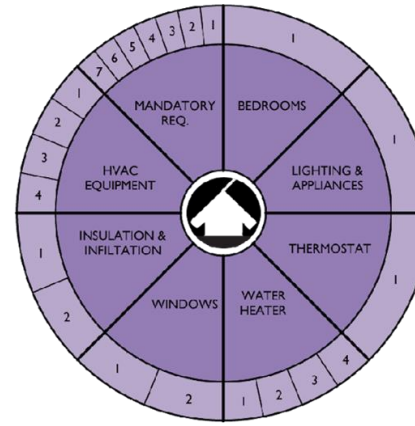
FEMA 499



LEED FOR HOMES



ZERO ENERGY READY HOME



PASSIVE HOUSE



LEGEND:  CATEGORIES NOT APPLIED

LEGEND:  CATEGORIES MET

LEGEND:  SUB-CATEGORIES: MET

LEGEND:  SUB-CATEGORIES: NOT MET

Architecture

Constructability

Financial

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MEP & IAQ

Innovation



# Team & Industry Partners

Team Mod Squad  
Prairie View A&M University



Economic  
Resilience



**Kristen Clark**  
B.S Mechanical  
Engineering



**Aaron Farray**  
B.S Architecture



**Kennia Yajaira  
Lopez**  
B.S Architecture



**Shannen L. Martin**  
B.S Architecture



**Noah Perkins**  
B.S Architecture



**Cynthia Suarez-Harris**  
B.S Architecture  
B.S Construction Sci.



**Shelby Skinner**  
B.S Architecture



**Ledell Thomas**  
B.S Architecture  
B.S. Construction Sci.

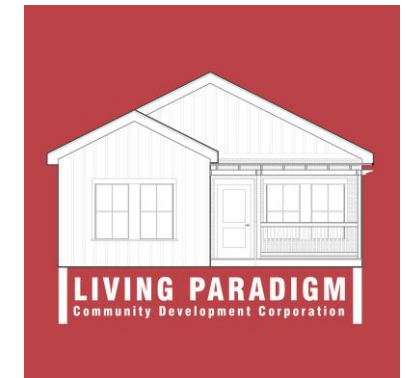


**Kaylah Wesley**  
B.S Architecture

Social  
Resilience



Environmental  
Resilience



Architecture

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Innovation

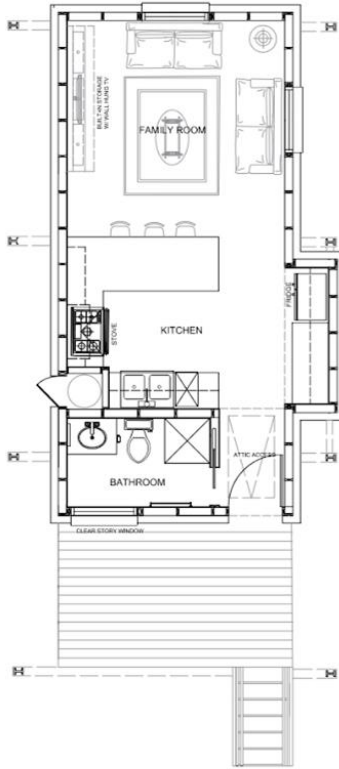
# Modules: Fab Lab Built



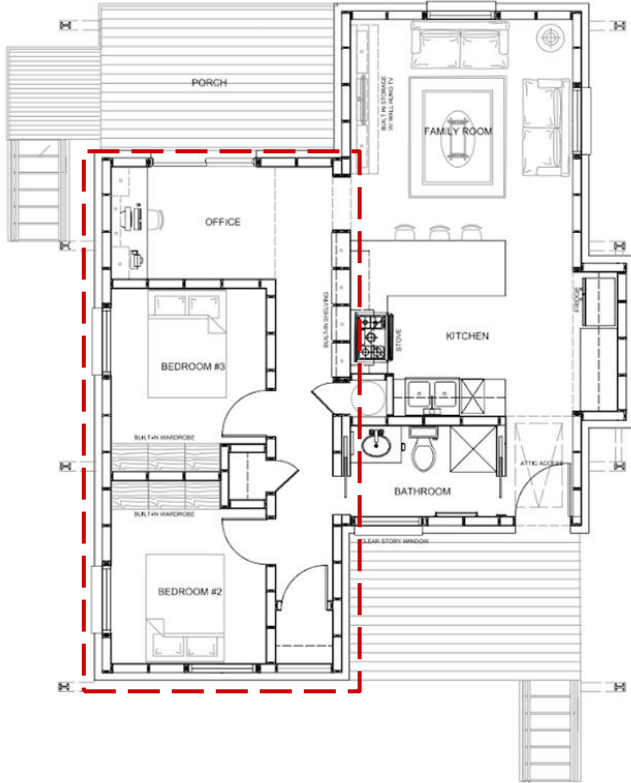
Economic Resilience

Social Resilience

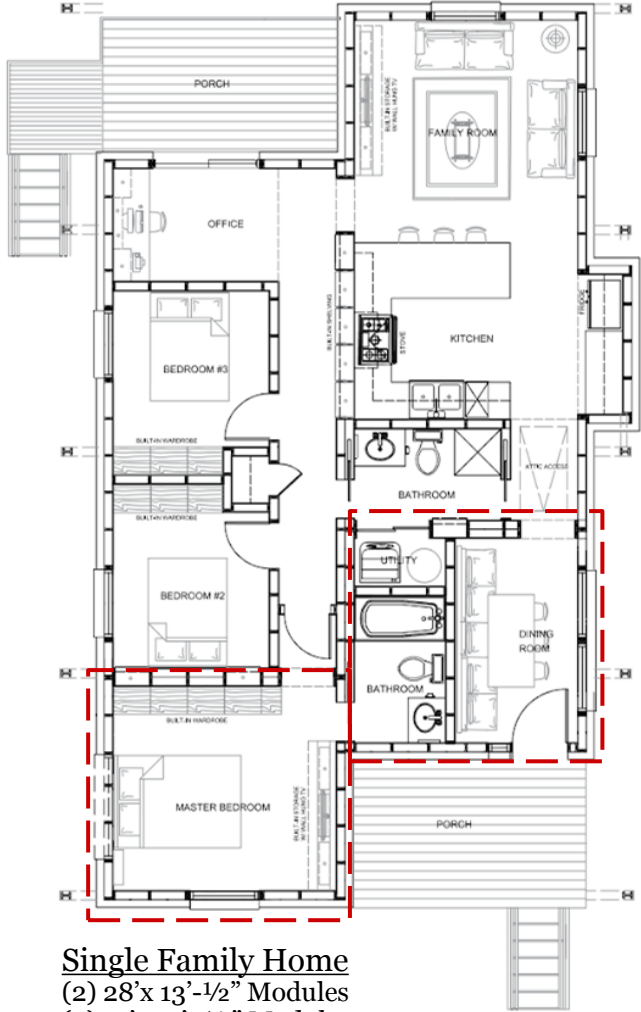
Environmental Resilience



**Single Person Home**  
(1) 28' x 13'-1/2" Module  
364 sqft.



**Elderly Couple Home**  
(2) 28' x 13'-1/2" Modules  
728 sqft.



**Single Family Home**  
(2) 28' x 13'-1/2" Modules  
(2) 12' x 13'-1/2" Modules  
1,040 sqft.



# Fly Roof: Site Built

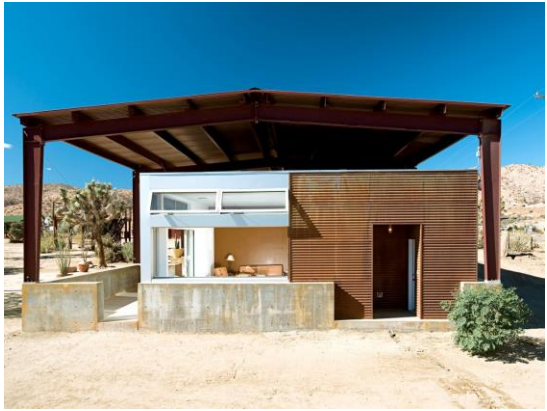
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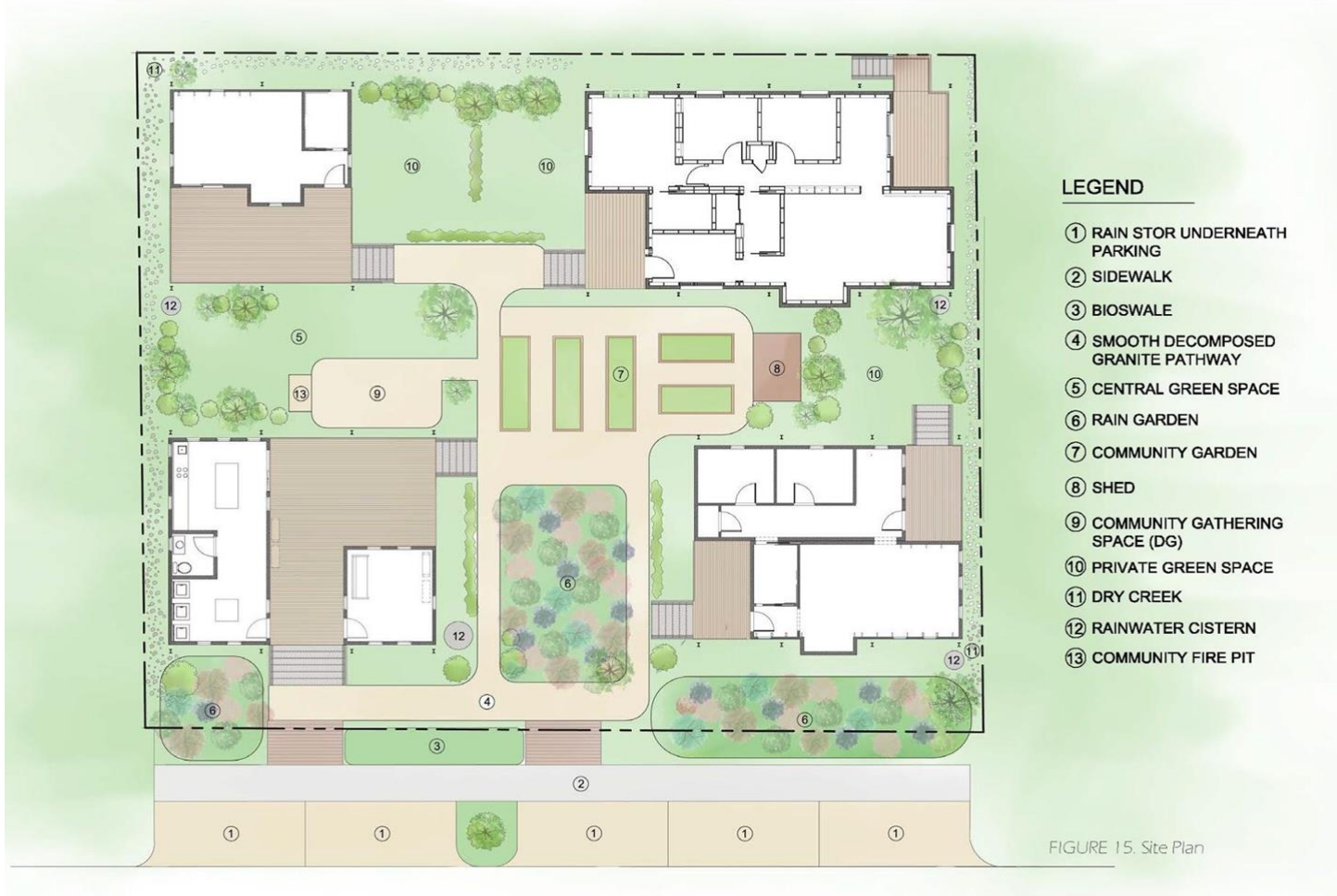




