ILLINOIS STATE UNIVERSITY

2015 RACE TO ZERO
STUDENT DESIGN COMPETITION

Team Members / Industrial Partners

CONSTRUCTION MANAGEMENT
Illinois State University

OFFICE OF SUSTAINABILITY
Illinois State University

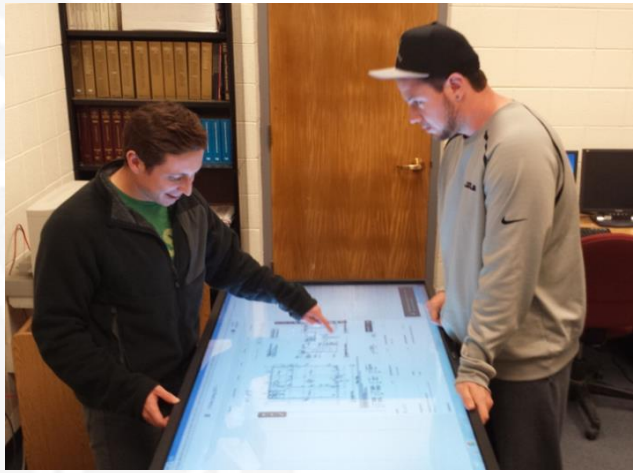
StraightUp SOLAR

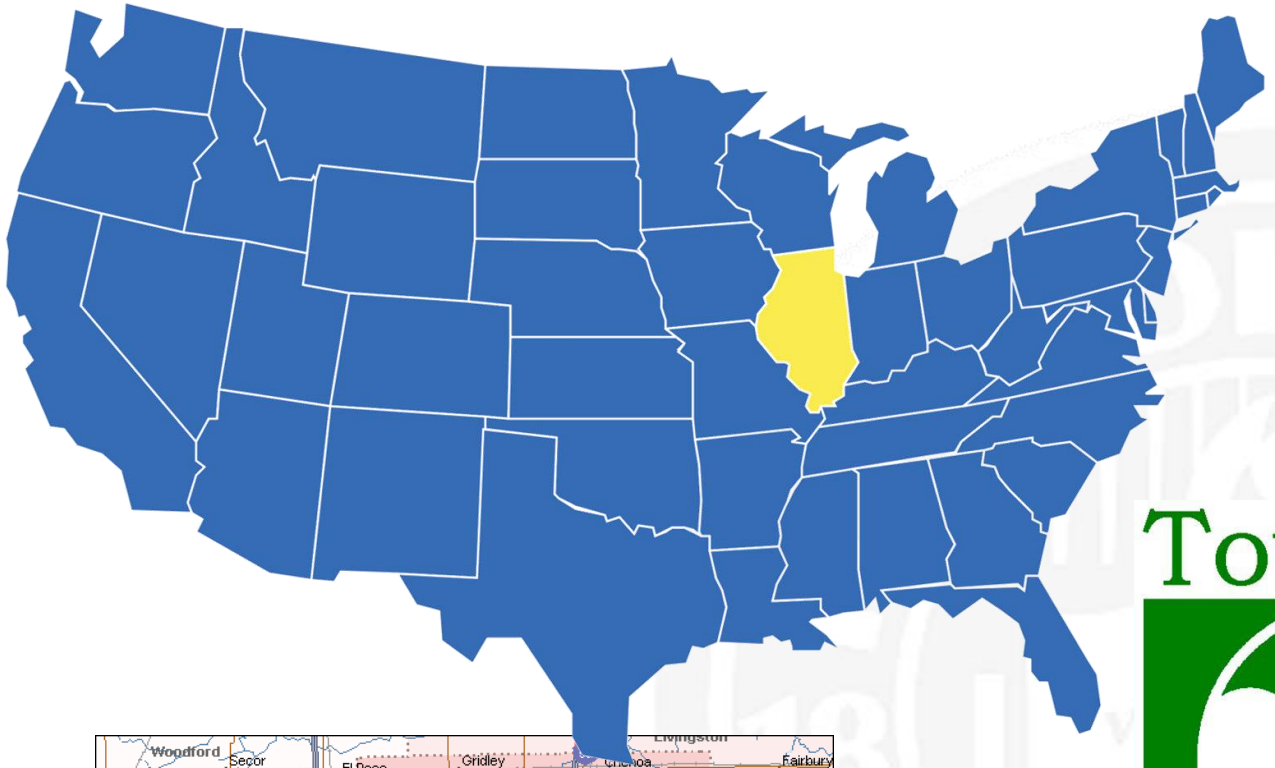
Solmetric

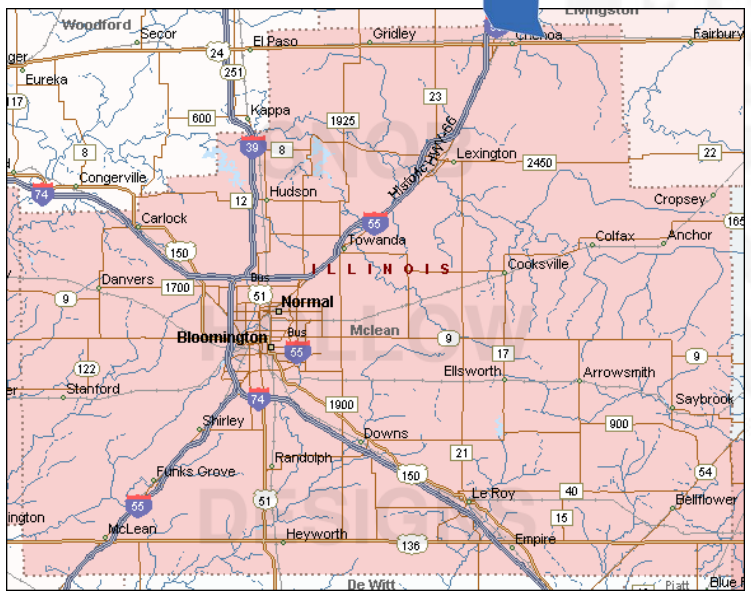
Habitat for Humanity® of McLean County

CONSTRUCTION MANAGEMENT

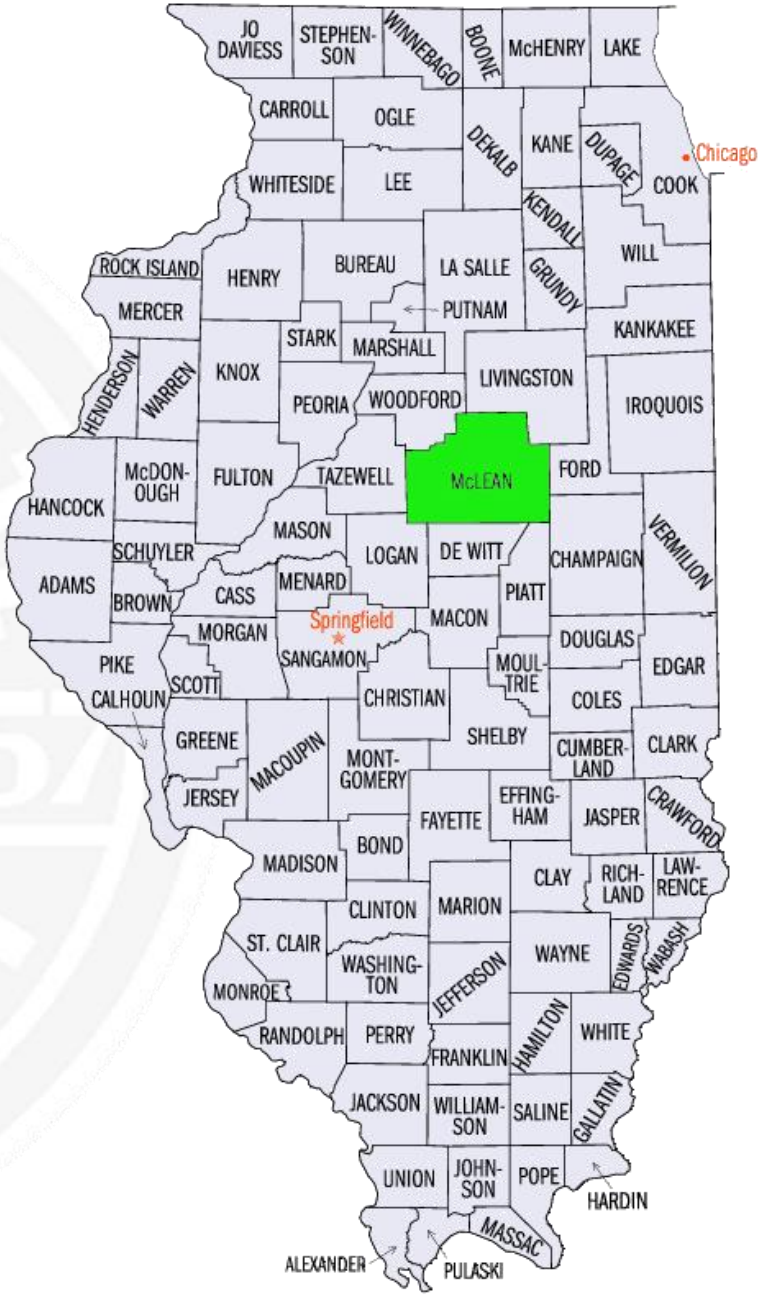
Illinois State University







Town of Normal



A C D E F G H I J

B. DESIGN GOALS

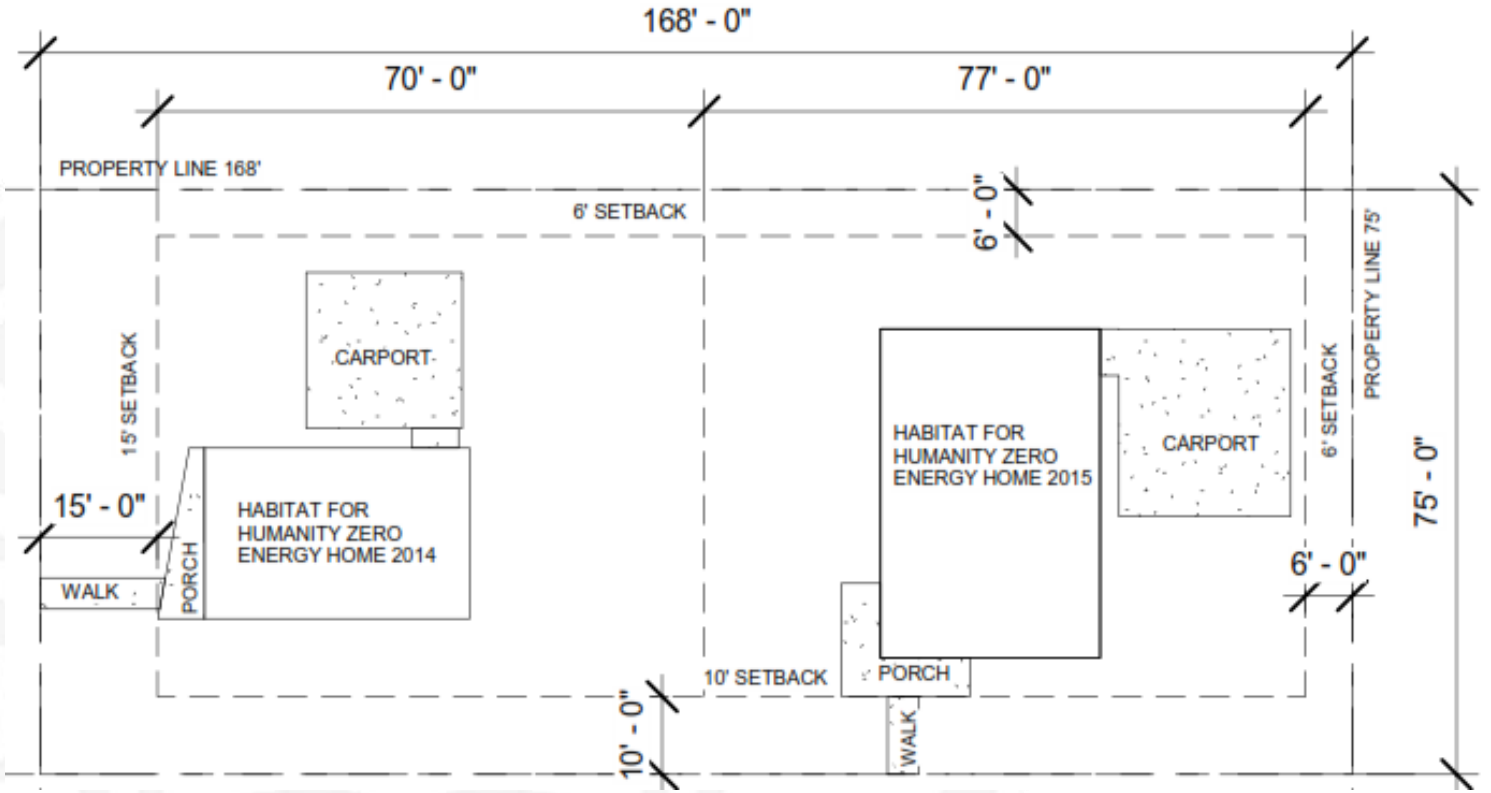
Project Site

Surrounding Architecture

Surrounding Architecture

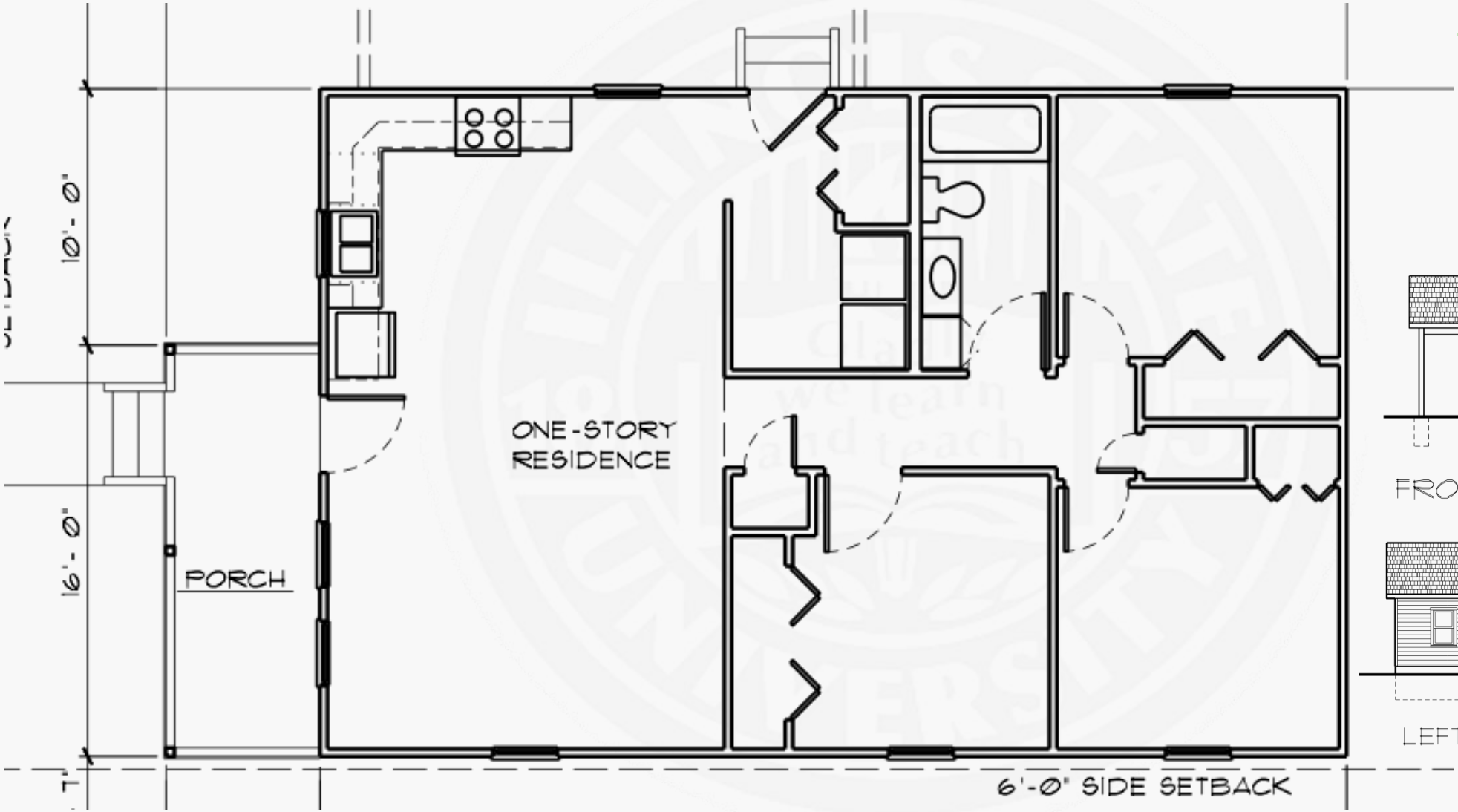
Surrounding Architecture

Surrounding Architecture



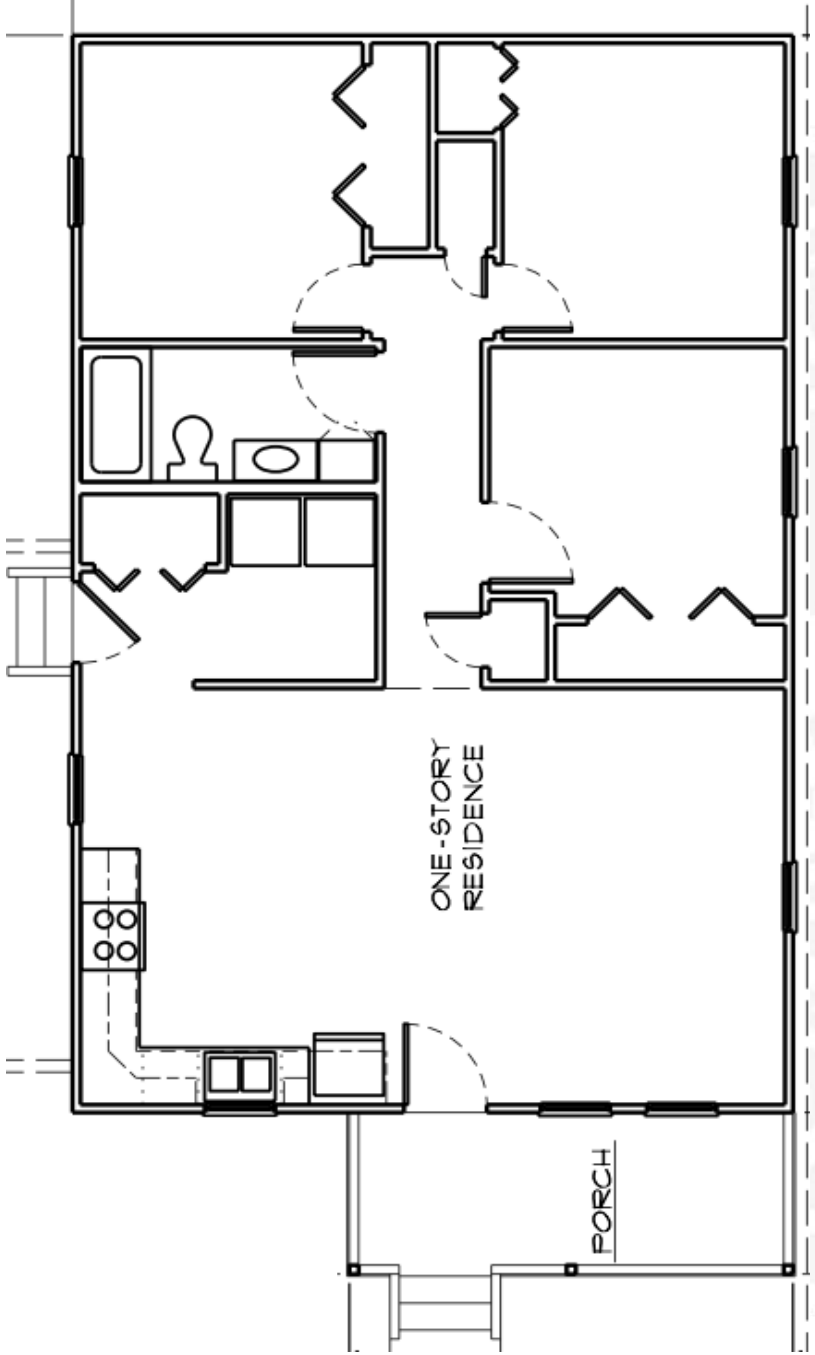
B. DESIGN GOALS

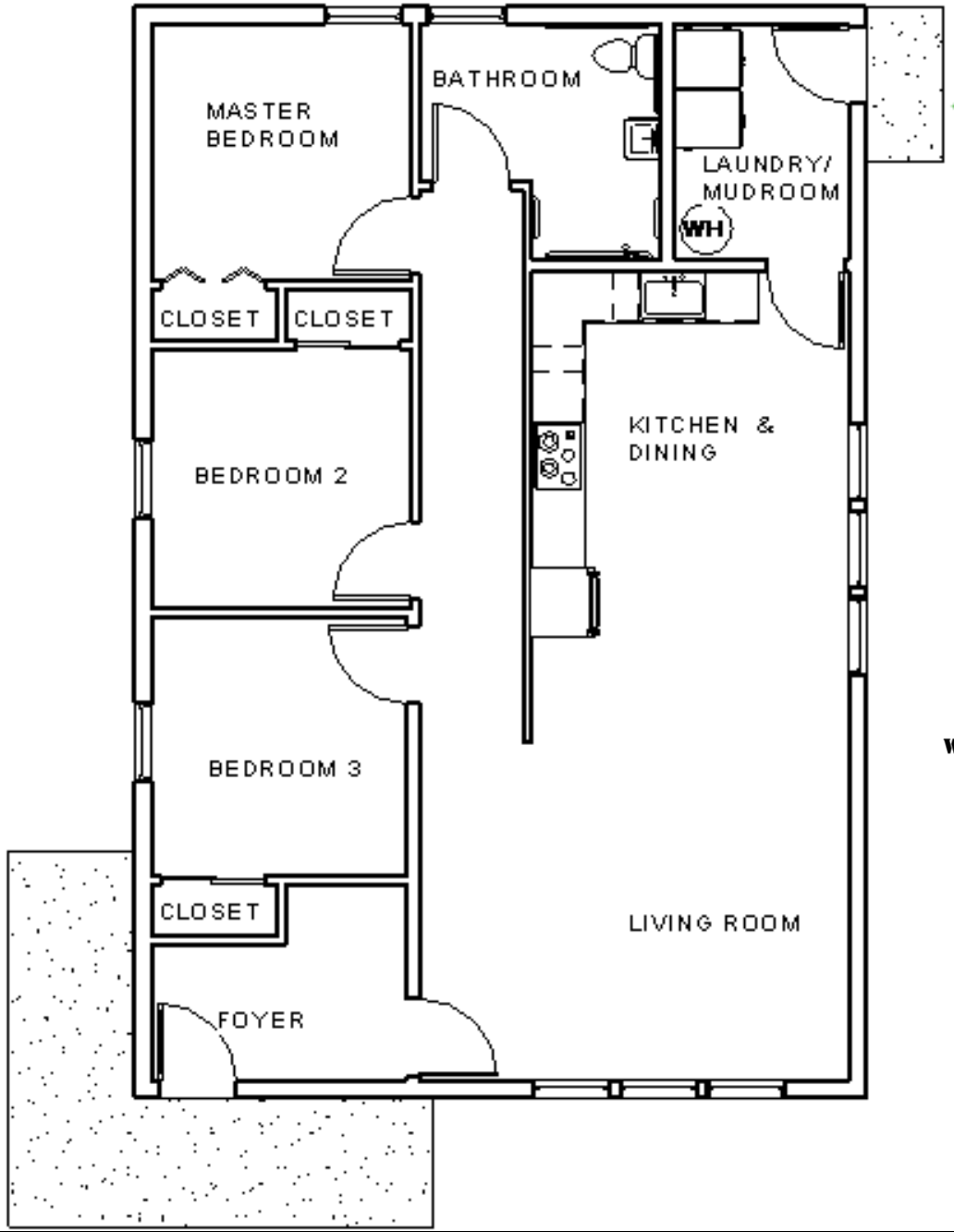
Standard Model



FRONT ELEVATION

LEFT ELEVATION





Habitat for Humanity® of McLean County

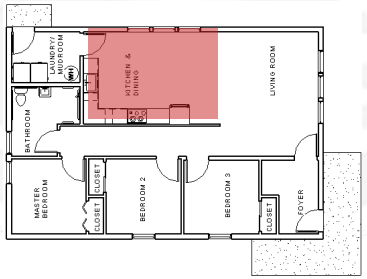
Americans with Disabilities Act

WOUNDED WARRIOR PROJECT

ZERO ENERGY READY HOME
U.S. DEPARTMENT OF ENERGY

A C D E F G H I J

B. DESIGN GOALS



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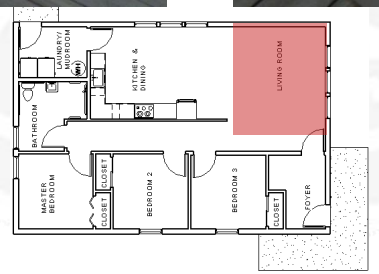

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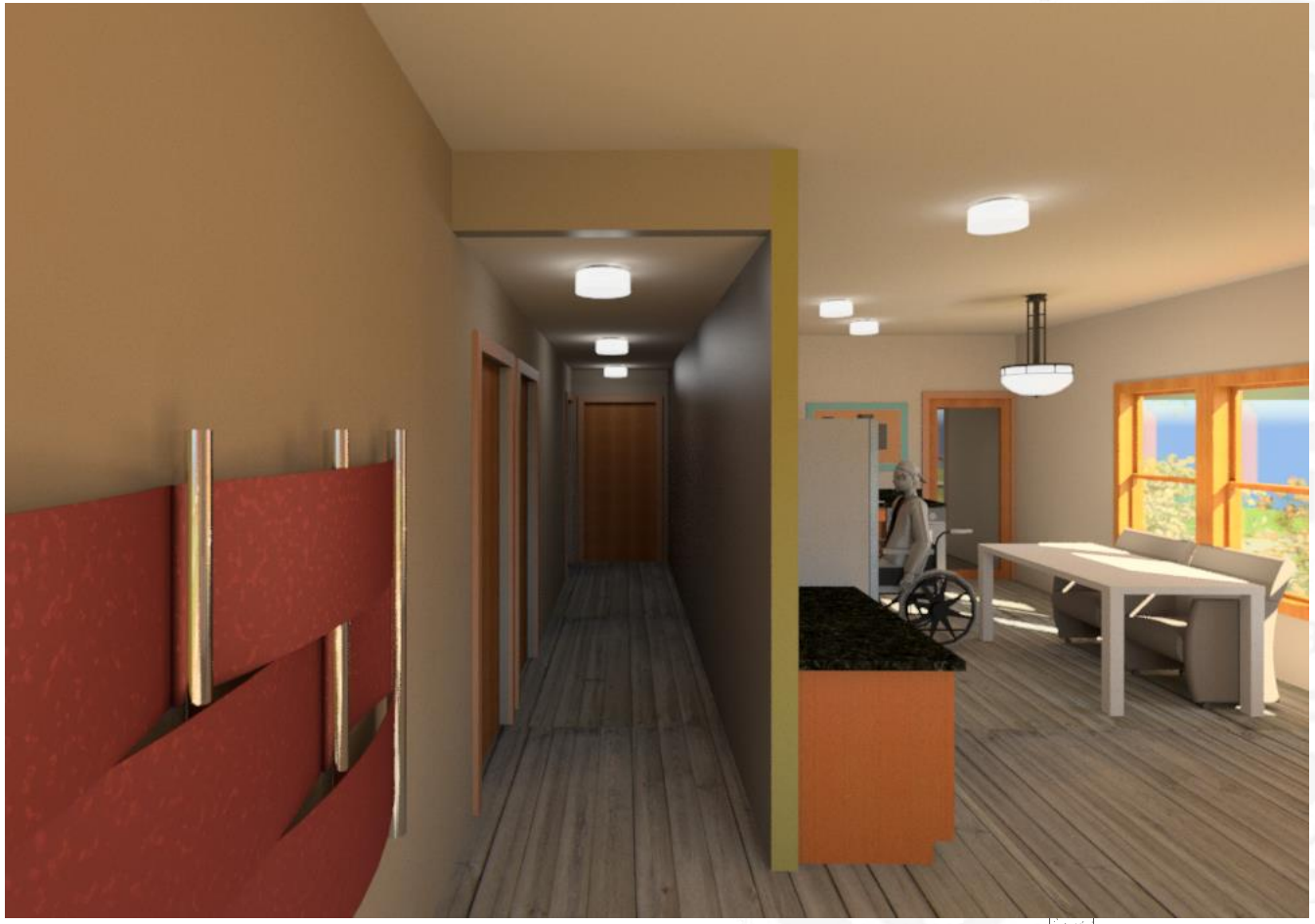

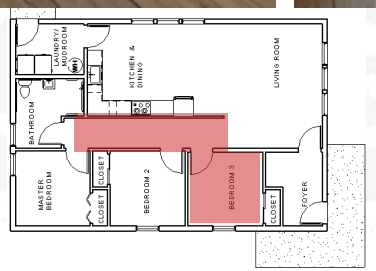

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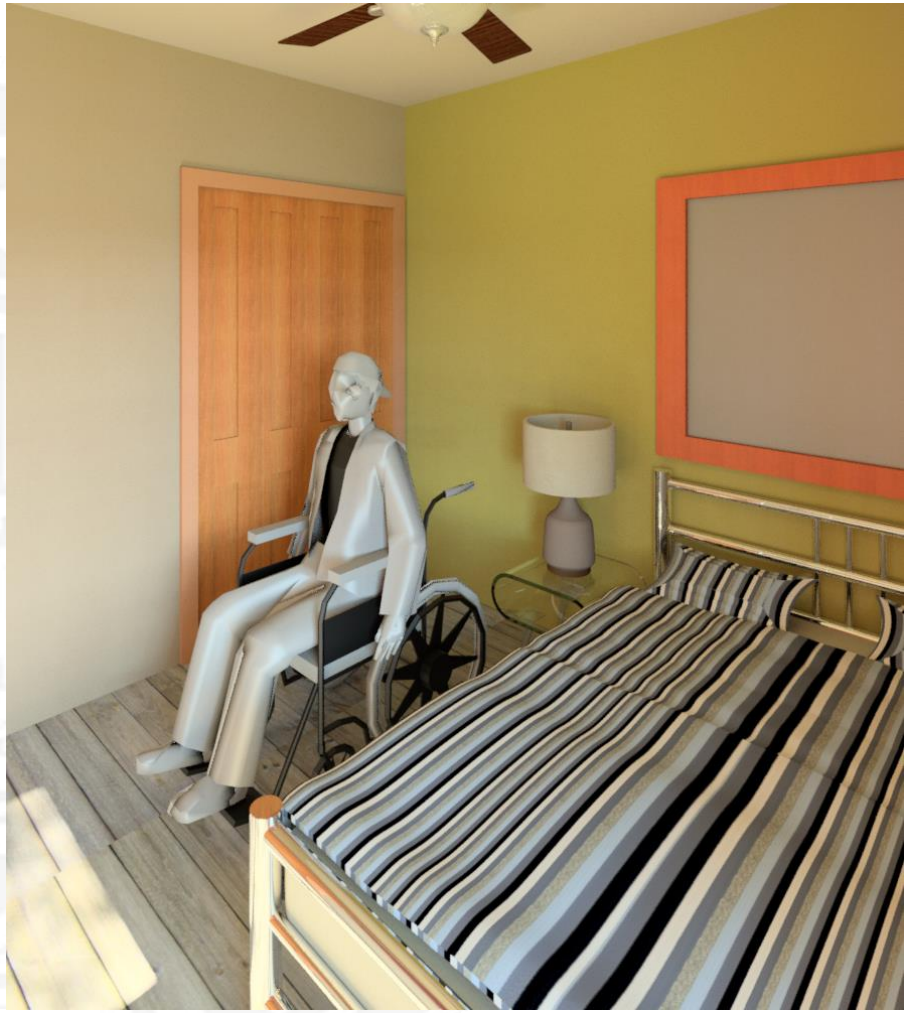

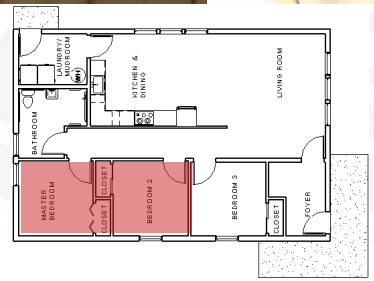

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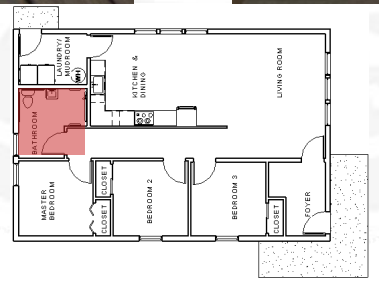

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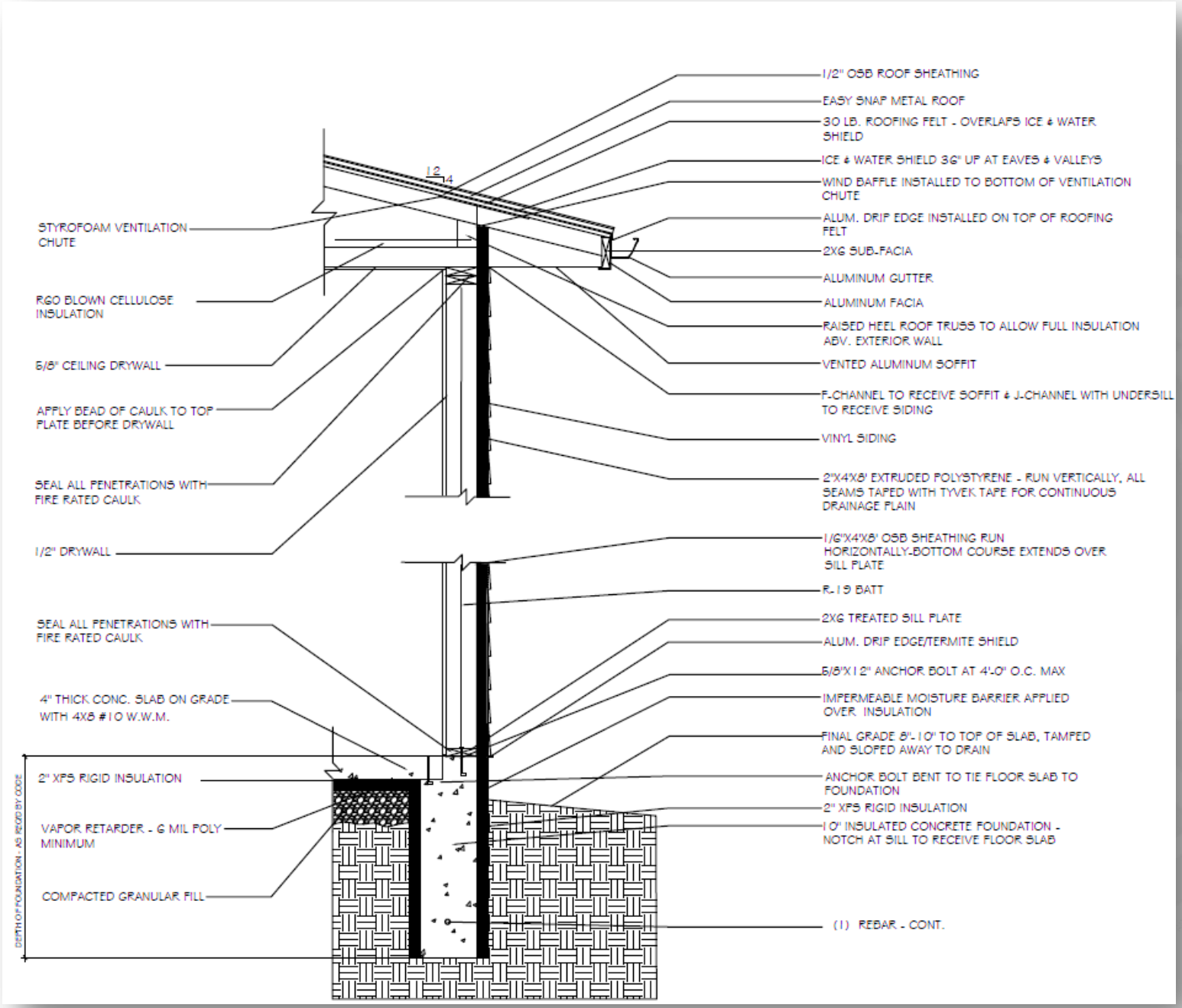
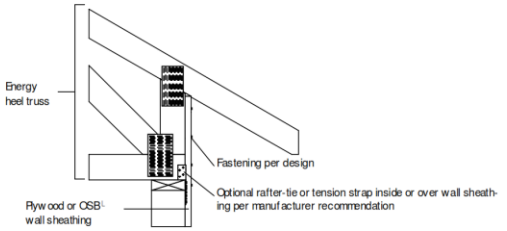


ENERGY HEEL TRUSS TO WALL

WOOD STRUCTURAL PANEL OVERLAP

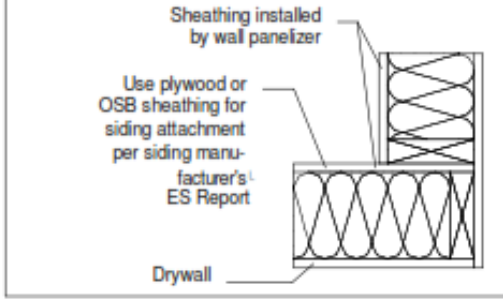


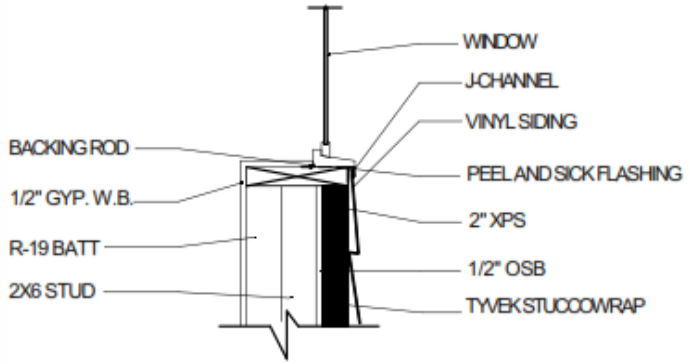
Ensure correct fastening of sheathing to top plate per shear wall, wall bracing, or combined shear and uplift requirements.*

*See rafter-tie manufacturer's instructions for installation of strap over sheathing and into framing.