Economic  
Resilience

Social  
Resilience

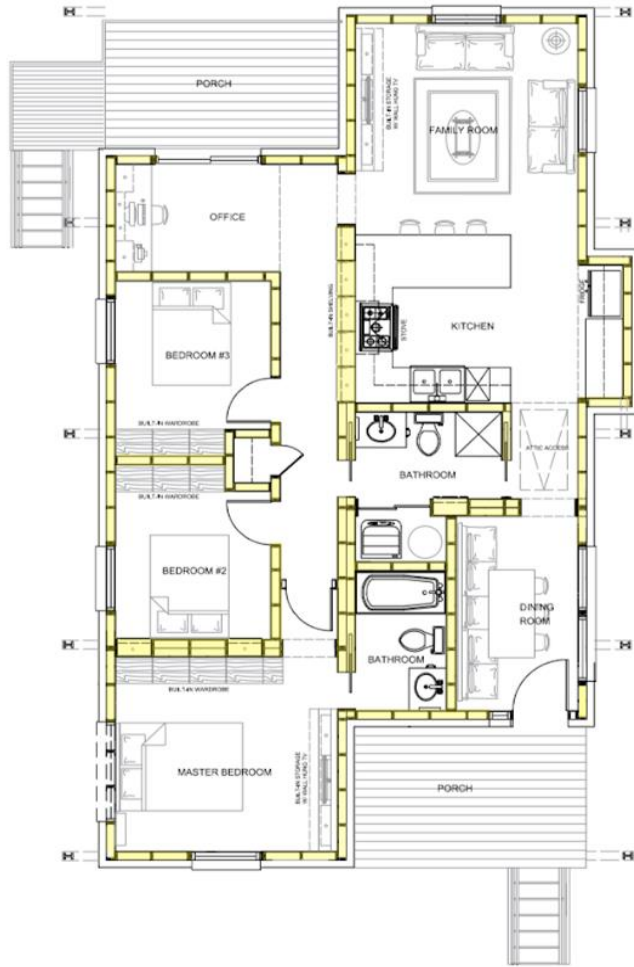
Environmental  
Resilience



Safe, Interactive Community Spaces







## Open Wall Cavities Benefits

- Gain 128 square feet of storage space
- Built-in furniture optimizes storage space
- Elimination of cavity insulation and drywall offset cost of continuous insulation to improve thermal performance



White Wash Finish

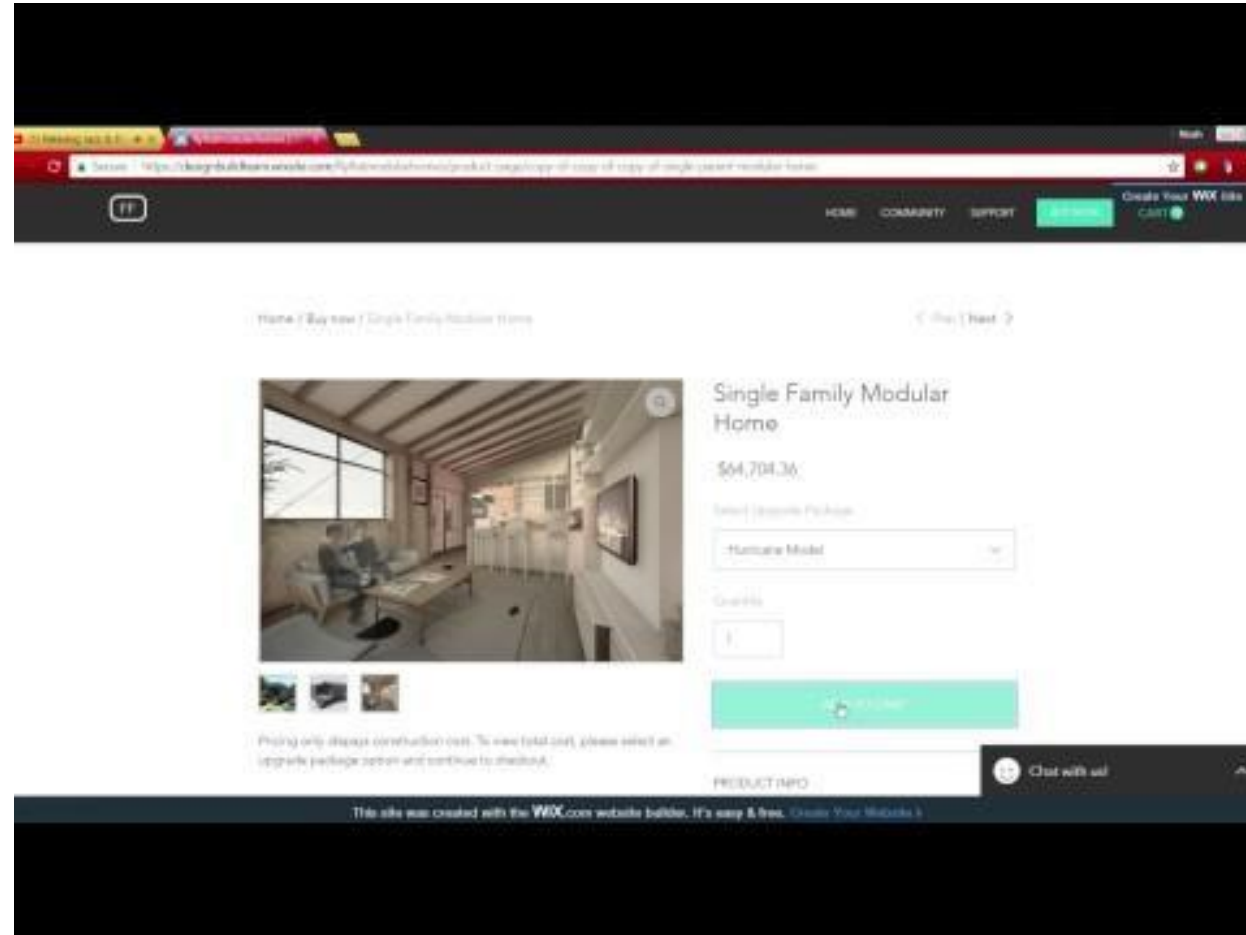


Natural Wood Finish





Owner customizes modules & packages along with built-in furnishings.