TWO-STUD CORNERS

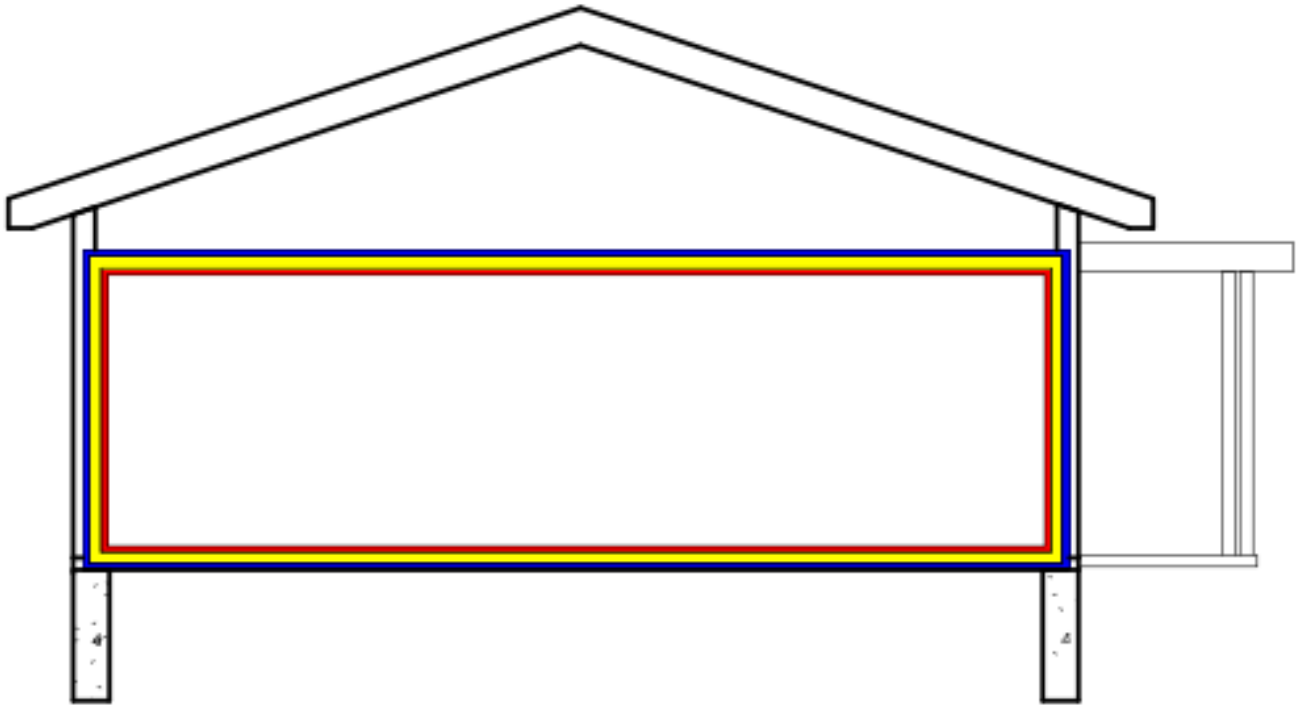
TWO-STUD INSIDE CORNER (FOR WALL PANELIZATION)





A B D E F G H I J

C. ENVELOPE DURABILITY



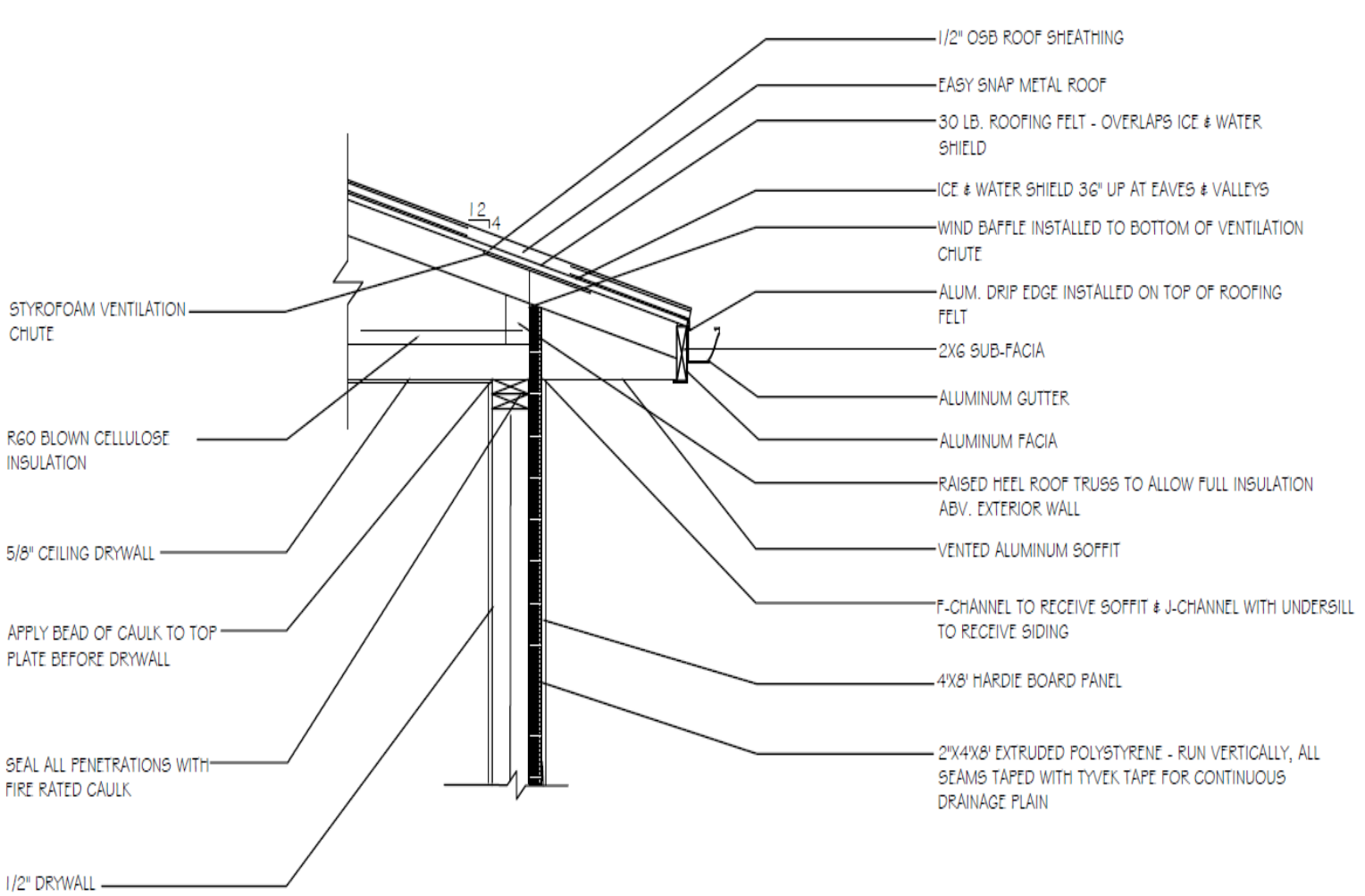
L E G E N D

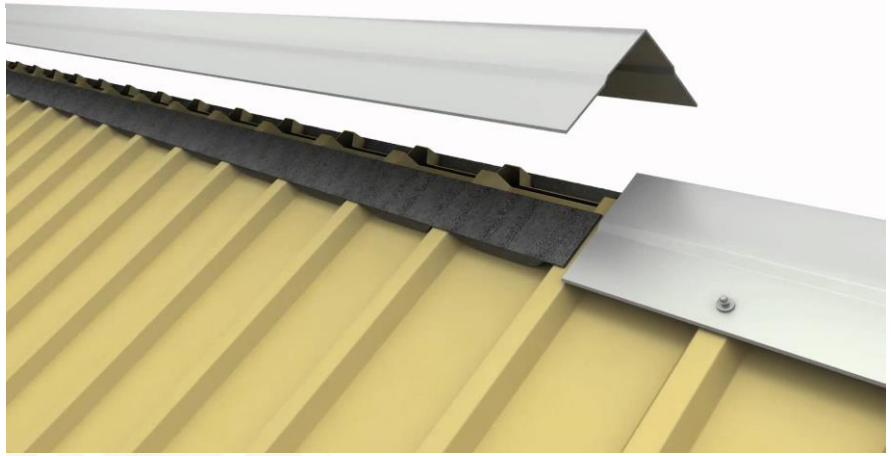
Limit of Thermal Envelope = Gross Enclosed Volume