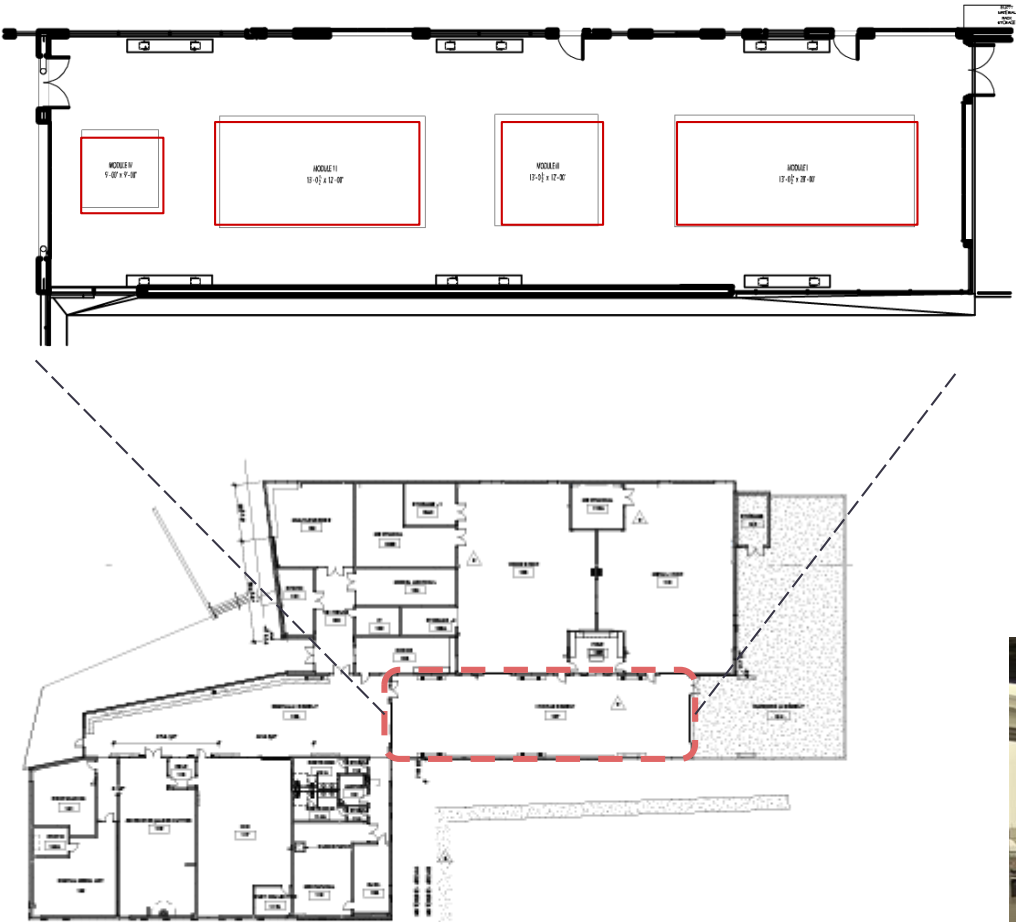
<http://www.designbuildteam.wixwebsite/flyflatmodularhomes>



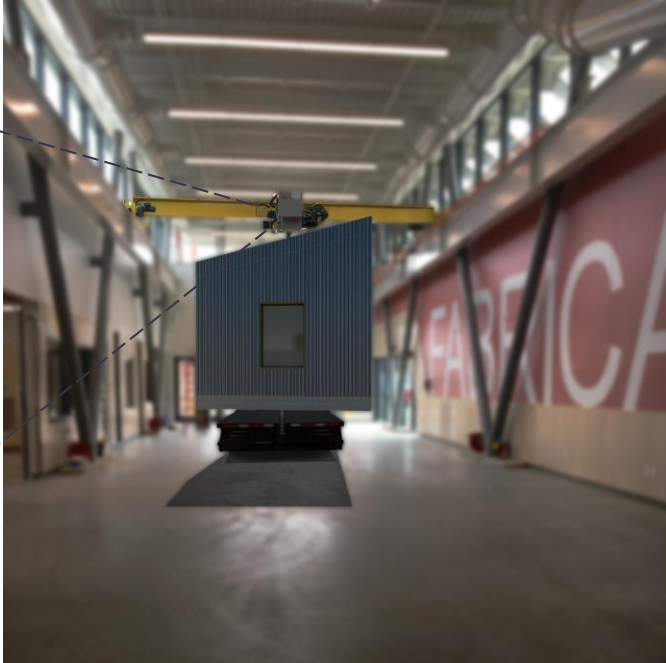
# Fabrication & Delivery



Economic Resilience  
Social Resilience  
Environmental Resilience



Prairie View A&M University Fabrication Center



# Installation



- Economic Resilience
- Social Resilience
- Environmental Resilience





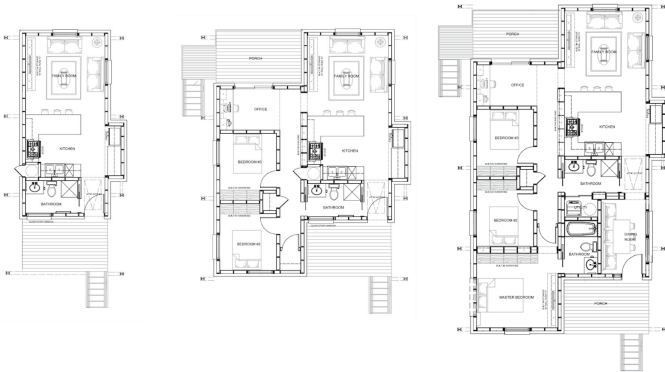


Economic Resilience

Social Resilience

Environmental Resilience

## Modularity



Single Person Home  
Energy Star: \$57,554.34  
ZERH: \$57,667.86  
PH: \$64,704.36



Elderly Couple Home  
Energy Star: \$74,741.81  
ZERH: \$74,959.06  
PH: \$88,306.24



Single Family Home  
Energy Star: \$94,575.03  
ZERH: \$94,896.01  
PH: \$115,837.21

## Packages

### ENERGY STAR



\$57,554.34  
 \$74,741.81  
 \$94,575.03

### ZERO ENERGY READY HOME



\$57,667.86  
 \$74,959.06  
 \$94,896.01

### PASSIVE HOUSE



\$64,704.36  
 \$88,306.24  
 \$115,837.21

### HURRICANE



\$65,871.49  
 \$89,944.81  
 \$118,642.74

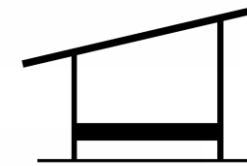
## Land & Infrastructure

### Land



- Land Trust, Or
- Privately Owned

### Fly Roof



- Land Trust, Or
- Privately Owned

### Solar

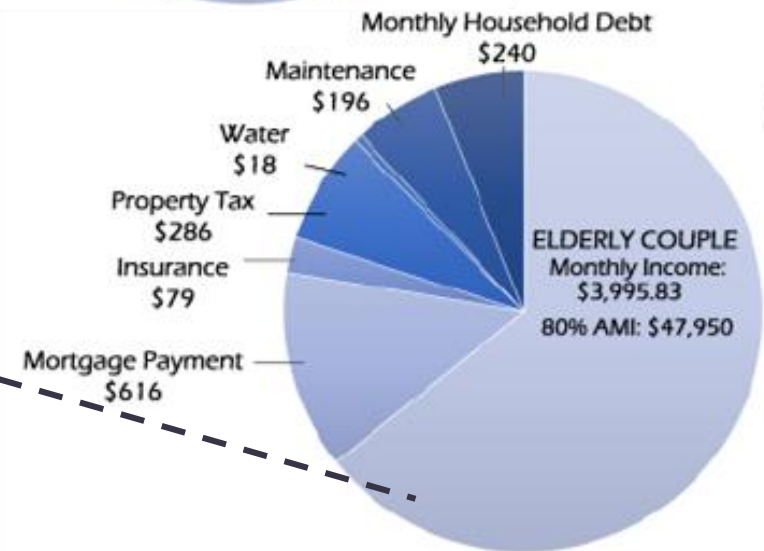
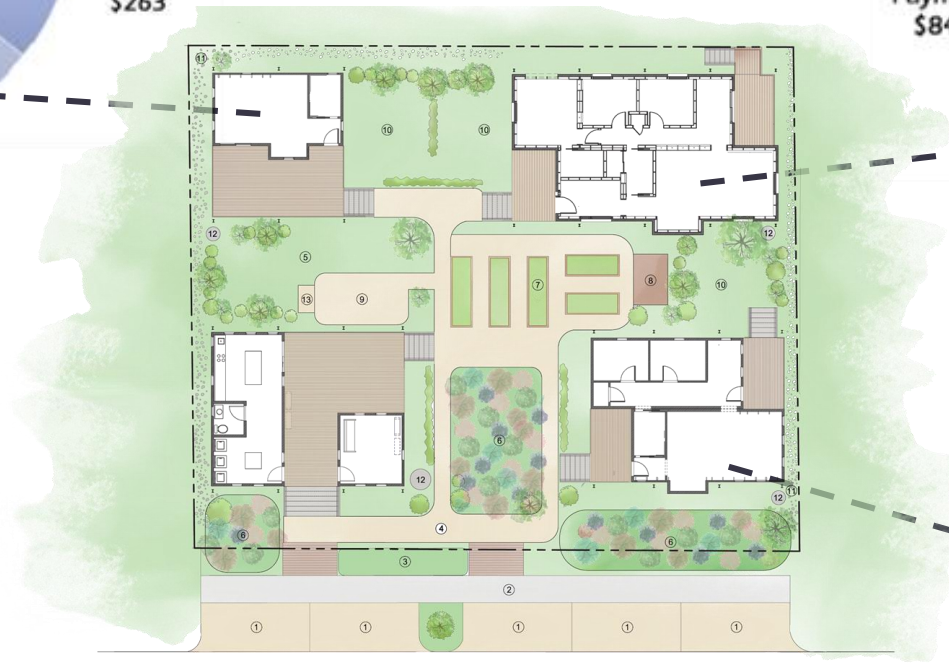
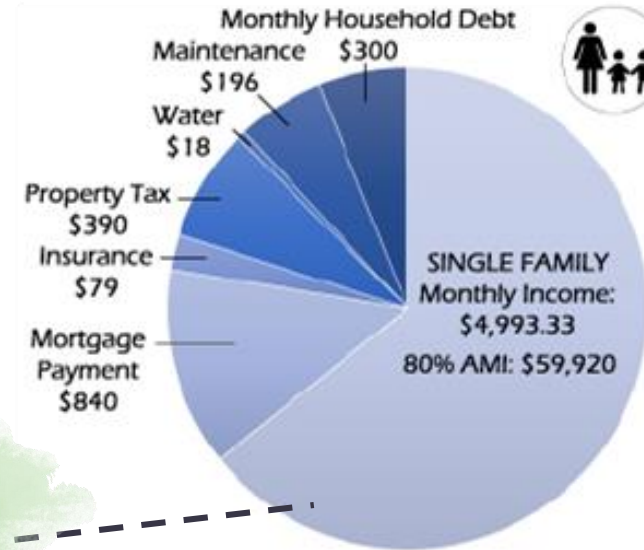
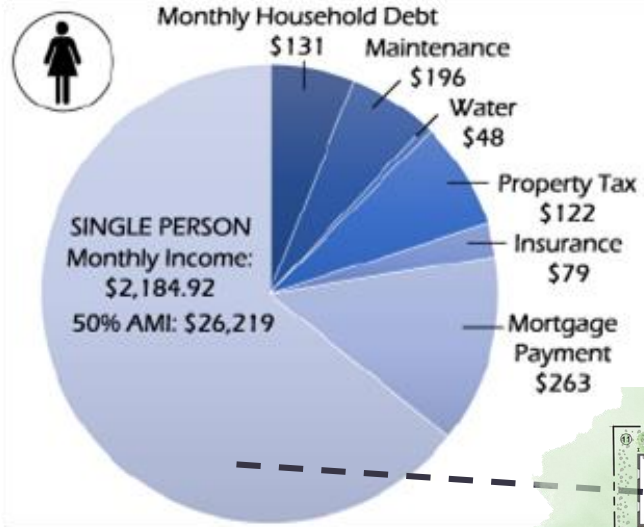