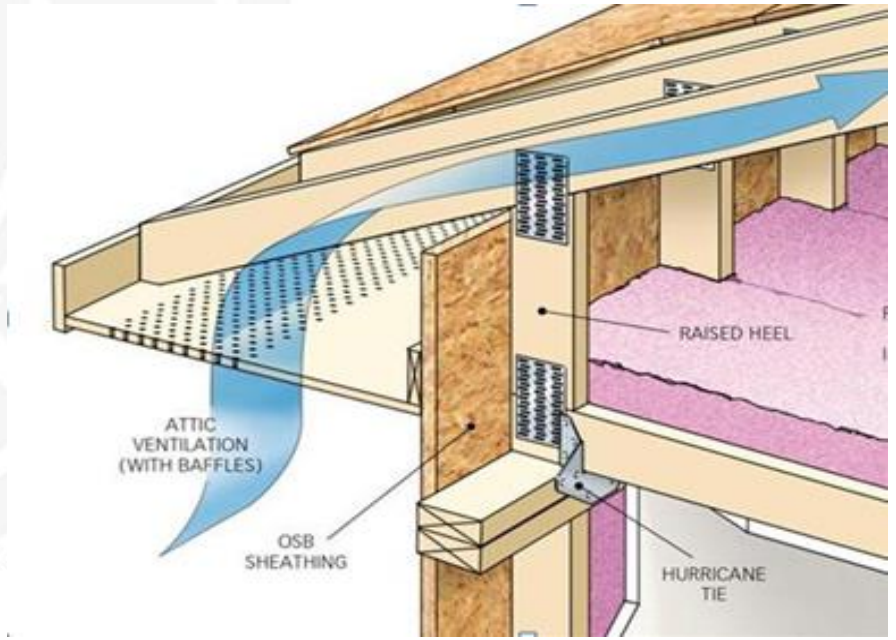
Thermal Envelope

Airtight Layer

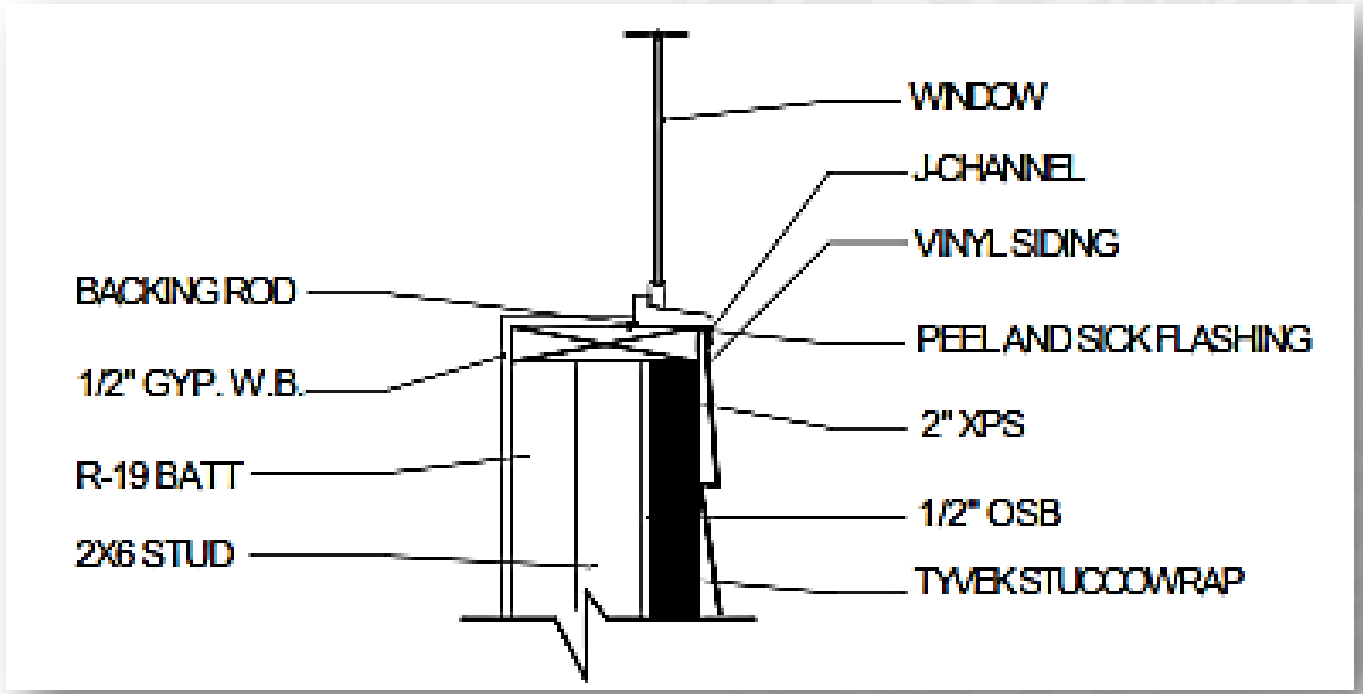
Roof Assembly

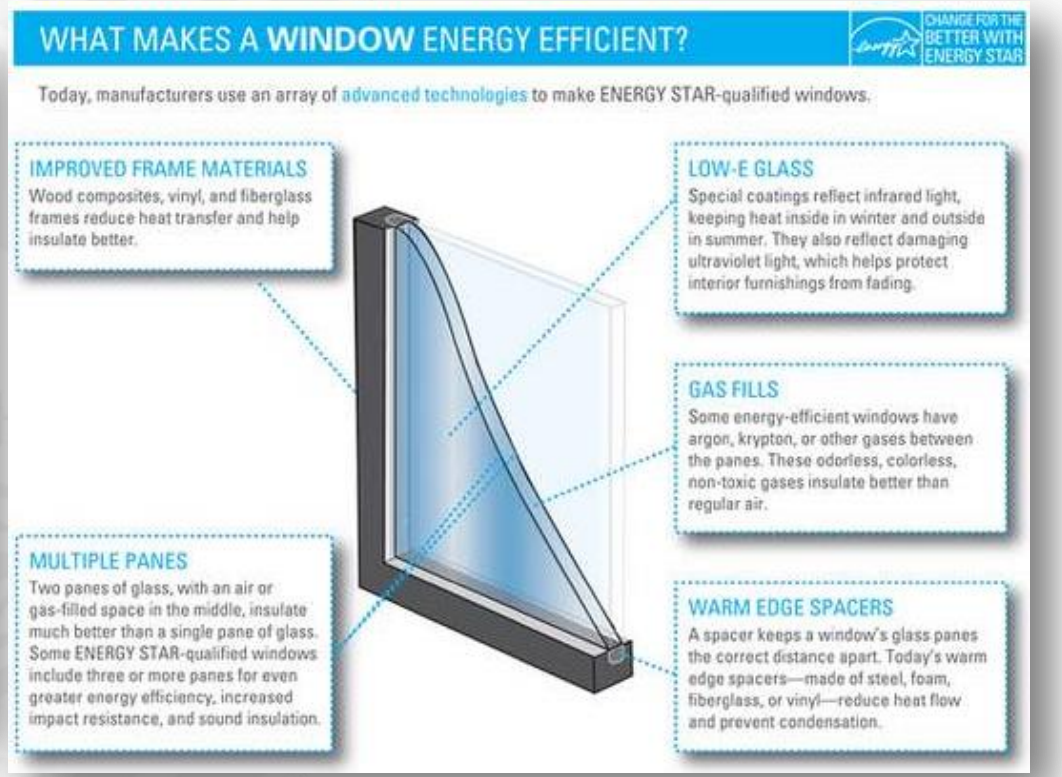




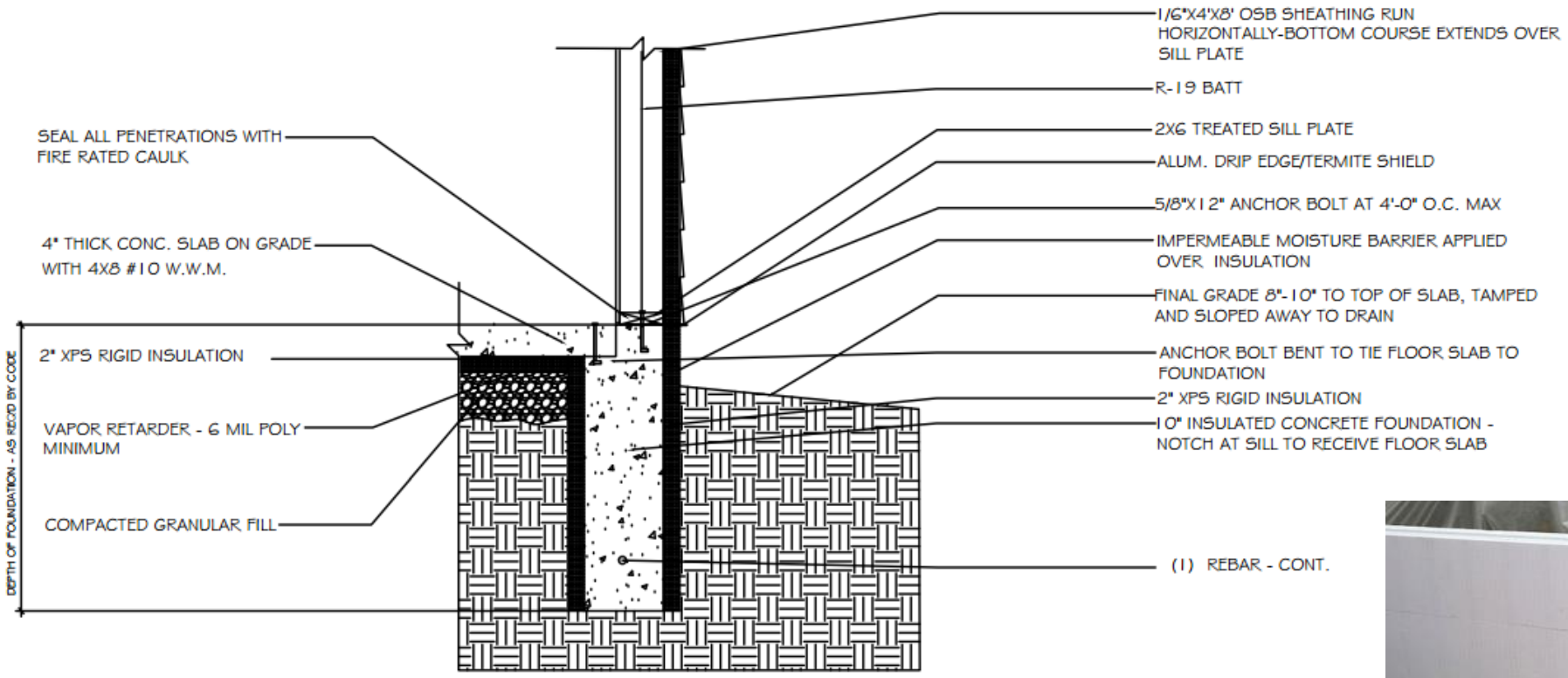


Fenestration

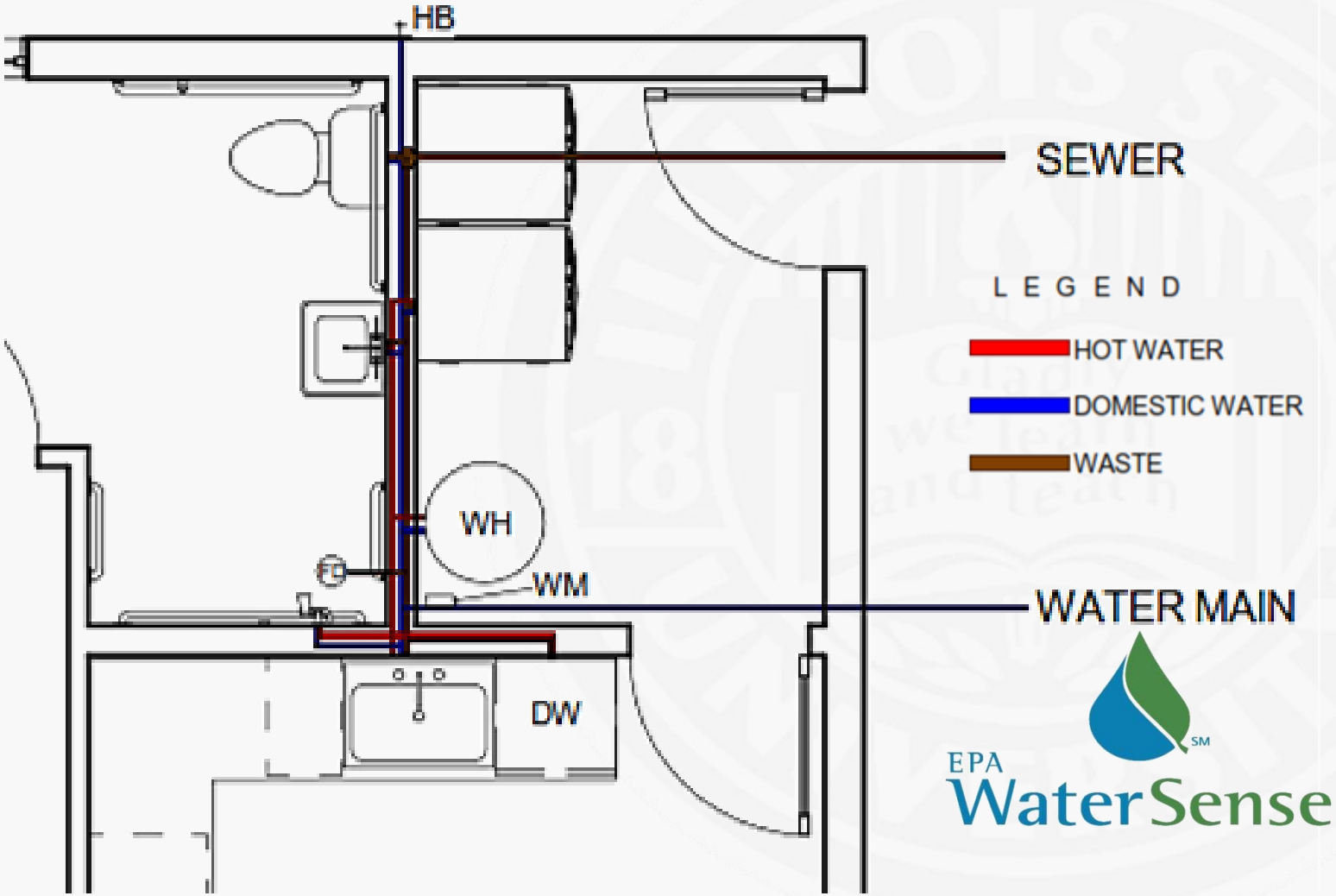


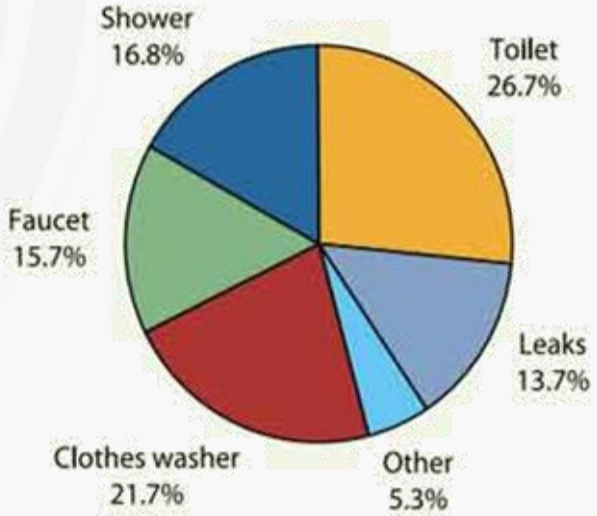


Wall Assembly

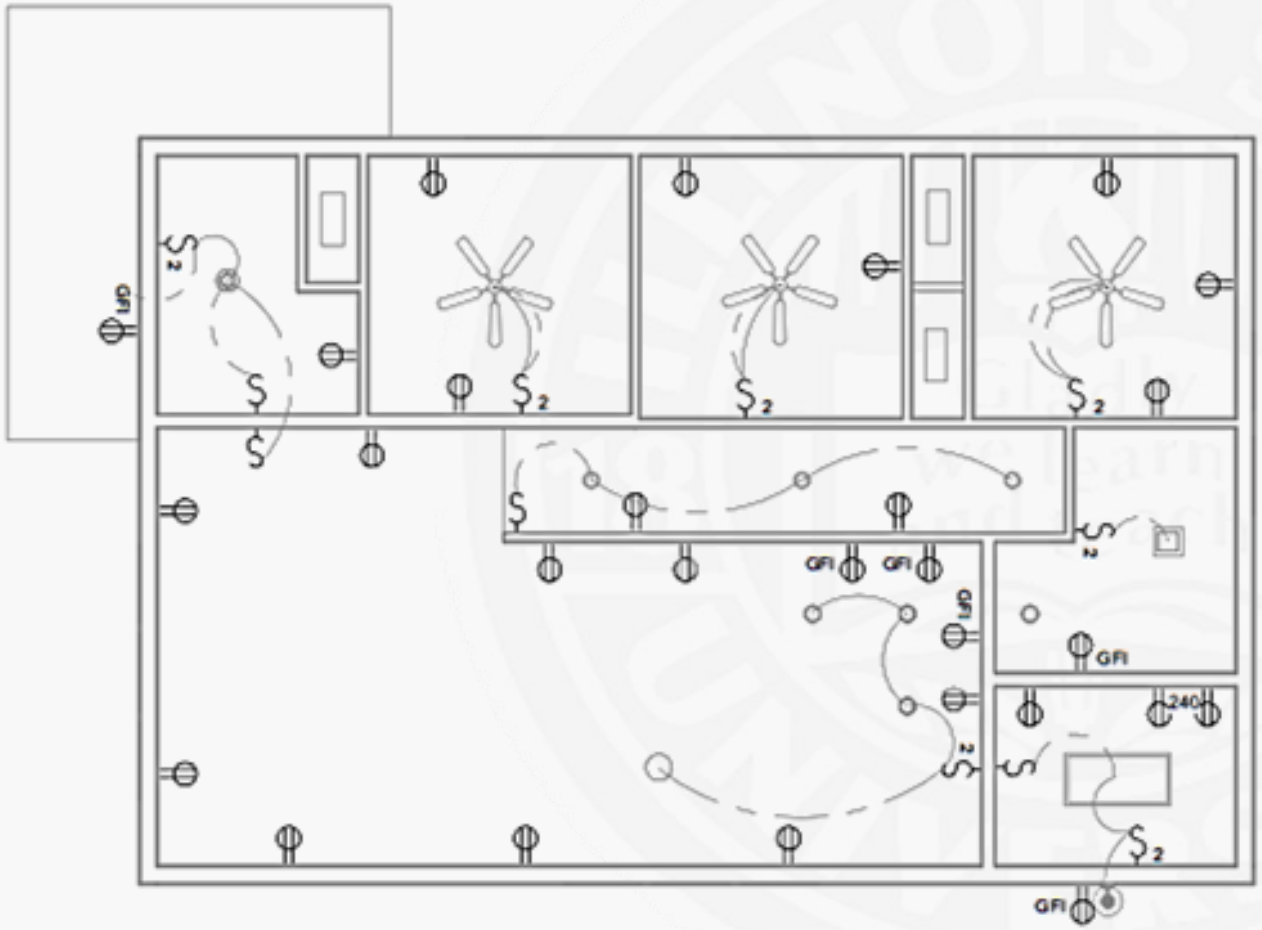


Domestic Hot Water

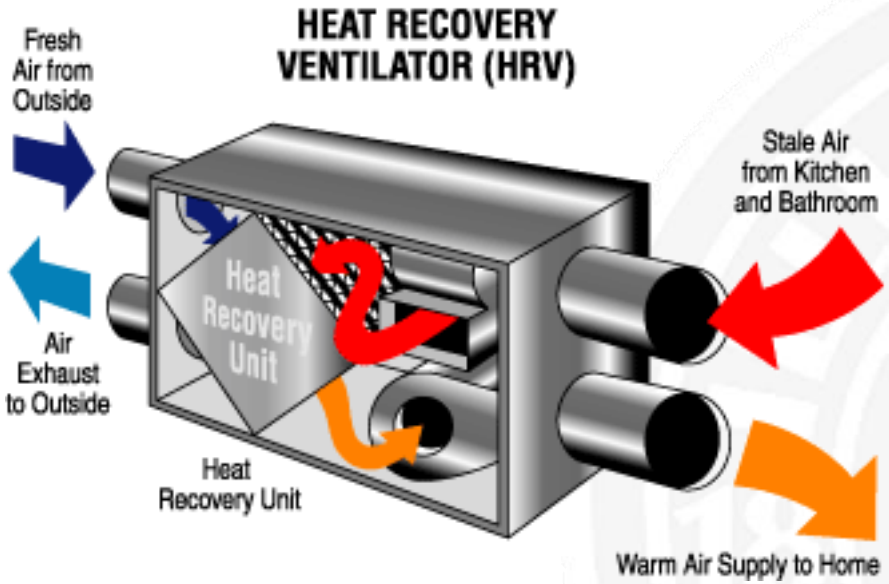


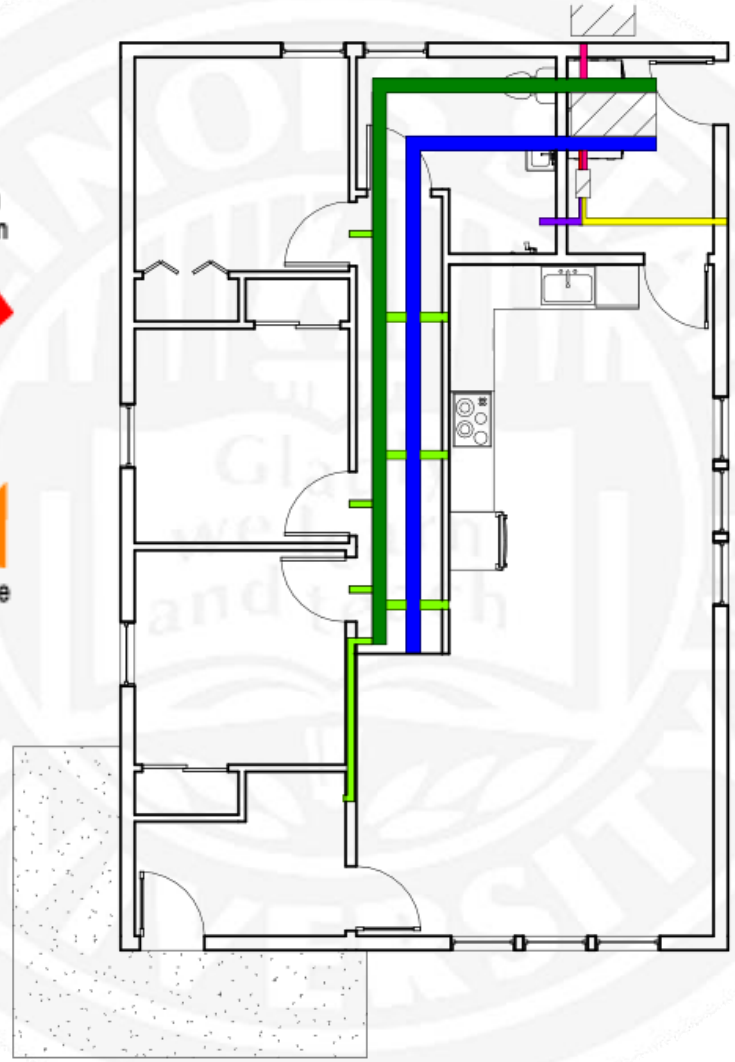


Lighting and Appliances



Indoor Air Quality



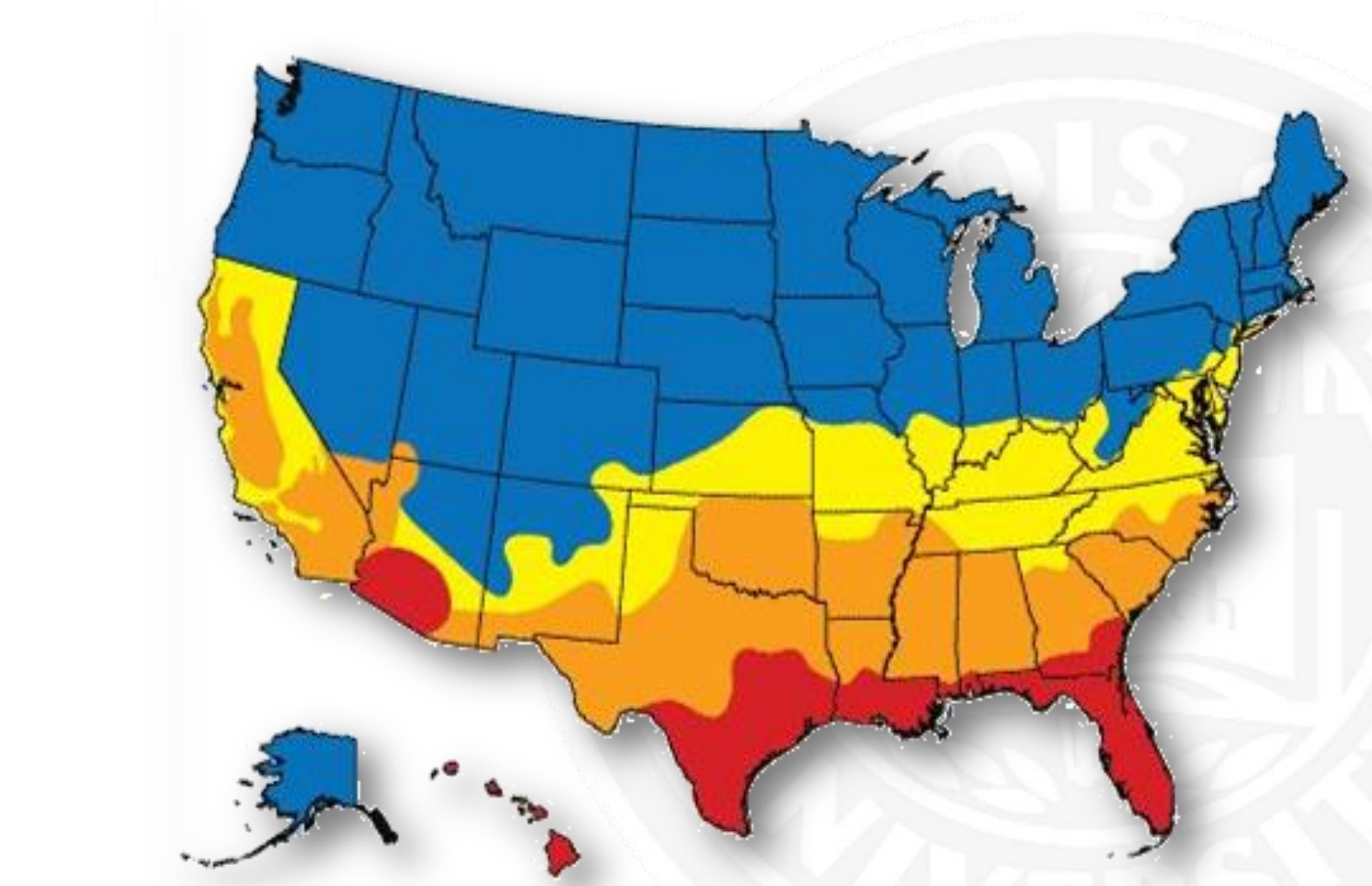


GE Profile Telescopic Downdraft System

Stamped Concrete

Wall Register

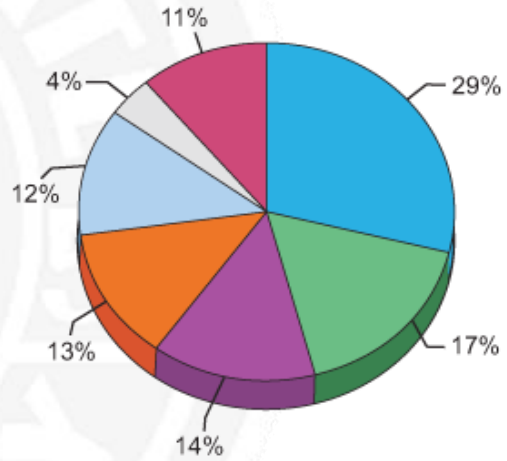
Heat Pump



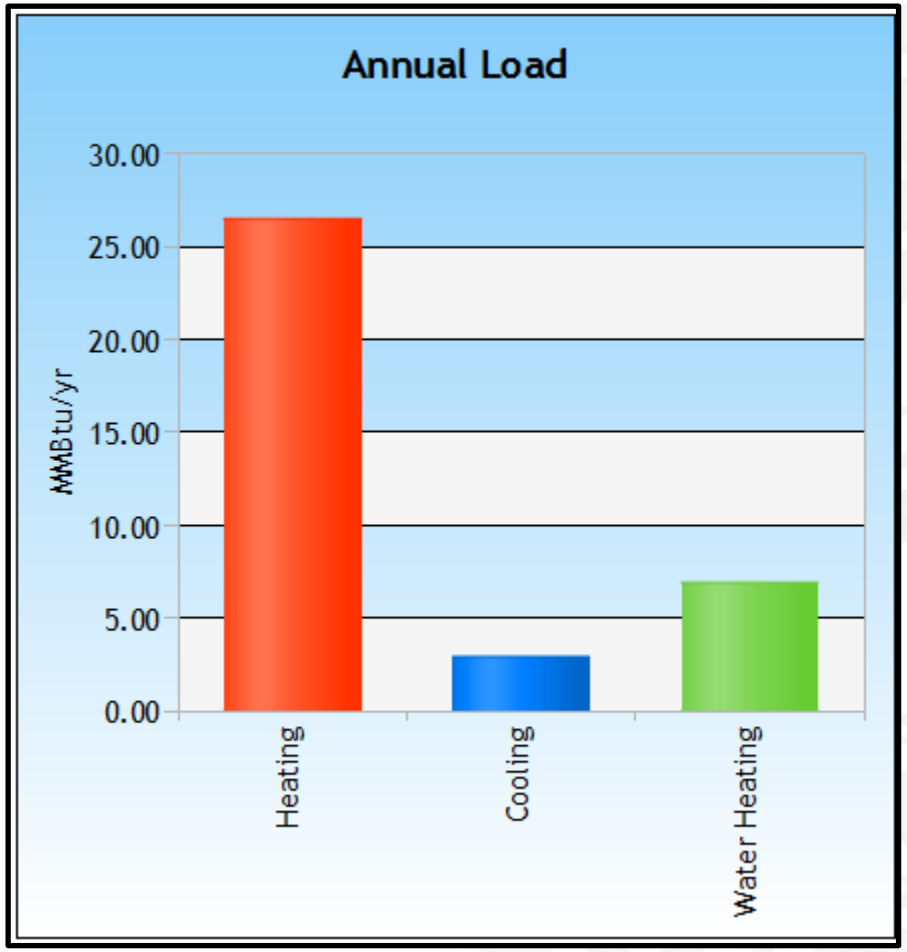
Northern
North-Central
South-Central