- Solar Co-op Utility, Or
- Privately Owned
  - PPA
  - Mortgage

# Affordability Scenarios



- Economic Resilience
- Social Resilience
- Environmental Resilience





# Community Impact

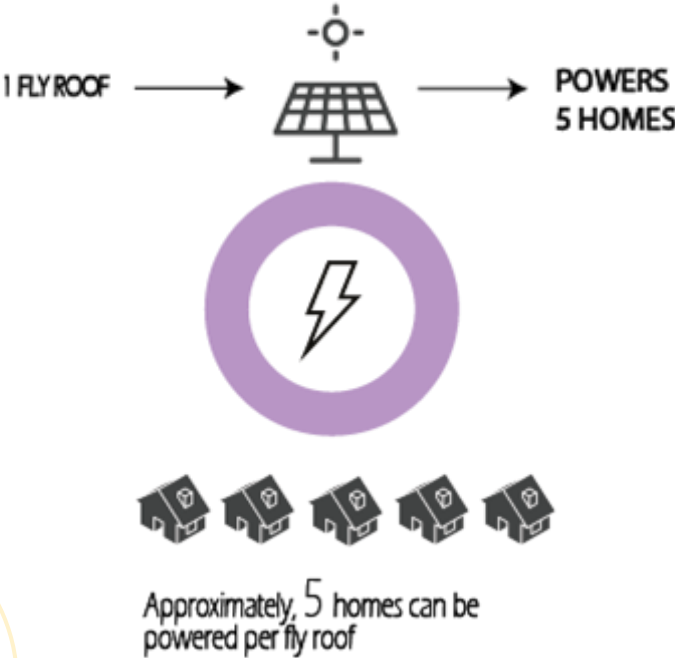


- Economic Resilience
- Social Resilience
- Environmental Resilience



Vacant lots in the studied area: 768 Lots  
**1,536 additional homes**

Lara lots in the studied area: 11 Lots  
**22 additional homes**

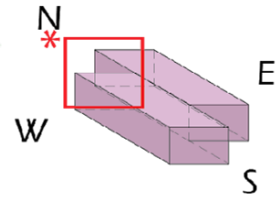


**7,680 Homes powered by fly roofs**



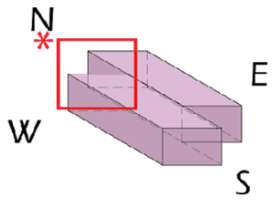
Economic Resilience  
Social Resilience  
Environmental Resilience

## Conceptual Design Sefaira



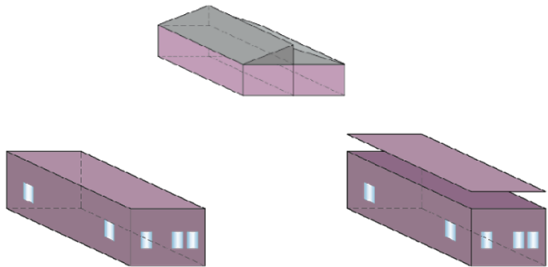
\*Note:  
amount of building exposed to the west may increase the EUI

■ Shifting connected modules will increase the EUI.



\*Note:  
amount of building exposed to the west may increase the EUI

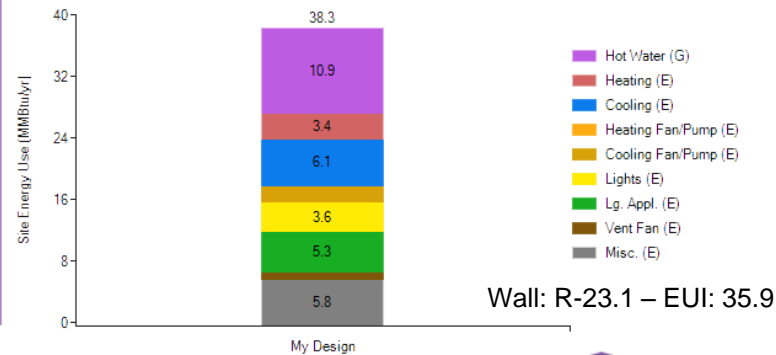
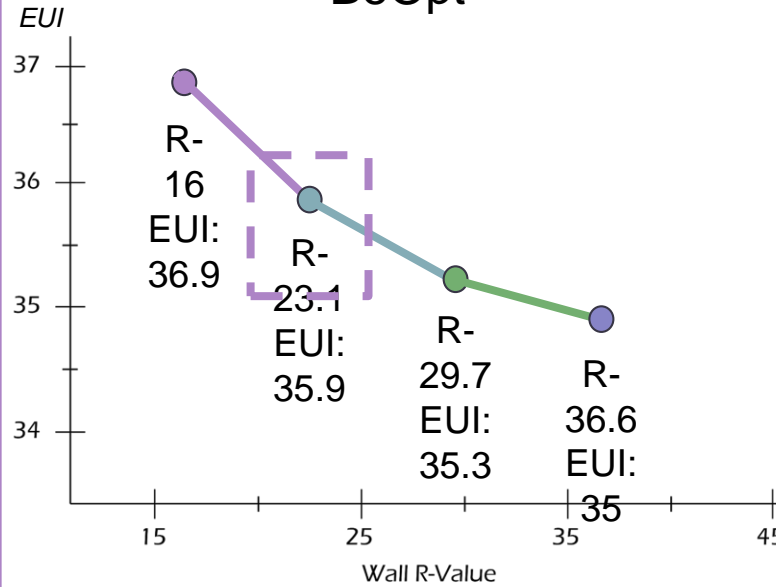
■ Adding a pitched roof will increase the EUI by 1.