Southern

Where Does My Money Go?

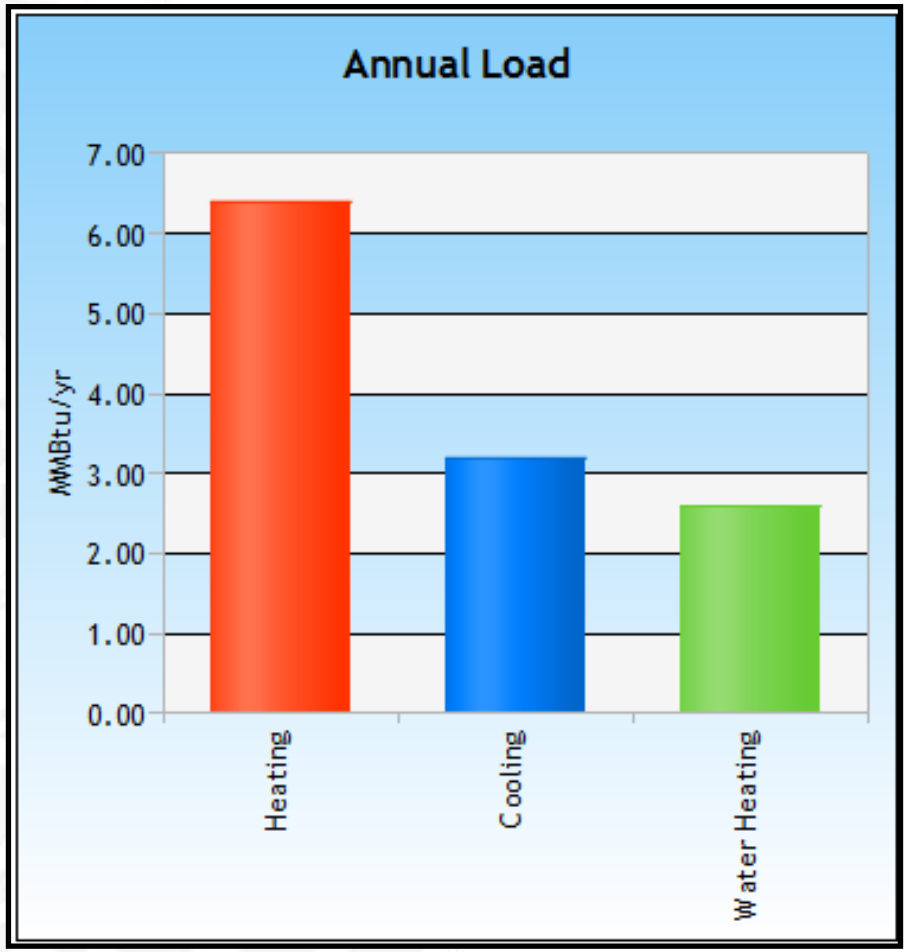
Annual Energy Bill for a typical Single Family Home is approximately $2,200.



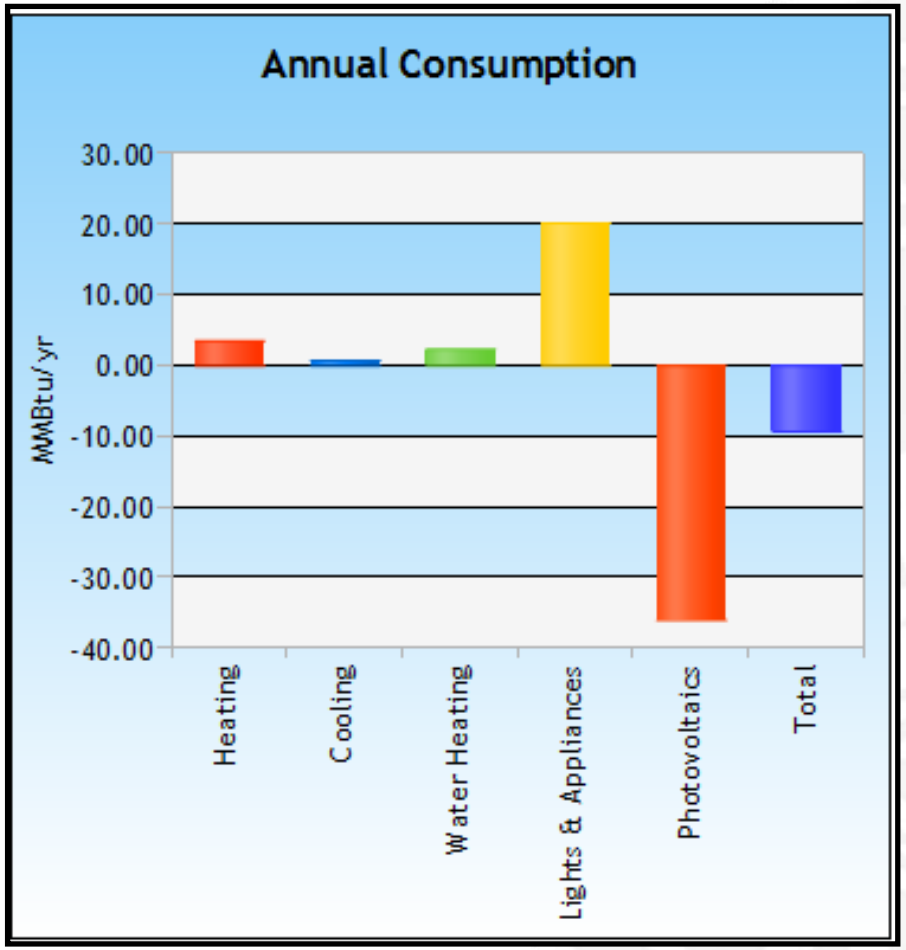
- Heating
- Cooling
- Water Heating
- Appliances (includes refrigerator, dishwasher, clothes washer and dryer)
- Lighting
- Electronics (includes computer and monitor and TV and DVD player)
- Other* (includes external power adapters, telephony, set-top boxes, ceiling fans, vent fans and home audio)



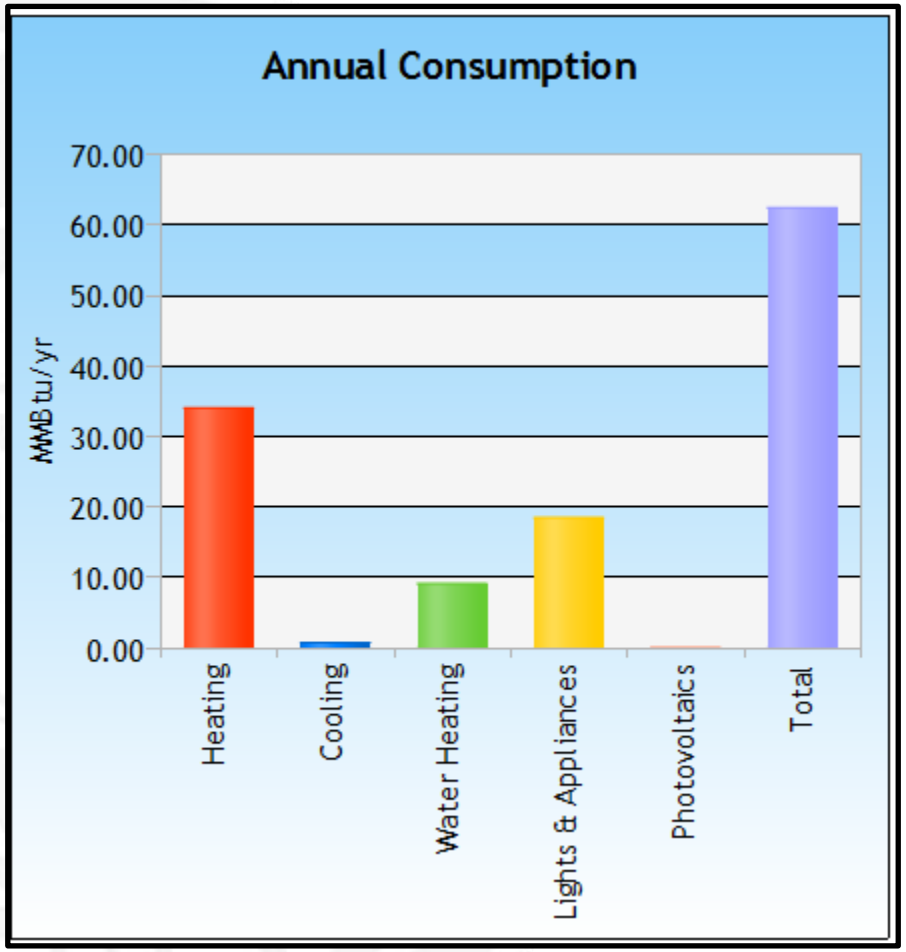
Base Home



Modified Home



Base Home

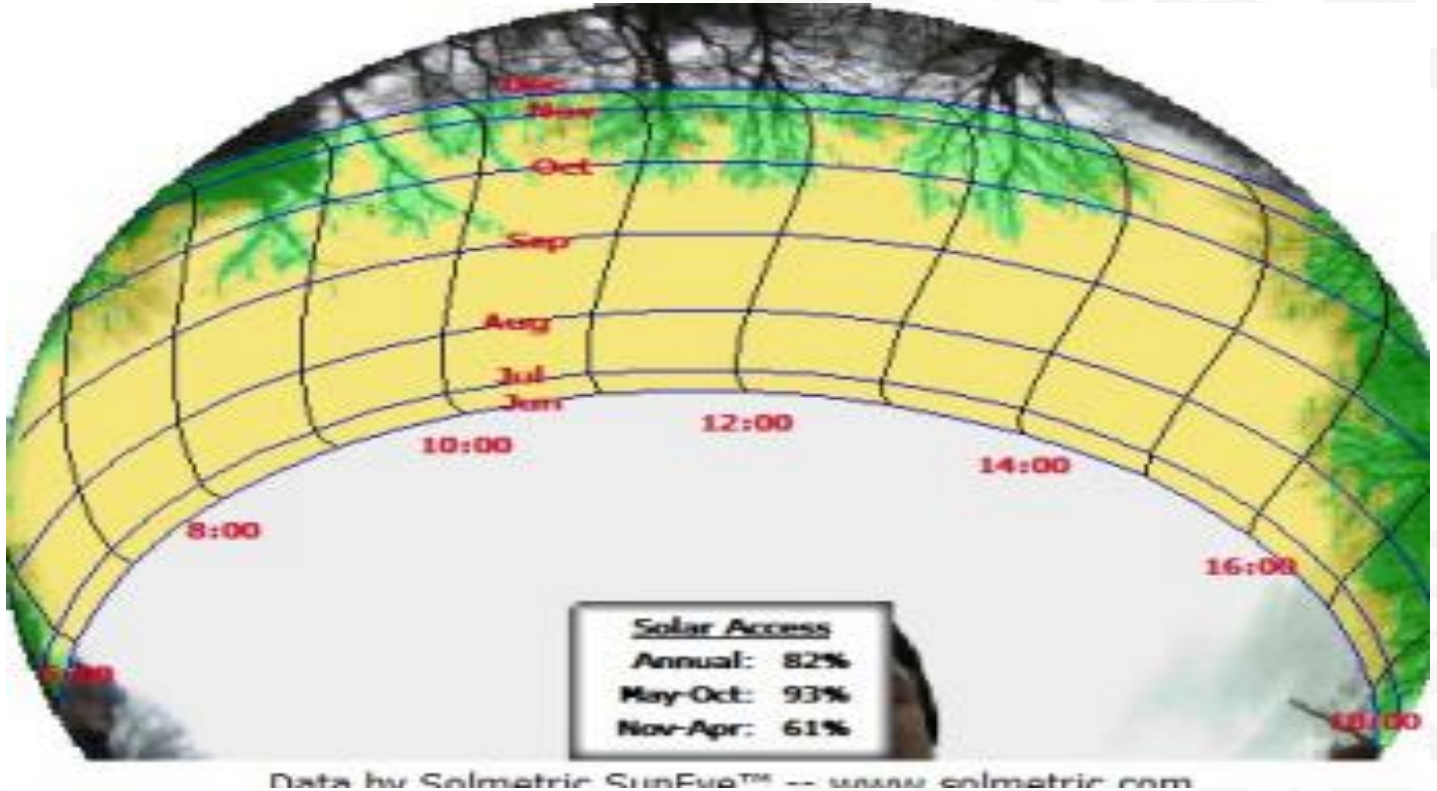


Modified Home

REM Rate/HERS Rating

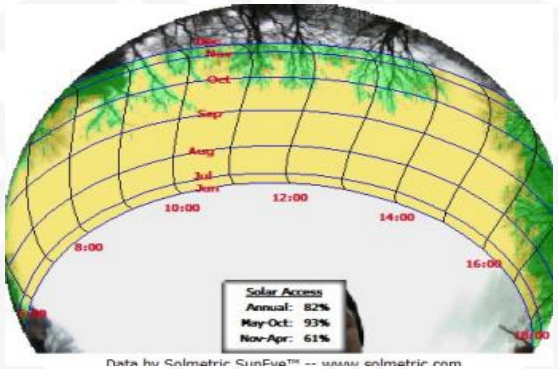
- HERS Rating: 52
- With onsite generation: -3
- $40.56 surplus annually.