Module w/ windows  
EUI:25

Simple double roof  
EUI: 24

## Schematic Design BeOpt



## Design Development Remrate; Wufi-Passive; Manual Calculations

$$T_{RS} = T_O + \frac{GR * SA}{RSE}$$

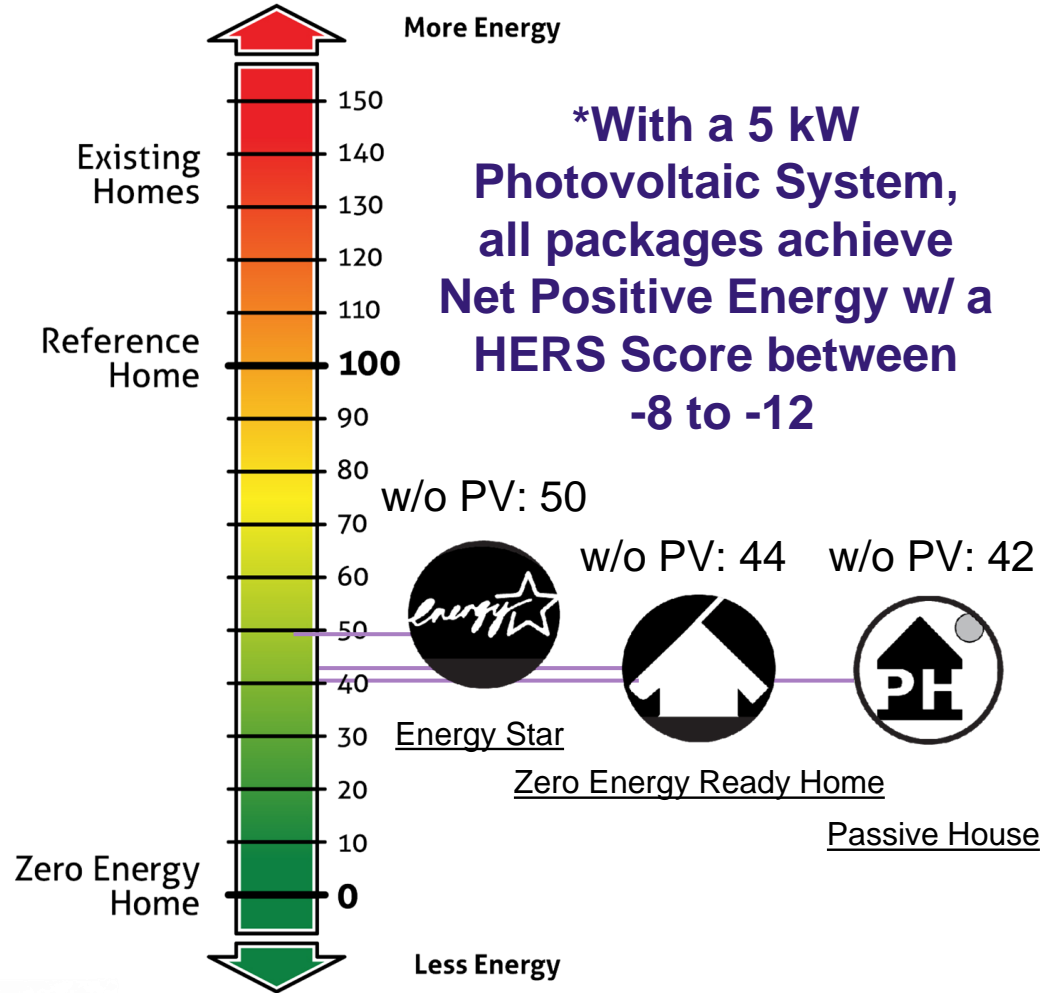
$$Q_{TO} = A * U * G_{T1}$$

Analysis of Heat Transmission Through Main Roof (without Fly Roof)			
Calculation	Energy Star	ZERH	PHIUS+2018
WUFI-Passive	2,074.8 kBtu/yr	498.4 kBtu/yr	409.1 kBtu/yr
Manual Calculation: Heat Transmission Relative to Roof Temperature	4,756 kBtu/cooling season	3,714 kBtu/cooling season	3,054 kBtu/cooling season
Manual Calculation: Heat Transmission Relative to Outdoor Air Temperature	1,309 kBtu/cooling season	1,021 kBtu/cooling season	841 kBtu/cooling season
Manual Calculation Difference	3,447 kBtu/cooling season	2,693 kBtu/cooling season	2,213 kBtu/cooling season
Potentially Unaccounted for Transmission in WUFI-Passive	2,681.2 kBtu/yr	3,215.6 kBtu/yr	2,644.9 kBtu/yr





## HERS® Index



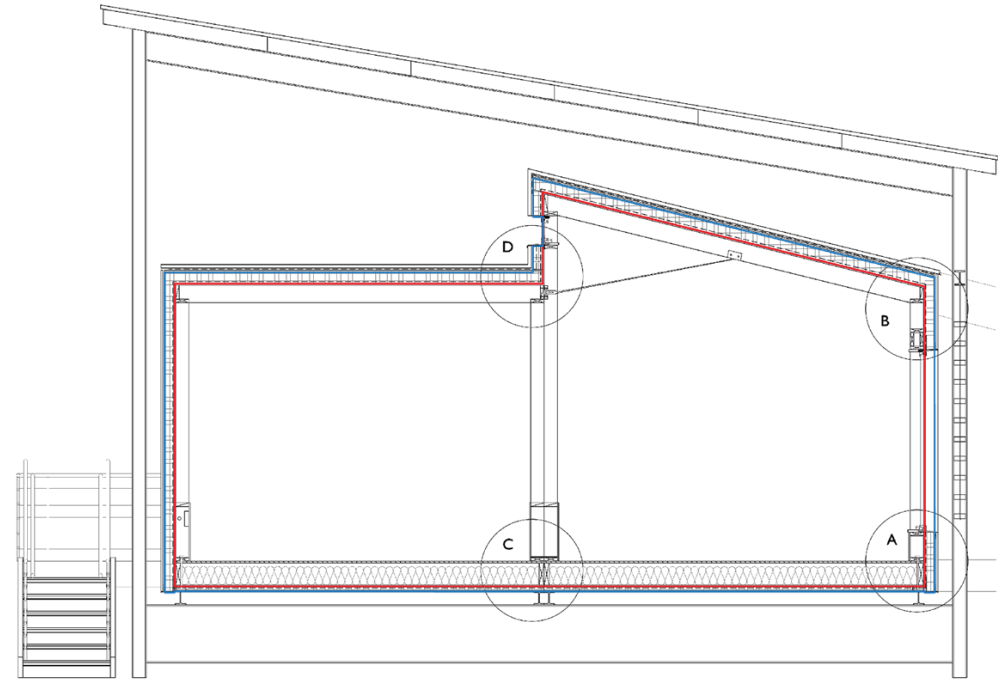
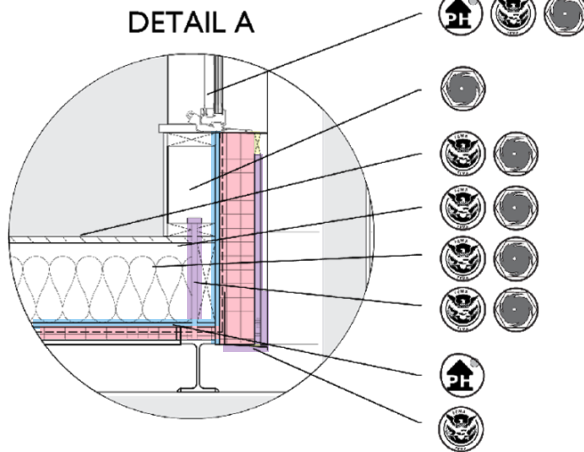
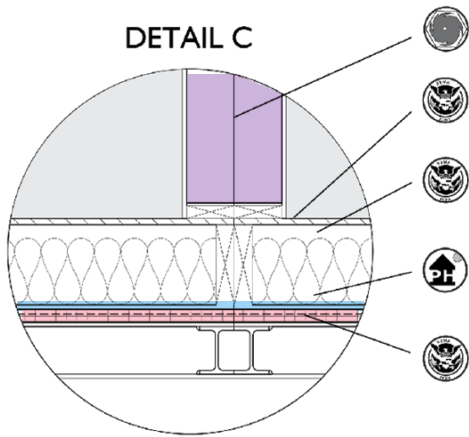
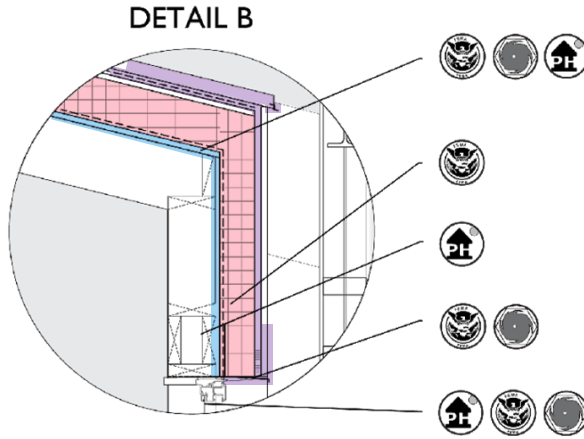
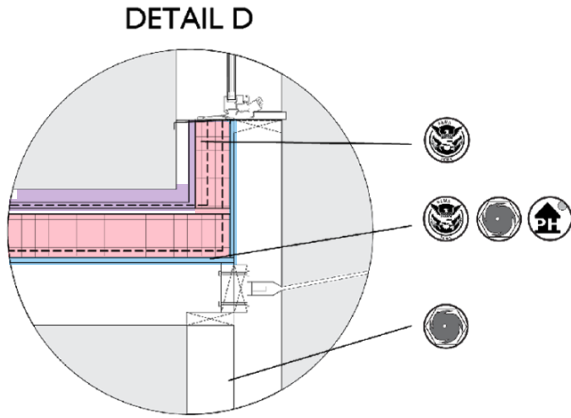
## Energy Comparison of Energy Performance Packages

Component	Energy Star	ZERH	PHIUS+2018
Floor Insulation	R-25 + R-6 c.i.	R-28 + R-6 c.i.	R-28 + R-9 c.i.
Wall Insulation	R-7 c.i.	R-18 c.i.	R-24 c.i.
Roof Insulation	R-18 c.i.	R-24 c.i.	R-30 c.i.
Air Tightness	3 ACH50	1.5 ACH50	.6 ACH50
Fresh Air Ventilation	Balanced (slightly +) Supply: Dehumidifier Exhaust: Bath Fans	Balanced (slightly +) Supply: Dehumidifier Exhaust: Bath Fans	Balanced (slightly +) Supply: ERV Exhaust: ERV
Hood Ventilation	Balanced (slightly +) Supply: Make-Up Air Exhaust: Hood	Balanced (slightly +) Supply: Make-Up Air Exhaust: Hood	Balanced (slightly +) Supply: Make-Up Air Exhaust: Hood
HERs Score w/out PV	50	44	42
REMRATE Annual Energy	32.6 MMBTU/yr	29.1 MMBTU/yr	29.1 MMBTU/yr
WUFI-Passive Annual Energy	25.5 MMBTU/yr	19.4 MMBTU/yr	15.6 MMBTU/yr
WUFI-Passive Cooling Demand	13.21 kBTU/yr ft <sup>2</sup>	10.64 kBTU/yr ft <sup>2</sup>	12.73 kBTU/yr ft <sup>2</sup>
WUFI-Passive Heating Demand	10.63 kBTU/yr ft <sup>2</sup>	7.51 kBTU/yr ft <sup>2</sup>	1.93 kBTU/yr ft <sup>2</sup>
WUFI-Passive Cooling Load	3.19 BTU/hr ft <sup>2</sup>	2.51 BTU/hr ft <sup>2</sup>	2.94 BTU/hr ft <sup>2</sup>
WUFI-Passive Heating Load	13.71 BTU/hr ft <sup>2</sup>	9.7 BTU/hr ft <sup>2</sup>	5.18 BTU/hr ft <sup>2</sup>
PHIUS+2018	No	No	Yes
Construction Cost 3BD/2B	\$94,575	\$94,896	\$115,837