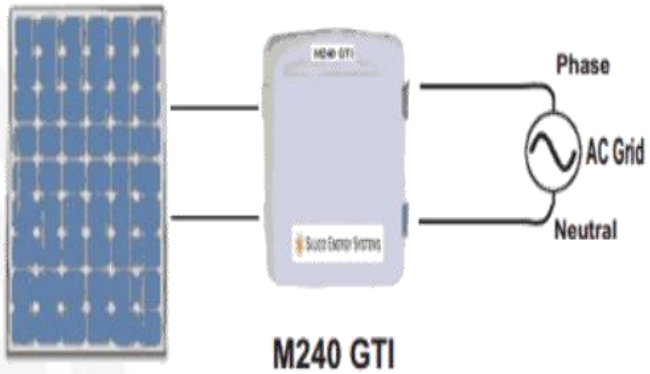
Solmetric Suneye Shading Data



Photovoltaic System

- Solar Obstruction
- Solar Access:
  - Annual: 82%
  - May - Oct: 93%
  - Nov - Apr: 61%
- System Advisor Model (SAM)

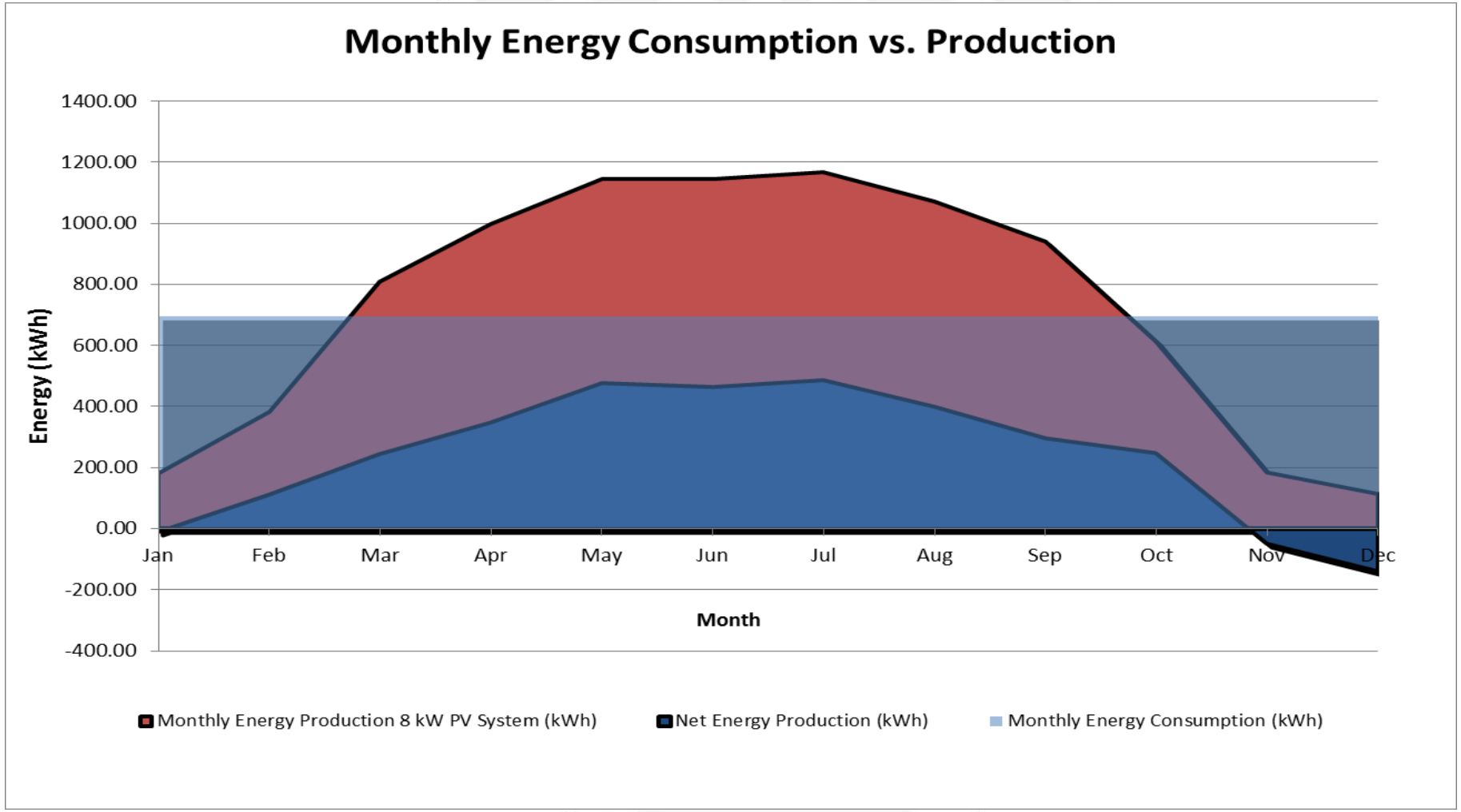




StraightUp SOLAR

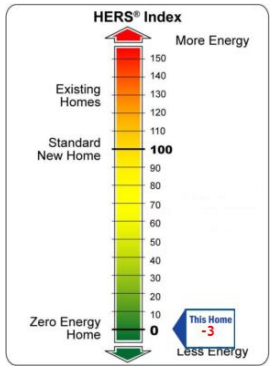
SUNPOWER Authorized Dealer

Energy Consumption and PV System Production



Project Score Card

If Checklists and Builder ID have been entered then home will qualify as DOE Zero Energy Ready



DOE Zero Energy Ready Home

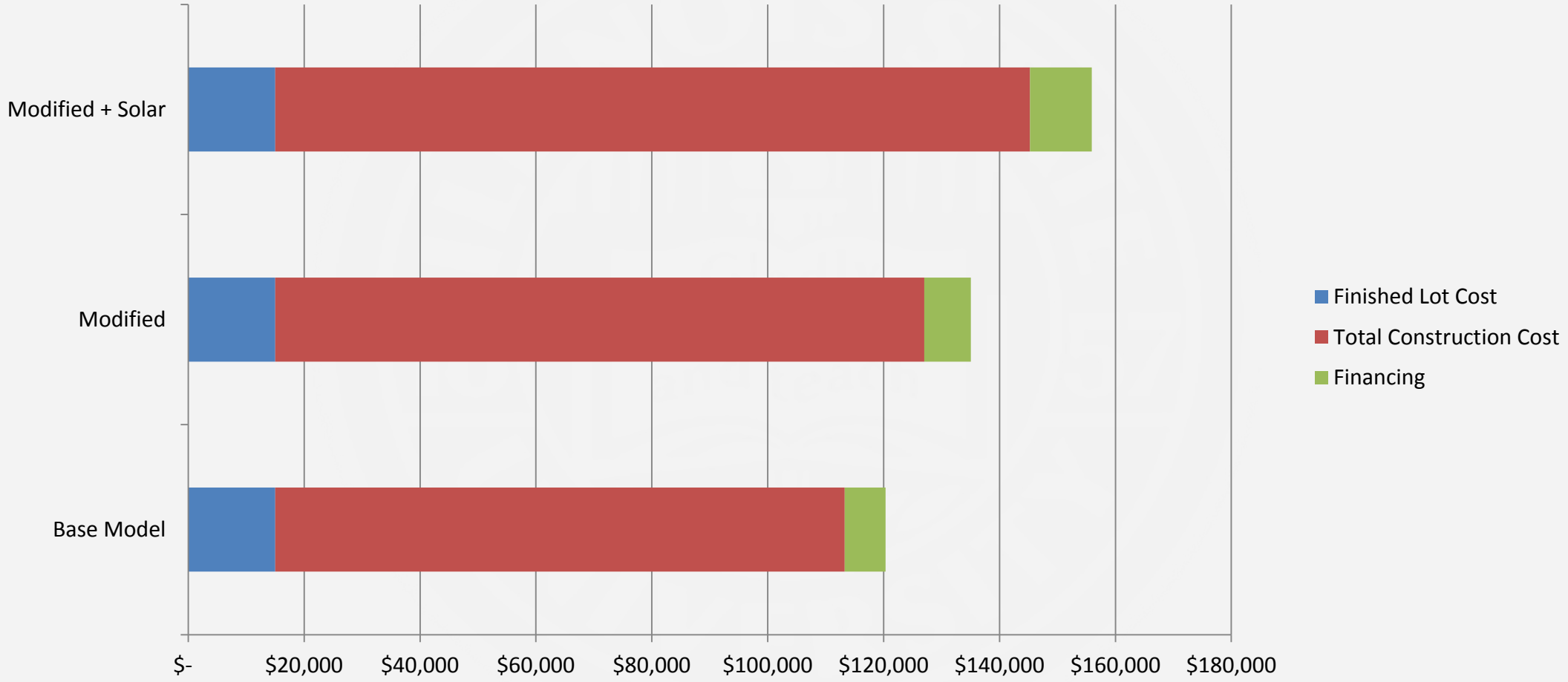
Projected Rating: Based on Plans - Field Confirmation Required.

The building DOES NOT meet DOE Zero Energy Ready Home for the following reasons:
The required Builder ID and/or checklists for DOE Zero Energy Ready have not been completed. Please go to the DOE Zero Energy Ready Summary screen and verify the checklists are complete.

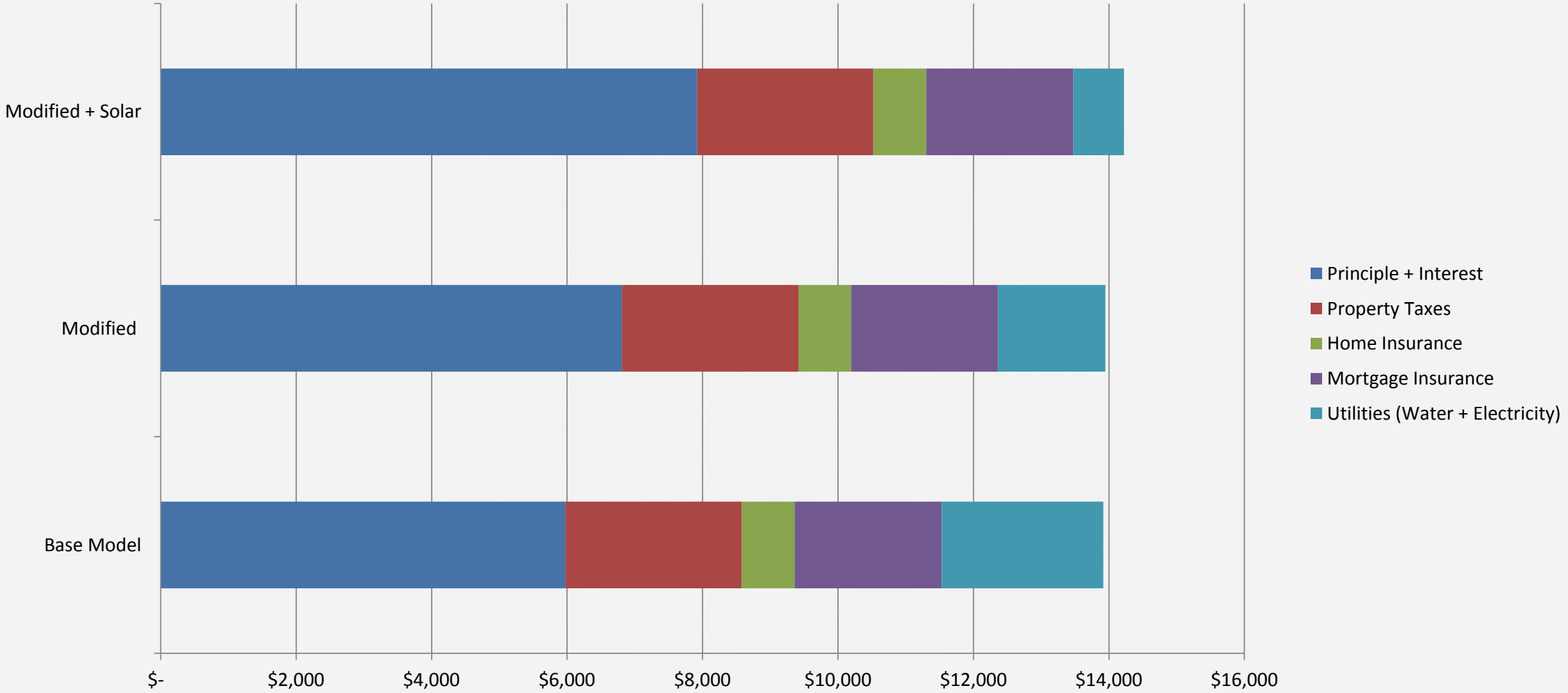
Energy Performance	
House Type	DOE Zero Energy Ready Home Builder Partner ID#
Single-family detached	
Year built	Square footage of Conditioned Space including Basement
2015	1176.0
Number of Bedrooms	Square footage of Conditioned Space without Basement
3	1176.0
Site address (if not available, list the site Lot #)	Registered Builder
1001 W Franklin	Habitat for Humanity
Normal	Certified Rater
IL, 61761	
HERS Index without On-site Generation	Date of Rating
52	
HERS Index with On-site Generation	Rating Software
-3	REM/Rate - v14.6.1
HERS Index of the Target Home using size adjustment factor	Estimated annual energy costs($)
59	0
Estimated annual energy use	Estimated annual energy savings
Electric: -591 kWh	Electric: 17005 kWh
Energy cost rates	Estimated annual emissions reductions
Electric: 0.10 $/kWh	CO2: 9.1 tons / SO2: 42.1 lbs / NOx: 12.9 lbs

DOE Zero Energy Ready Home Certification	
As the certified Rater for this house, I certify this house meets/complies with all mandatory requirments of the DOE Zero Energy Ready home guidelines, including the following:	
	Compliance with all ENERGY STAR Qualified Homes Version 3 requirements and checklists
X	Compliance with Mandatory Fenestration Requirements
X	Compliance with Mandatory Insulation Requirements
X	Compliance with Mandatory Duct Location Requirements
X	Compliance with Mandatory Appliance Requirements
X	Compliance with Mandatory Lighting Requirements
X	Compliance with Mandatory Fan Efficiency Requirements
X	Compliance with Mandatory EPA Indoor airPLUS
X	Compliance with Mandatory Renewable Energy Ready Solar Electric Requirements
	Compliance with Mandatory Renewable Energy Ready Solar Hot Water Requirements
	This home was qualified via sampling in lieu of testing, in accordance with allowable sampling provisions as stated in the DOE Zero Energy Ready Home National Program Requirements