# Envelope: Base Package



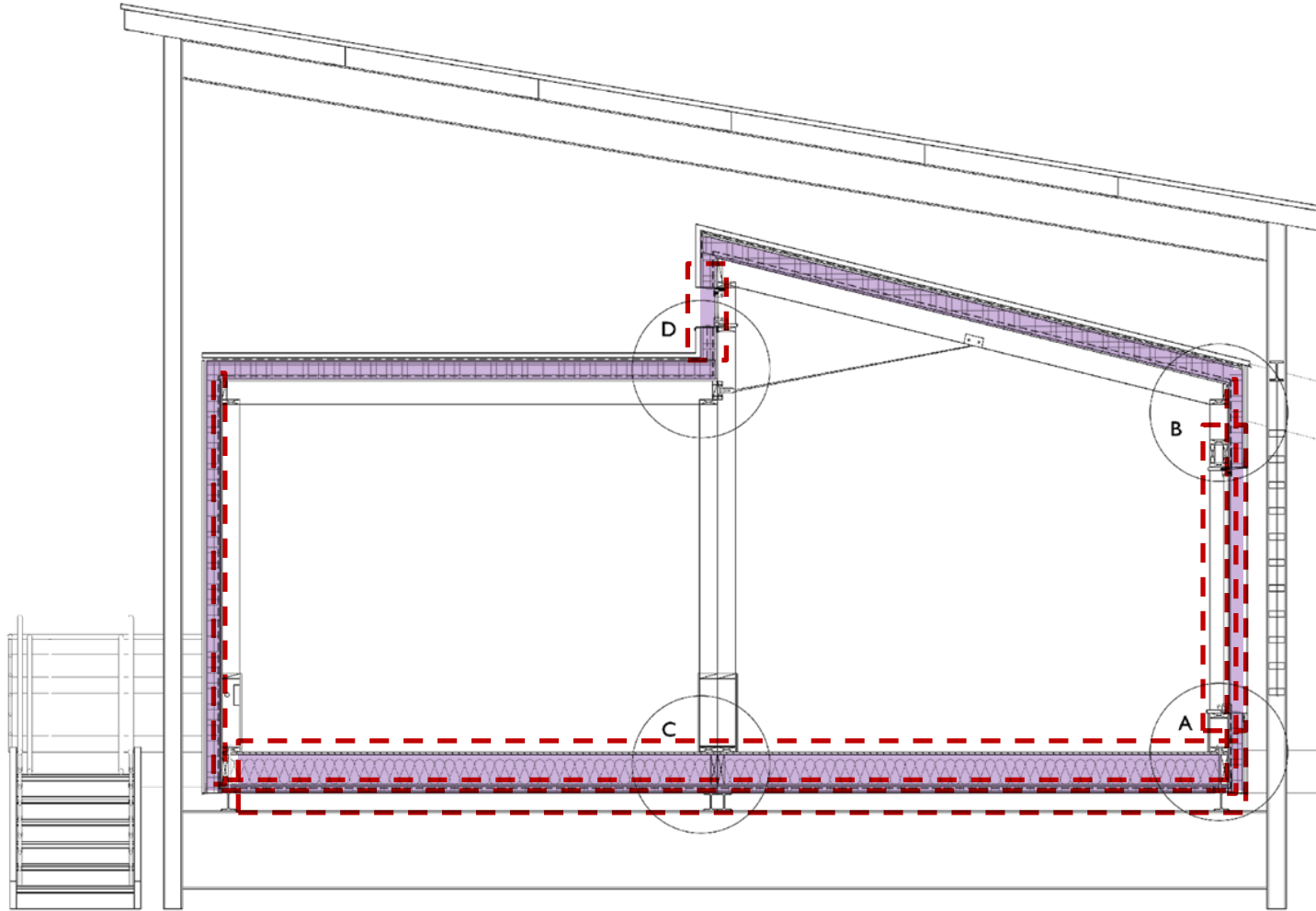
Economic Resilience  
Social Resilience  
Environmental Resilience



— CONTINUOUS AIR BARRIER  
— CONTINUOUS THERMAL BOUNDARY



# Performance Upgrades



Roof: R-18ci | Wall: R-7ci | Floor: R-21, R-5ci



Roof: R-24ci | Wall: R-18ci | Floor: R-25, R-6ci



Roof: R-30ci | Wall: R-24ci | Floor: R-25, R-9ci



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PANASONIC  
INTELLI-BALLANCE ERV

## Ventilation

- Balanced Ventilation
- BSC Standard 01
- 100 CFM Kitchen Hood with makeup air
- 12 MERV Filtration



MITSUBISHI MINI-SPLIT

## Heating & Cooling

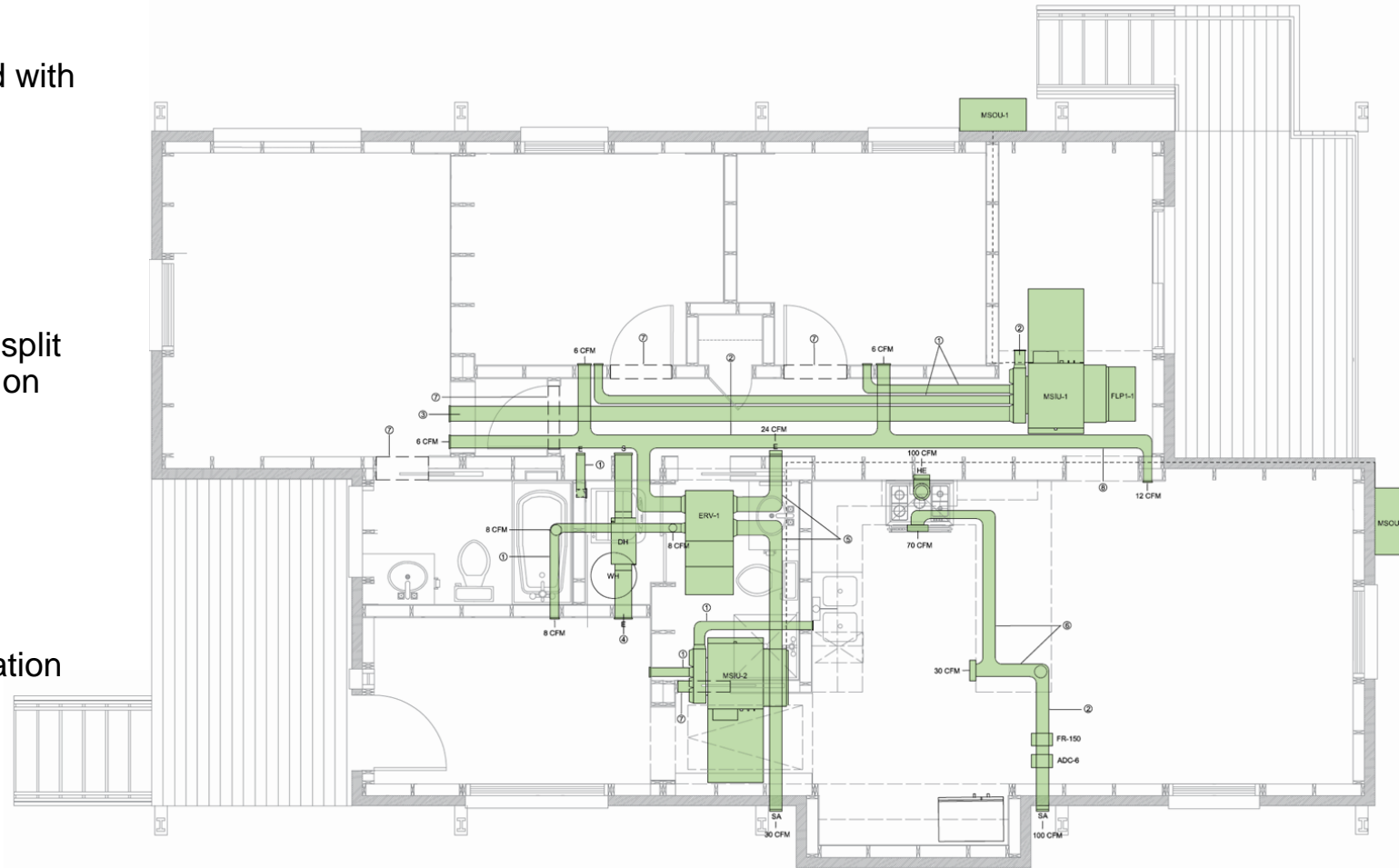
- right sized ducted mini-split
- 1.34 ton system based on Manual J