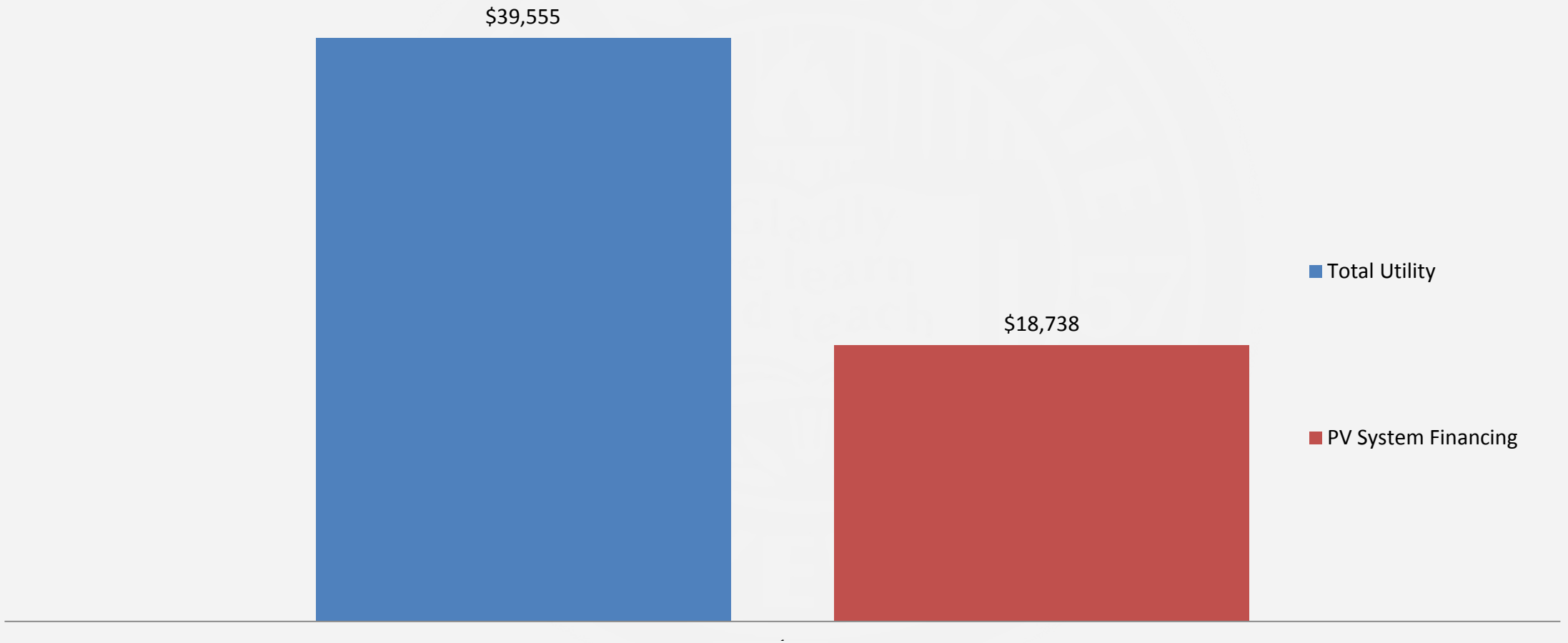
Sale Price Breakdown



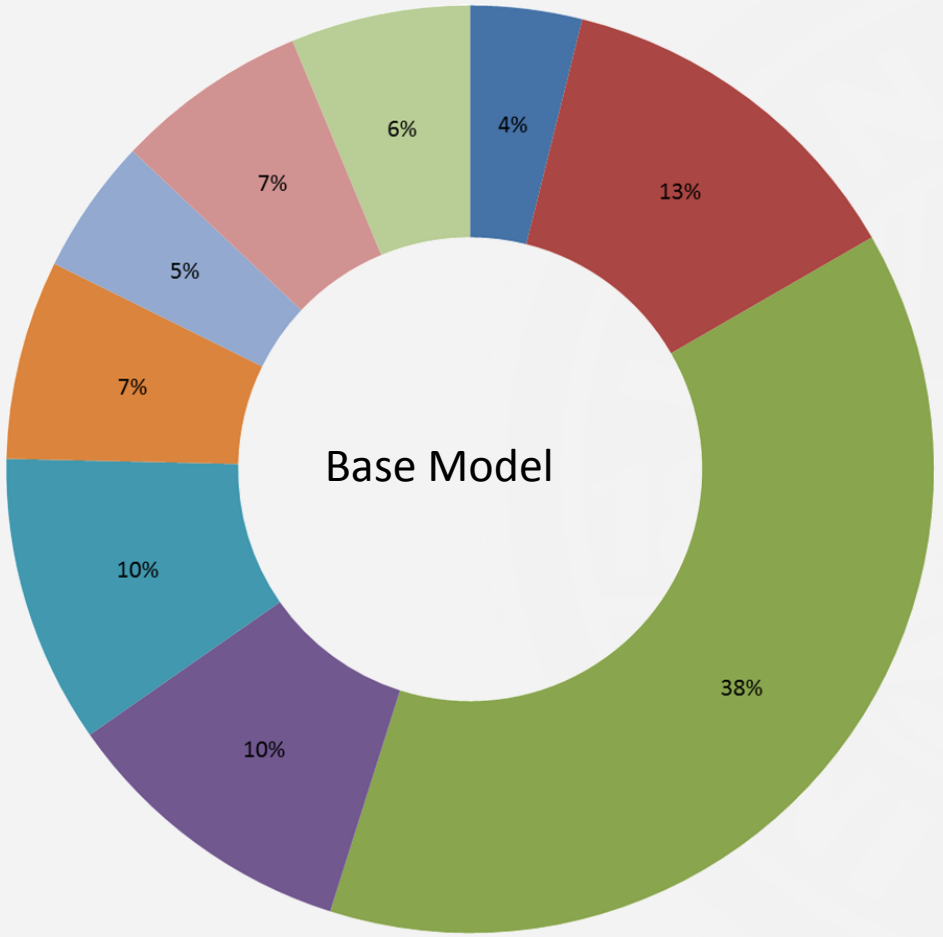
Annual Cash Flow



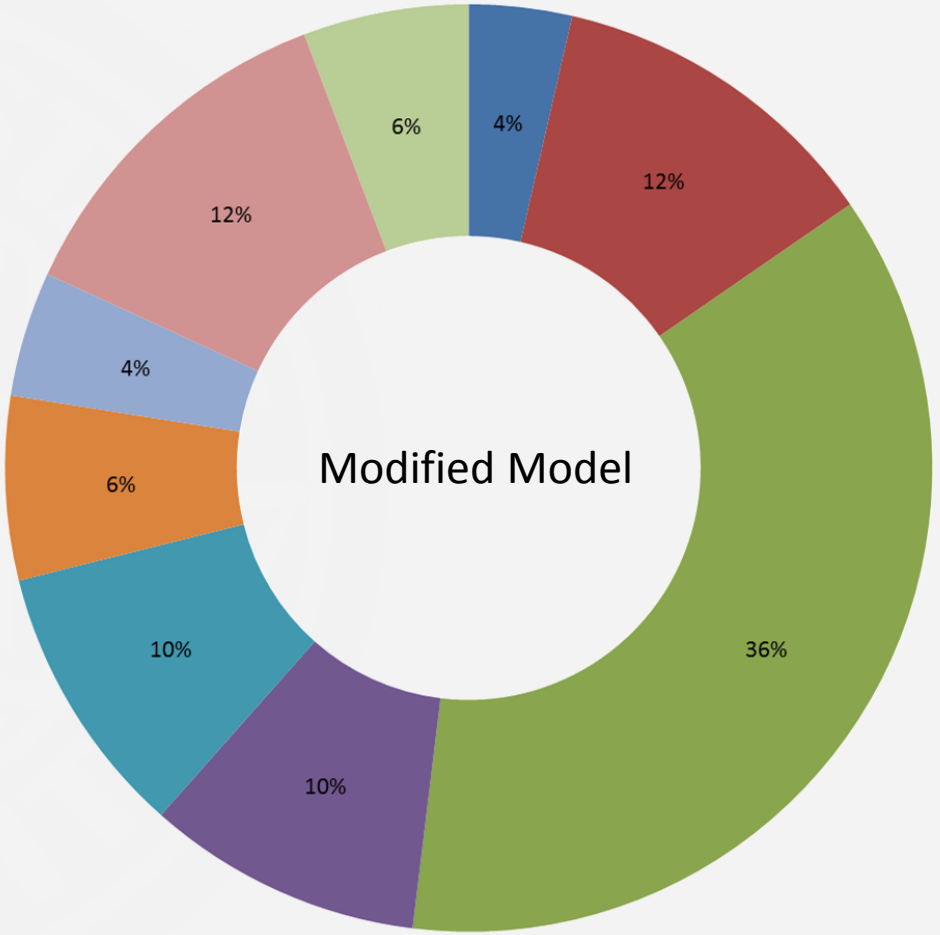
Electric Consumption Cost vs. Finance PV Over 25 Years



Difference = $20,187

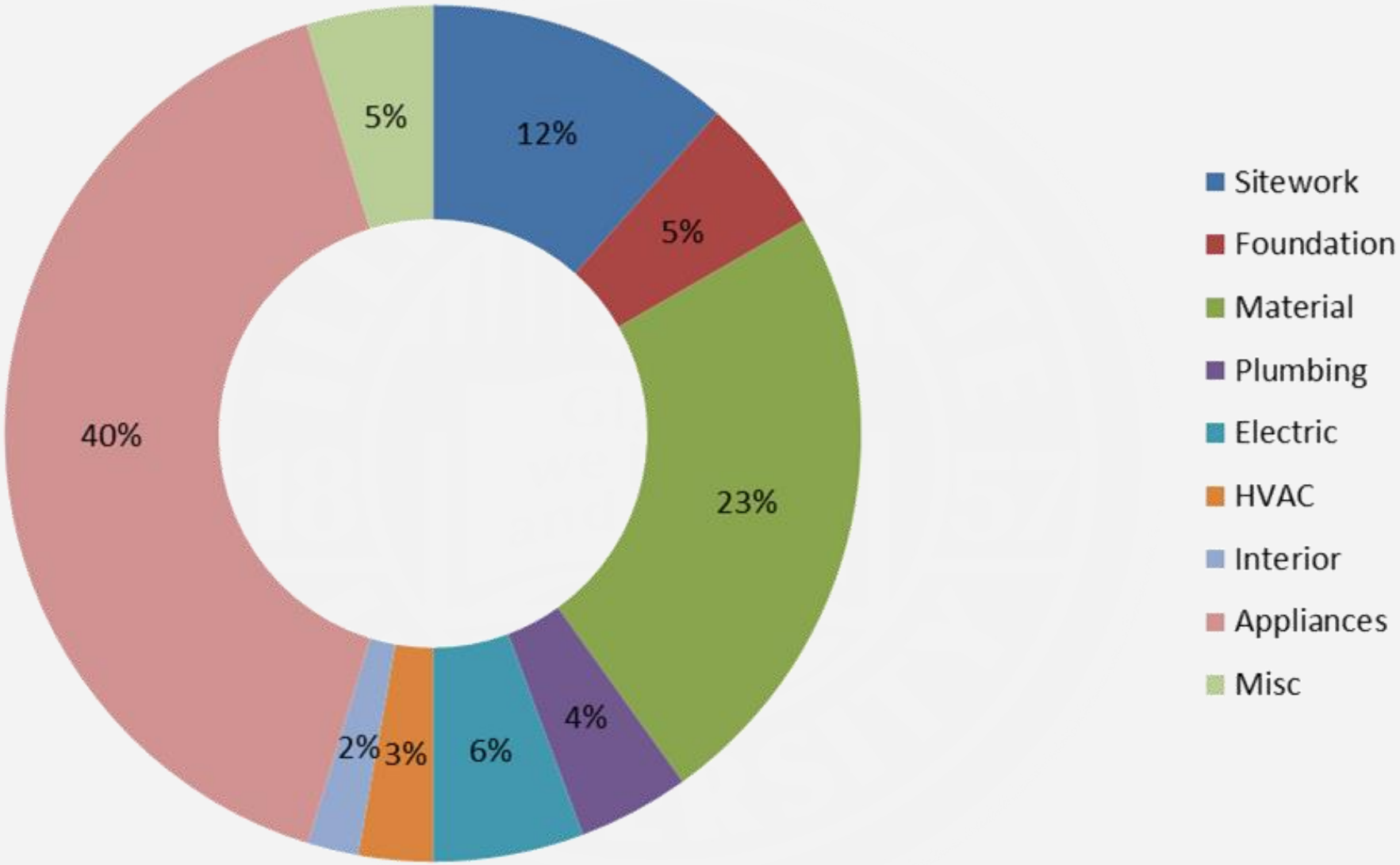


Sitework
Foundation
Material
Plumbing
Electric
HVAC
Interior
Appliances
Misc



A B C D E F H I J

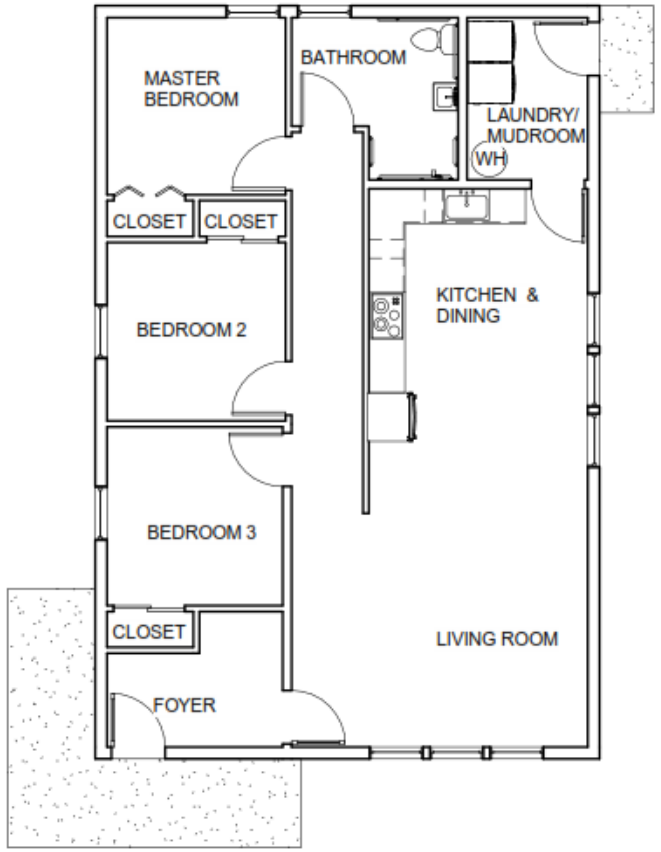
G. FINANCIAL ANALYSIS


12%
5%
23%
4%
6%
3%
2%
40%
5%
Sitework
Foundation
Material
Plumbing
Electric
HVAC
Interior
Appliances
Misc

Construction Documents

Drawings Included:

1. Overall Plan
2. Dimension Plan
3. ADA Compliant
4. North and South Elevation
5. East and West Elevation
6. Wall Section
7. Door and Window Plan / Schedule
8. Furniture Plan
9. Site Plan
10. Electrical / Lighting Plan
11. Mechanical Plan
12. Plumbing Plan



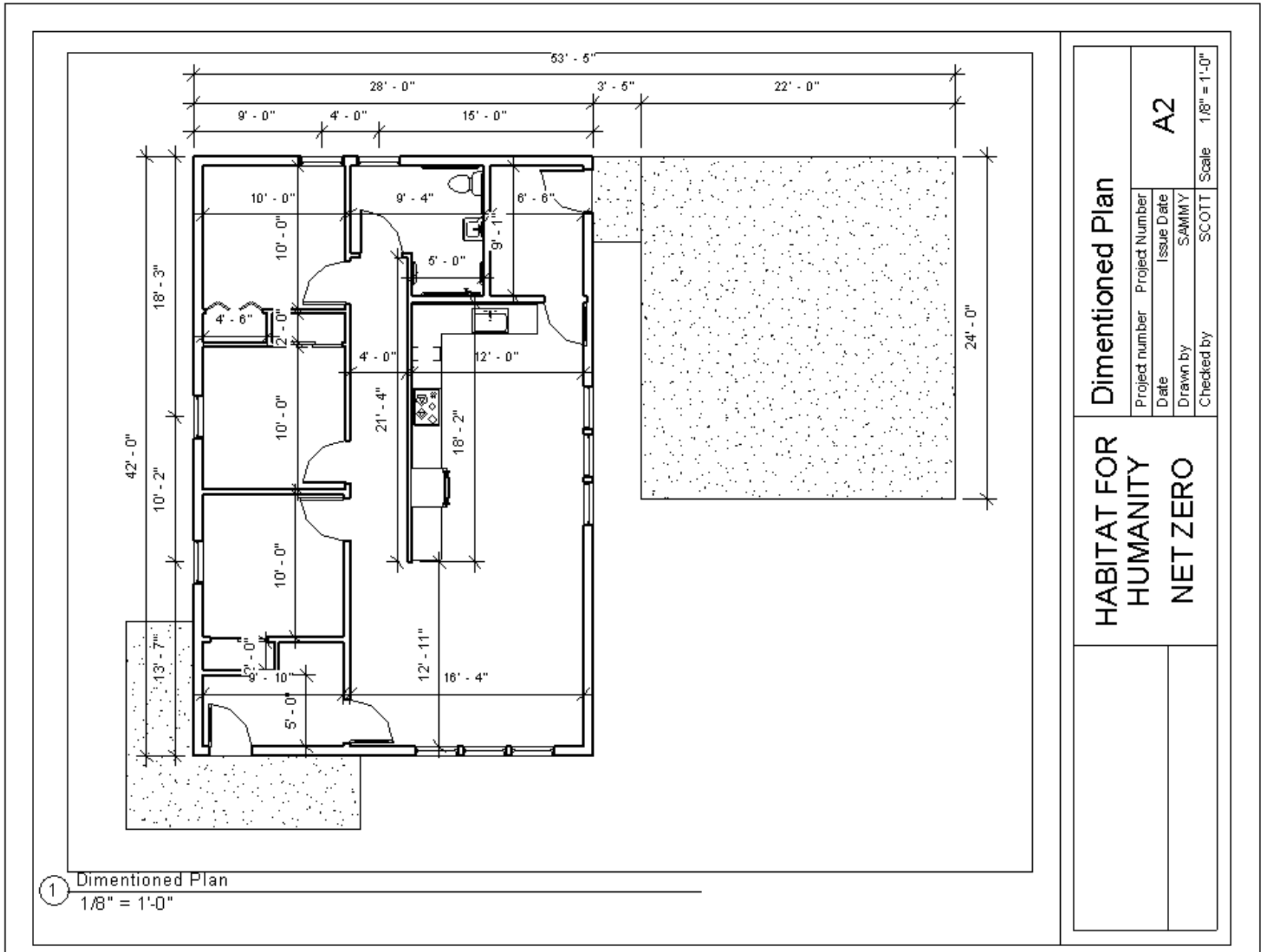
1 First Floor Plan
1/8" = 1'-0"

First Floor Plan

Project number	Project Number
Date	Issue Date
Drawn by	SAMMY
Checked by	SCOTT
Scale	1/8" = 1'-0"