ULTRAAIRE DEHUMIDIFIER

## Dehumidification

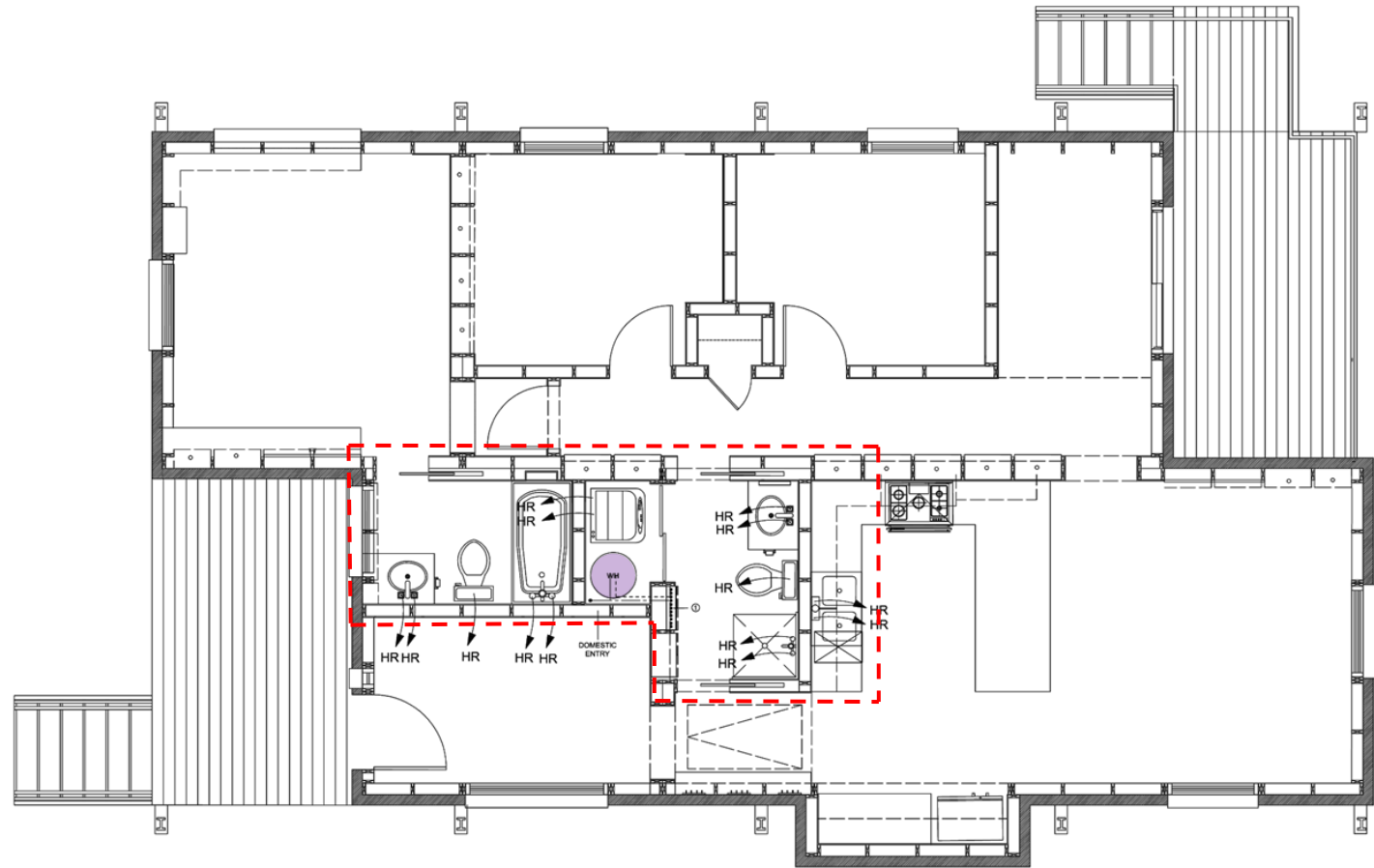
- dedicated dehumidification
- Solves IAQ issues







- Tight wet core
- Includes heat pump hot water heater
- Meets WaterSense requirement for residual hot water in pipes



# Electrical



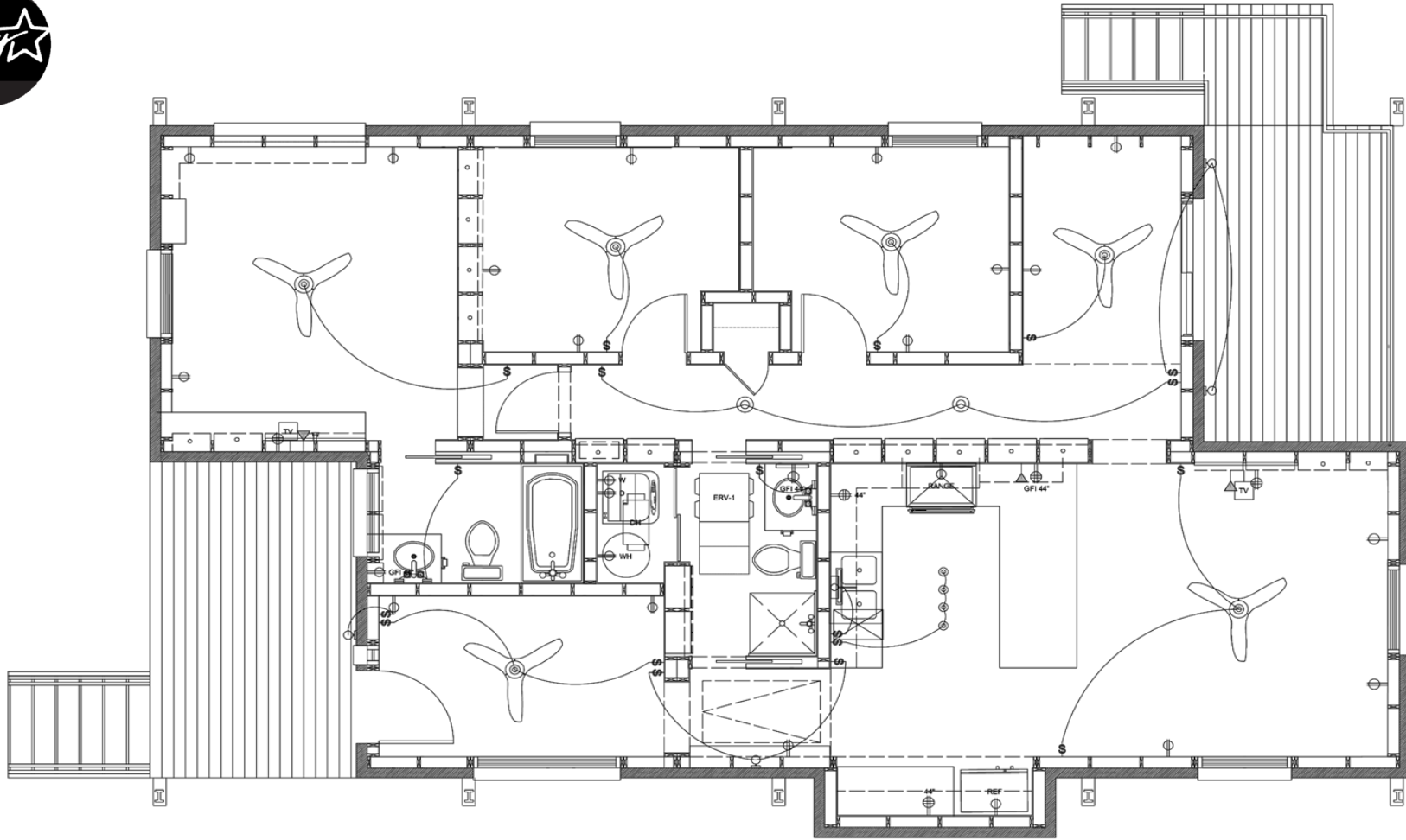
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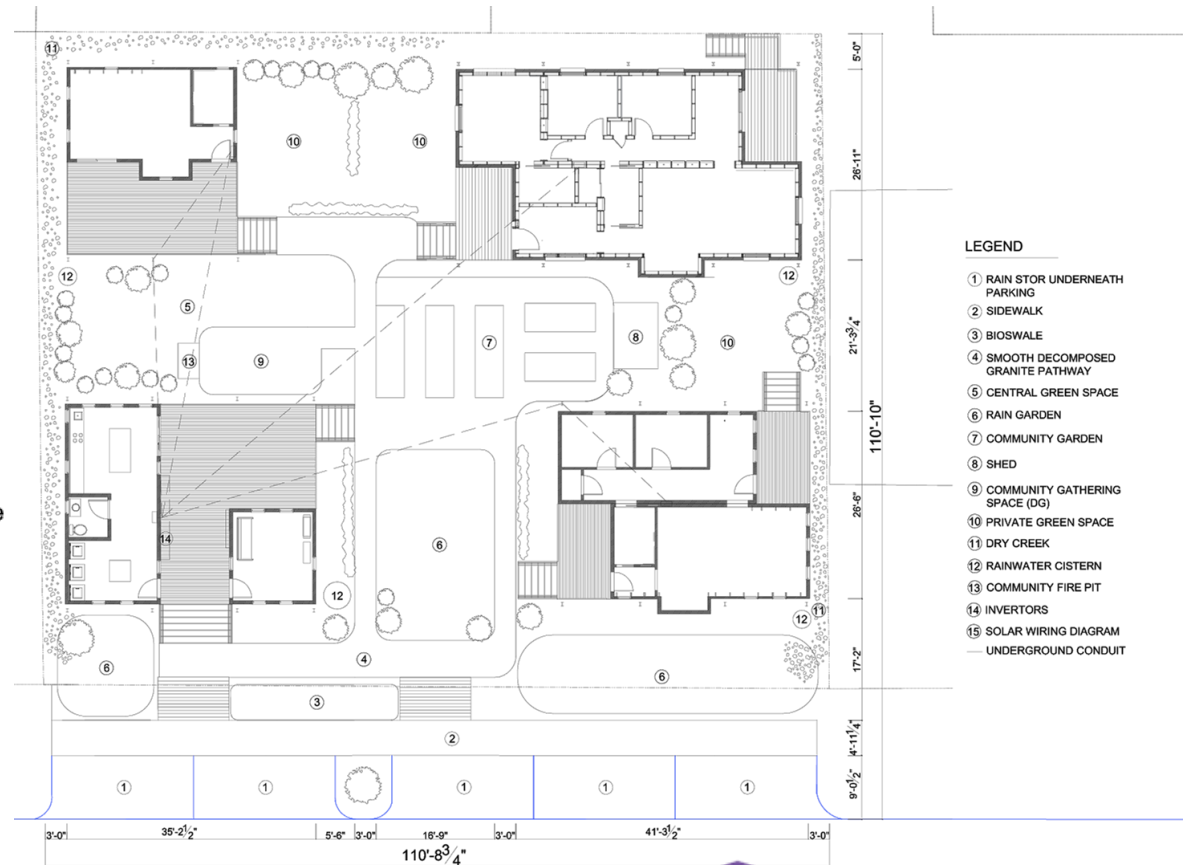
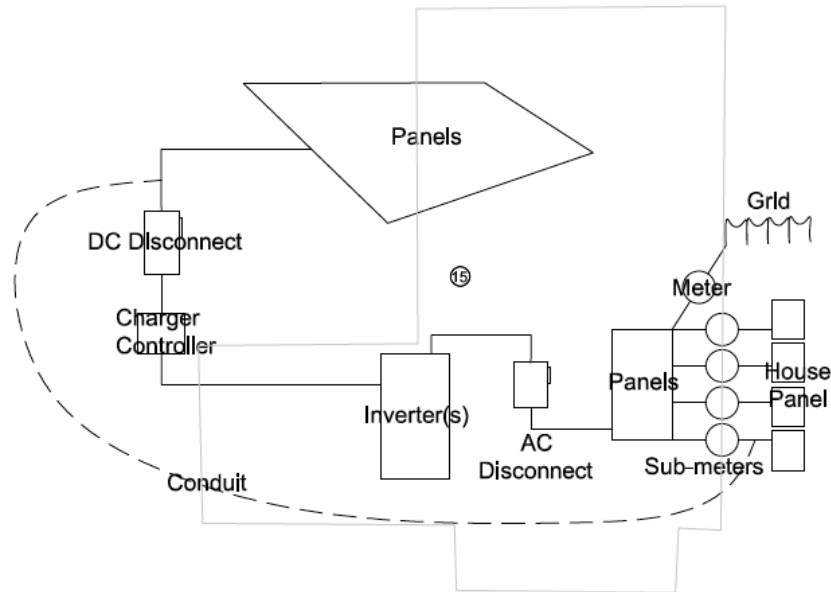
Innovation



# Photovoltaic System



- 27.3 kW PV system per fly roof
- 5.2 kW PV system required for 3 bedroom home



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Innovation

# Sustainability Overview



- Economic Resilience
- Social Resilience
- Environmental Resilience

 Solar Fly Roof

 Resilient Materials

 Shading Device

 Airtight Exterior



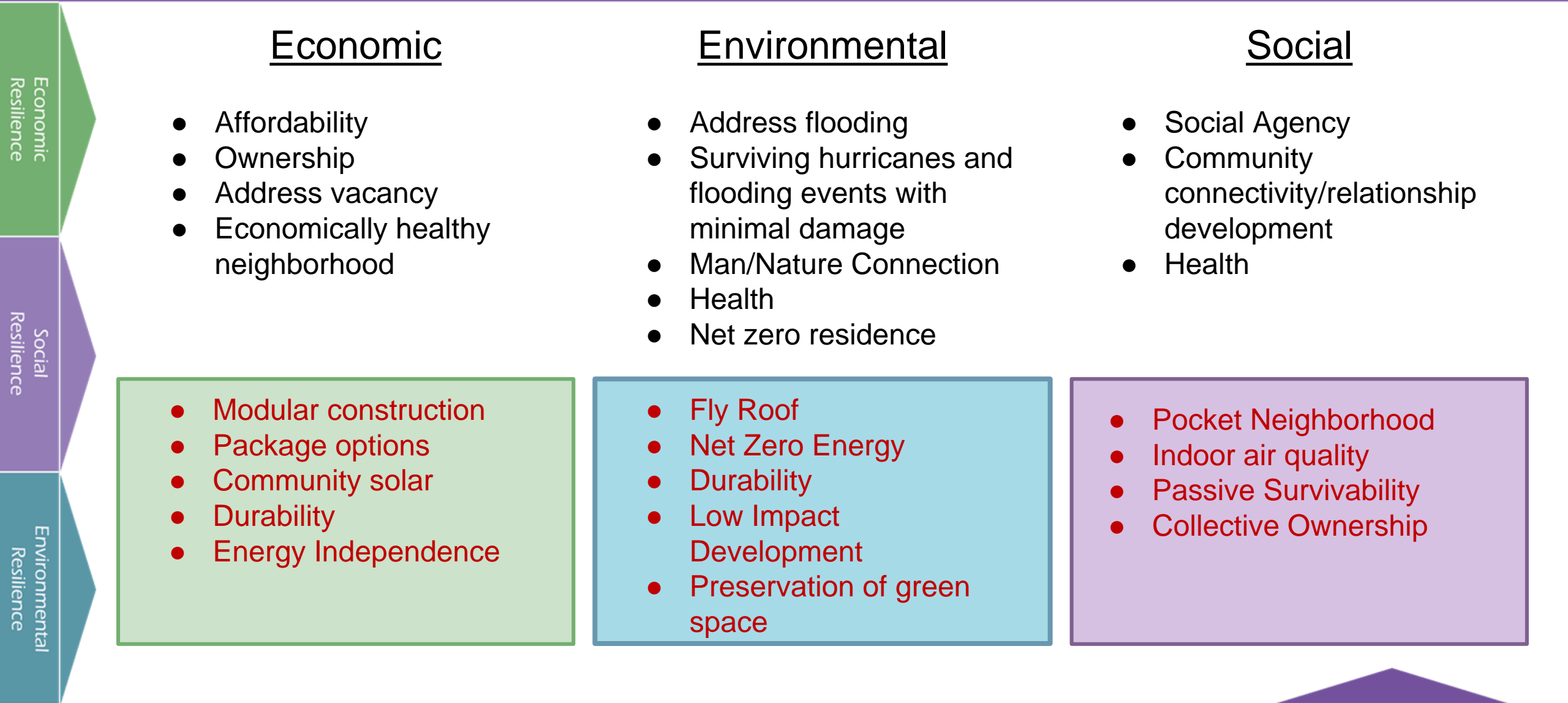
 Wind Resistant Windows

 Elevated Home

 Community Garden/Greenspace

 Site Water Management





Architecture

Constructability

Financial

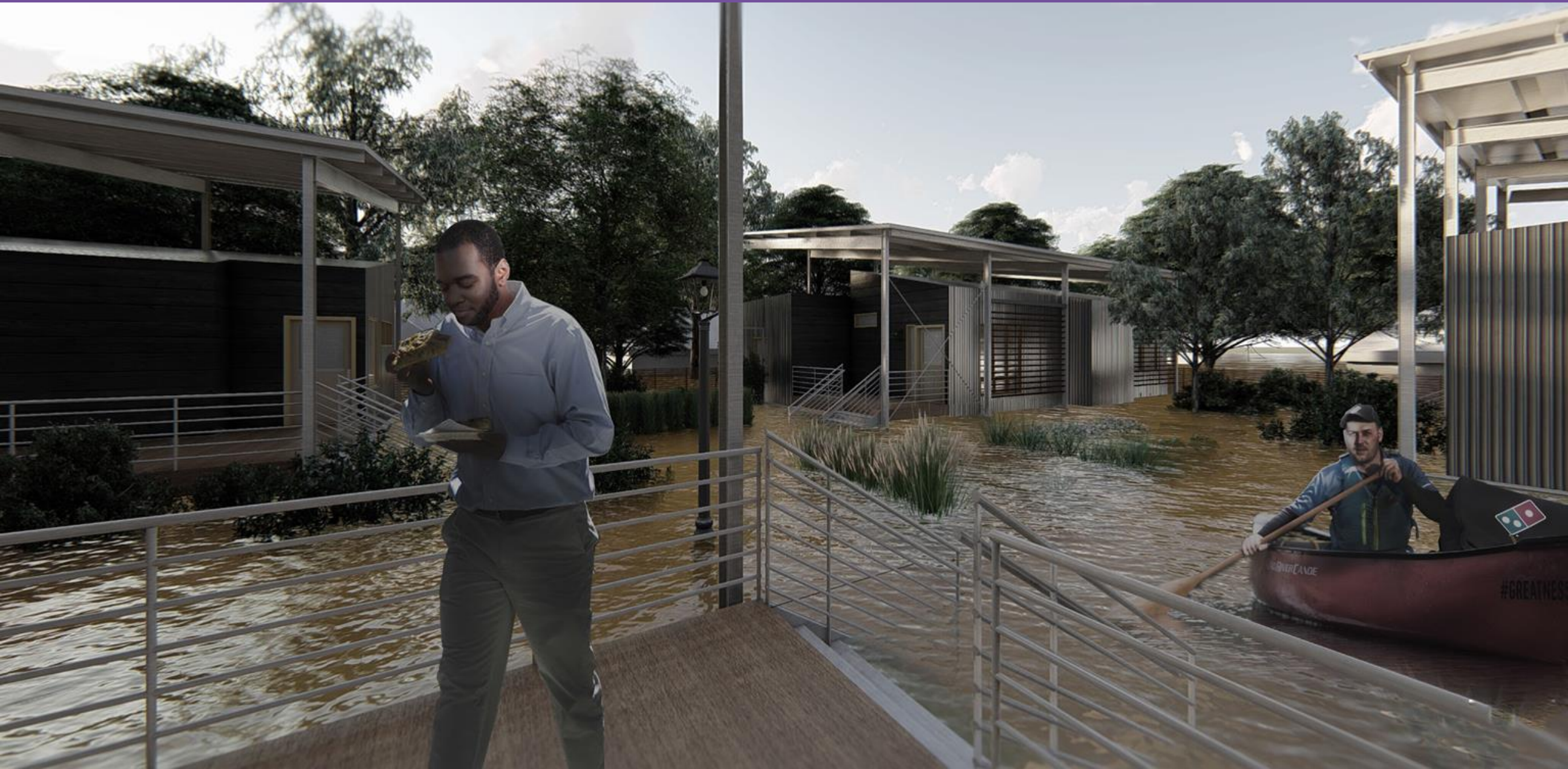
Energy & Envelope

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Thank you!