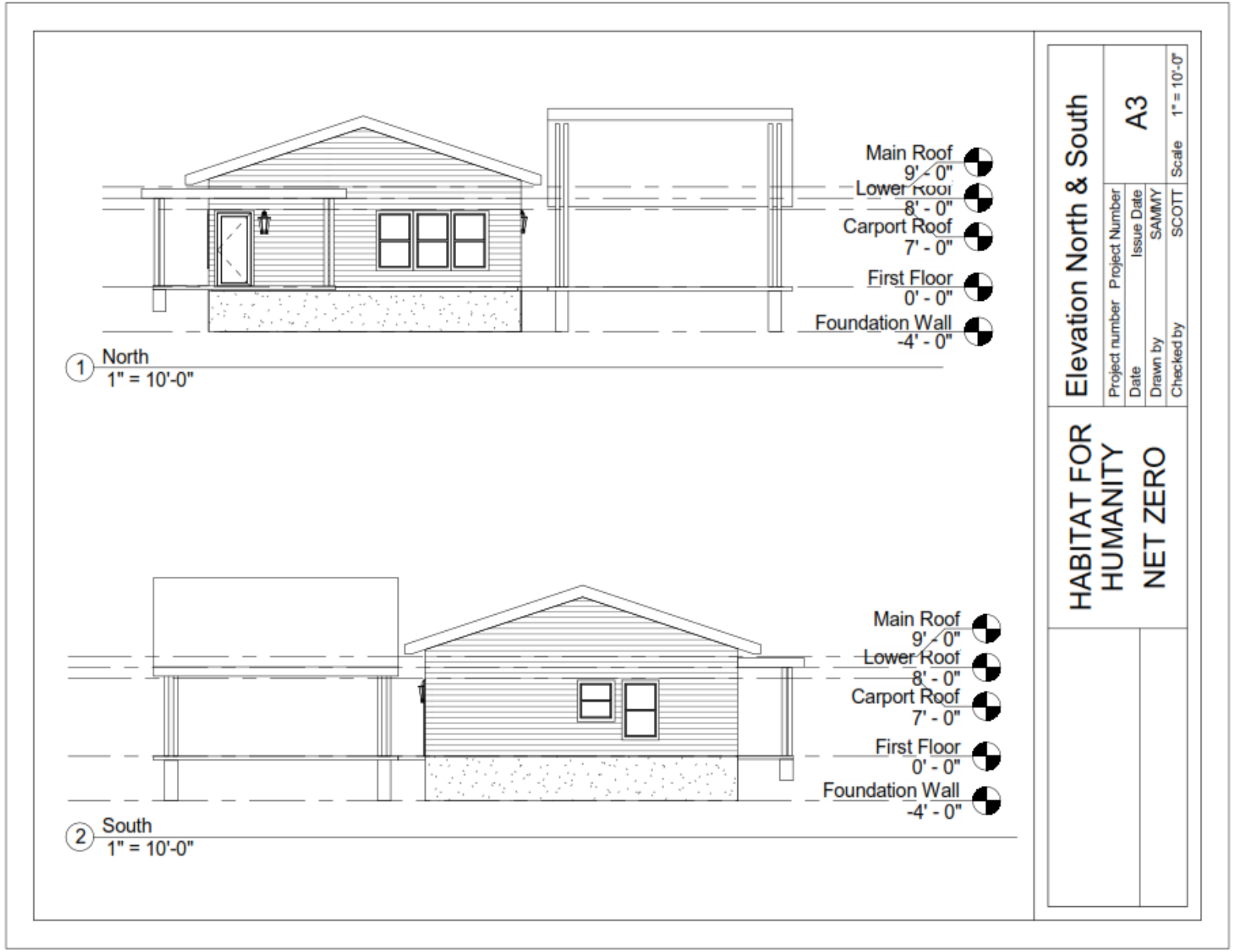
A1

HABITAT FOR HUMANITY
NET ZERO



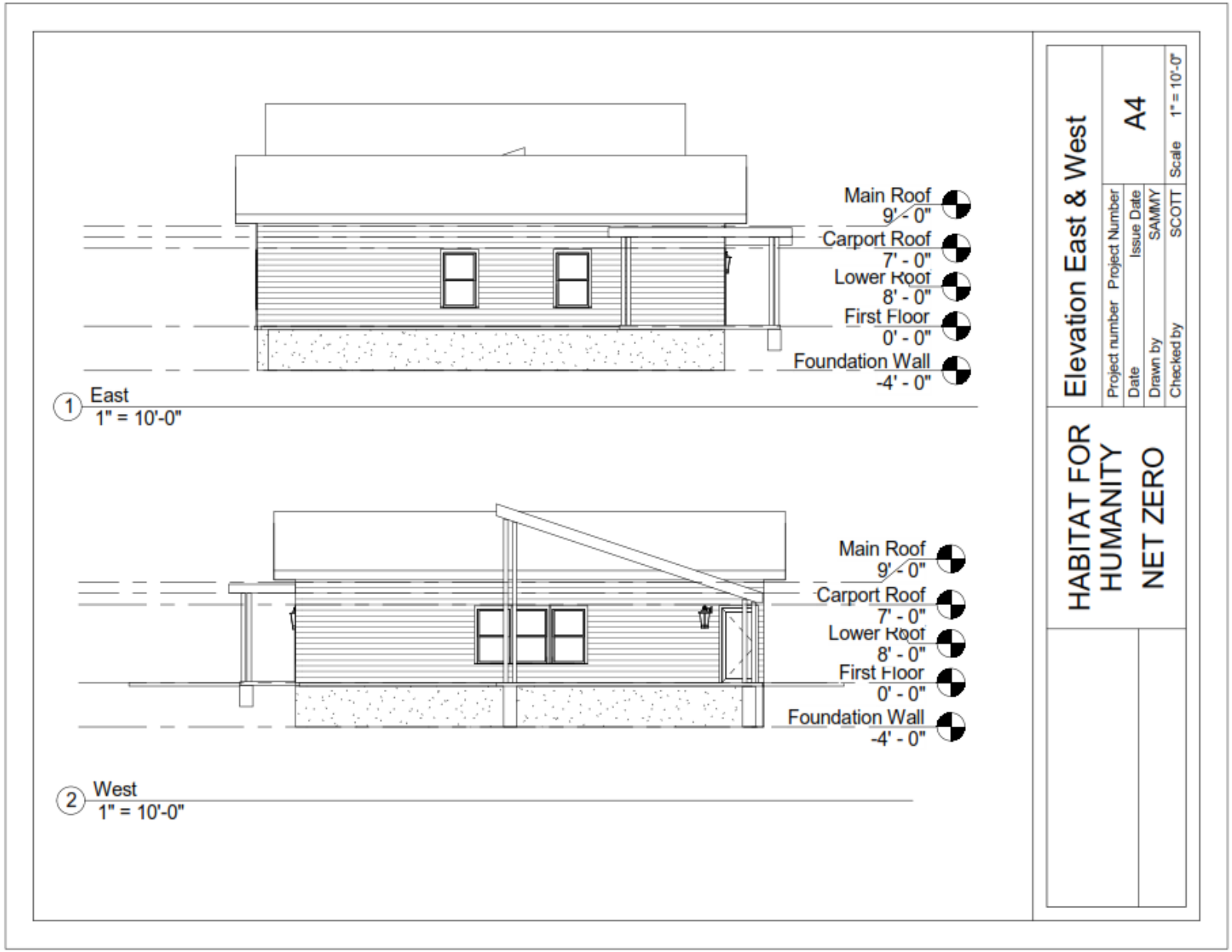
A B C D E F G H J

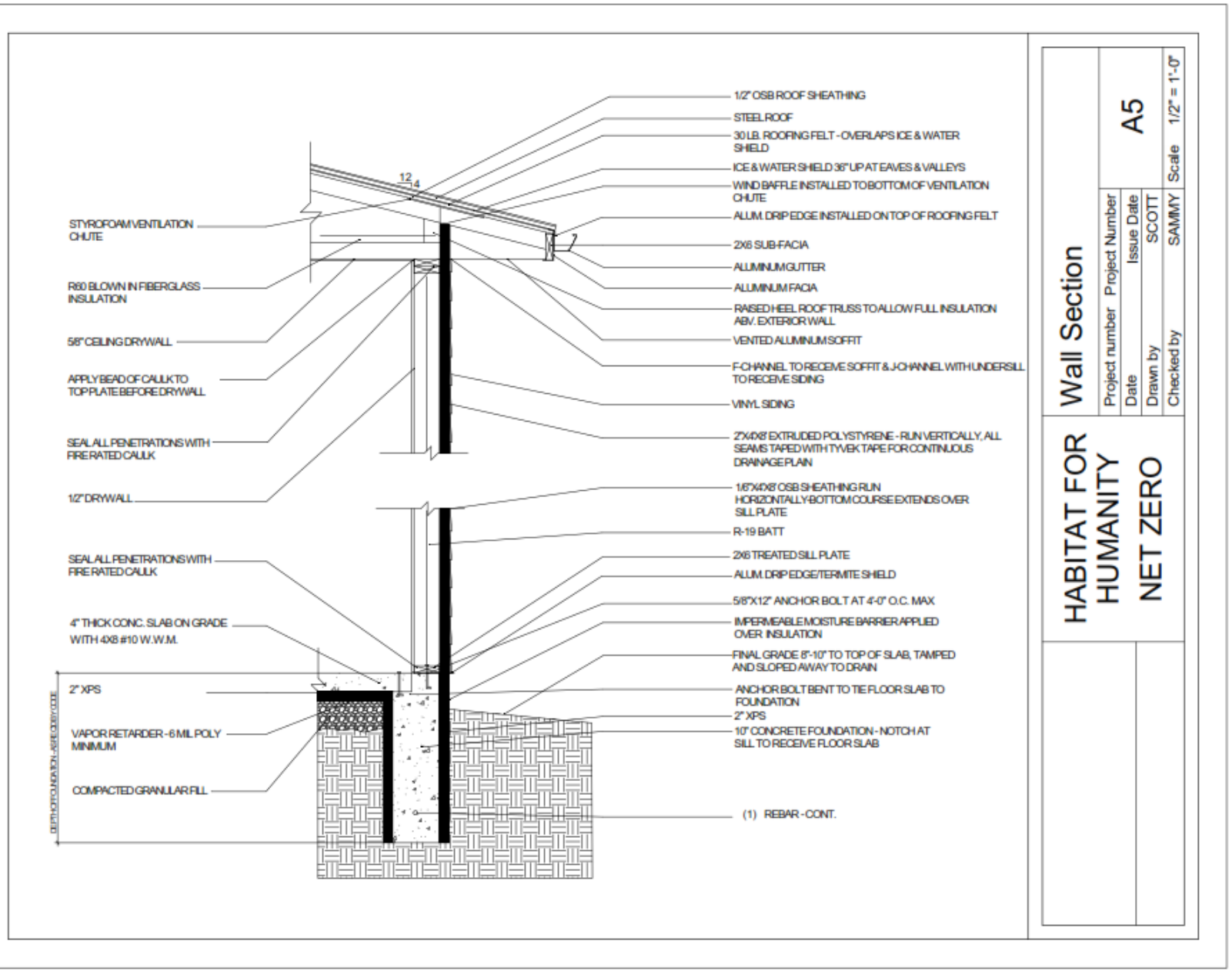
I. CONSTRUCTION DOCUMENTS

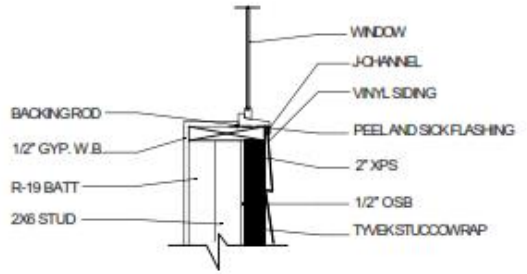


A B C D E F G H J

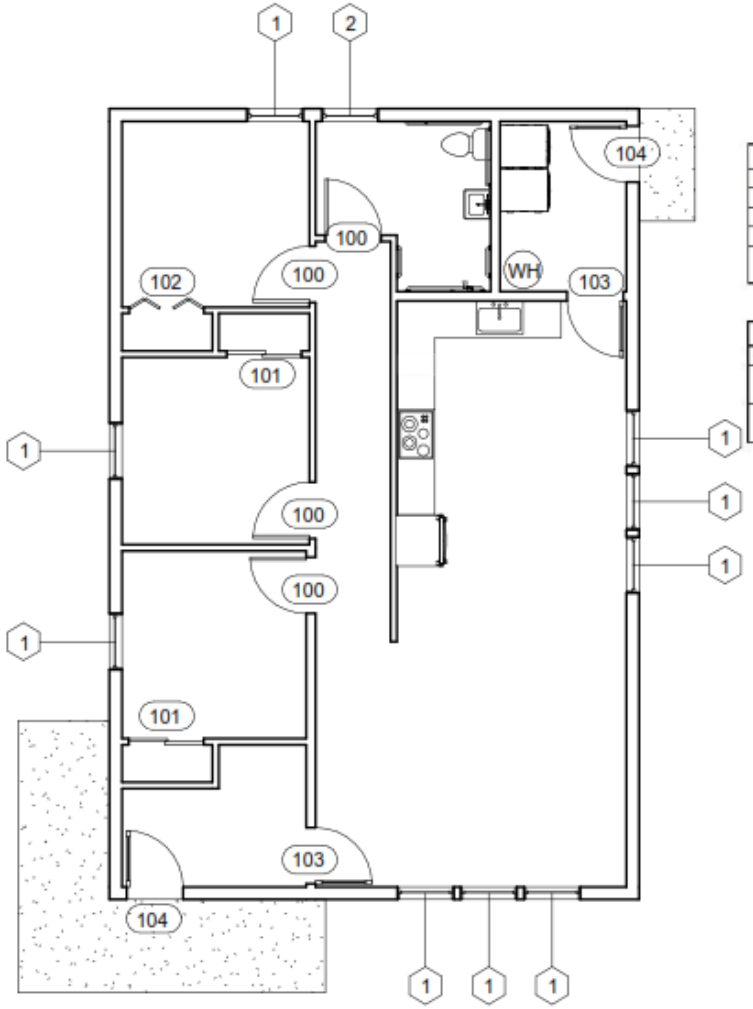
I. CONSTRUCTION DOCUMENTS


Main Roof
9' - 0"
Carport Roof
7' - 0"
Lower Roof
8' - 0"
First Floor
0' - 0"
Foundation Wall
-4' - 0"
1
East
1" = 10'-0"
Main Roof
9' - 0"
Carport Roof
7' - 0"
Lower Roof
8' - 0"
First Floor
0' - 0"
Foundation Wall
-4' - 0"
2
West
1" = 10'-0"
Elevation East & West
A4
Project number
Project Number
Date
Issue Date
Drawn by
SAMMY
Checked by
SCOTT
Scale
1" = 10'-0"
HABITAT FOR HUMANITY
NET ZERO





1 Flashing Detail
3/4" = 1'-0"



1 Window and Door Plan
1/8" = 1'-0"

DOOR SCHEDULE

QUANTITY	MARK	DESCRIPTION	SIZE
4	100	SOLID WOOD	36" X 80"
2	101	SLIDING CLOSET	48" X 80"
1	102	BI-FOLD	48" X 80"
2	103	INTERIOR SINGLE GLASS	36" X 80"
2	104	EXTERIOR SINGLE GLASS	36" X 80"

WINDOW SCHEDULE

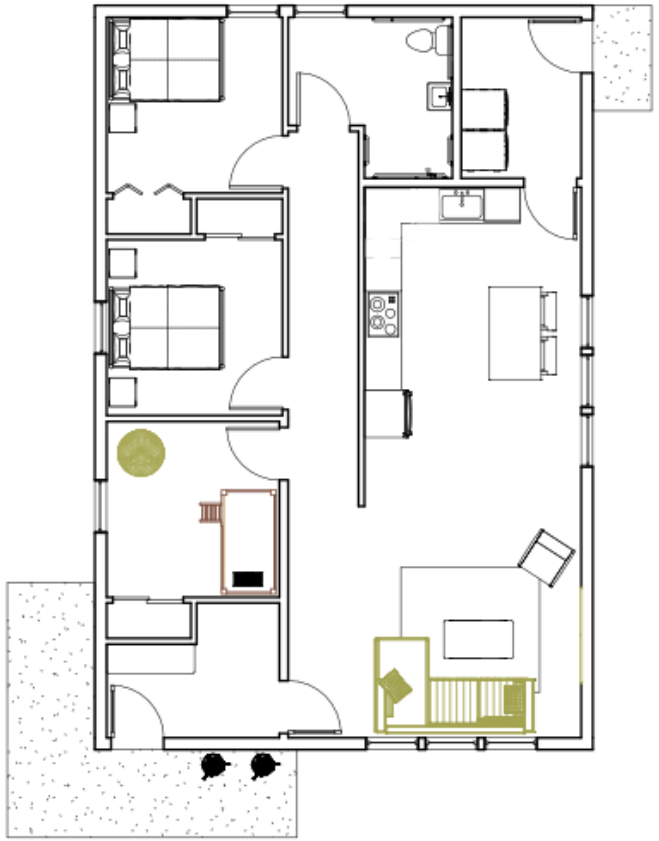
QUANTITY	MARK	DESCRIPTION	SIZE
10	1	DOUBLE HUNG, DOUBLE PANE, VINYL, LOW E, ARGON FILLED, U-2.7, SHGC-.33	36" X 60 1/2"
1	2	DOUBLE HUNG, DOUBLE PANE, VINYL, LOW E, ARGON FILLED, U-2.7, SHGC-.33	36" X 60 1/2"

Window & Door Schedule

A8

Project number
Date
Drawn by SAMMY
Checked by SCOTT
Project Number
Issue Date
Scale 1/8" = 1'-0"

HABITAT FOR HUMANITY
NET ZERO



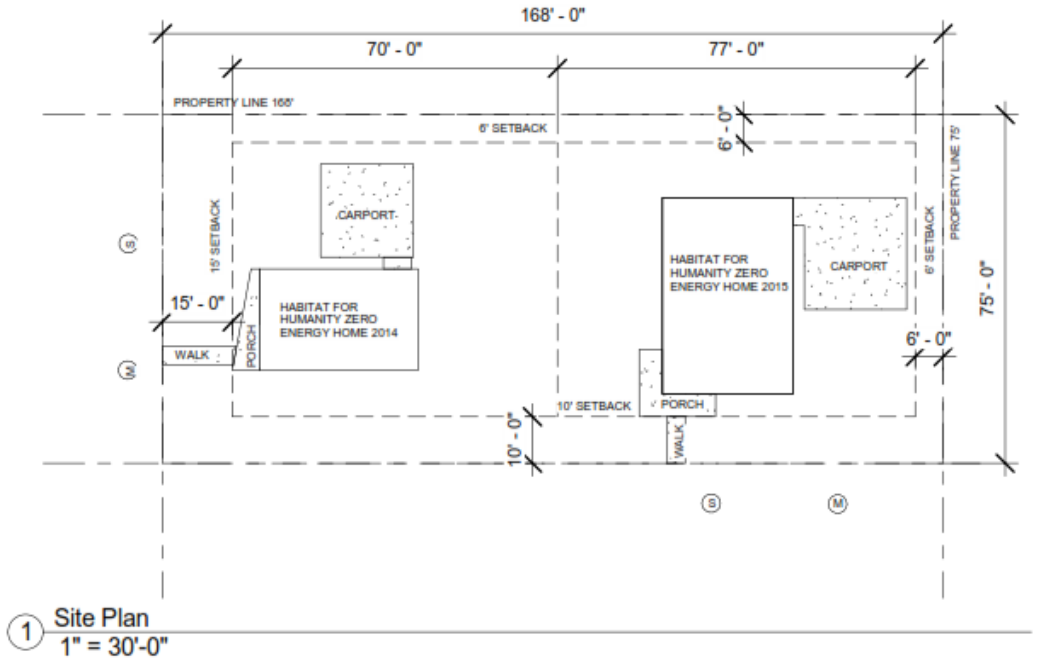
1 Furniture Plan
1/8" = 1'-0"

HABITAT FOR HUMANITY
NET ZERO

Furniture Plan

Project number	Project Number
Date	Issue Date
Drawn by	SAMMY
Checked by	ALEX
Scale	1/8" = 1'-0"

A9



1 Site Plan
1" = 30'-0"

Site Plan

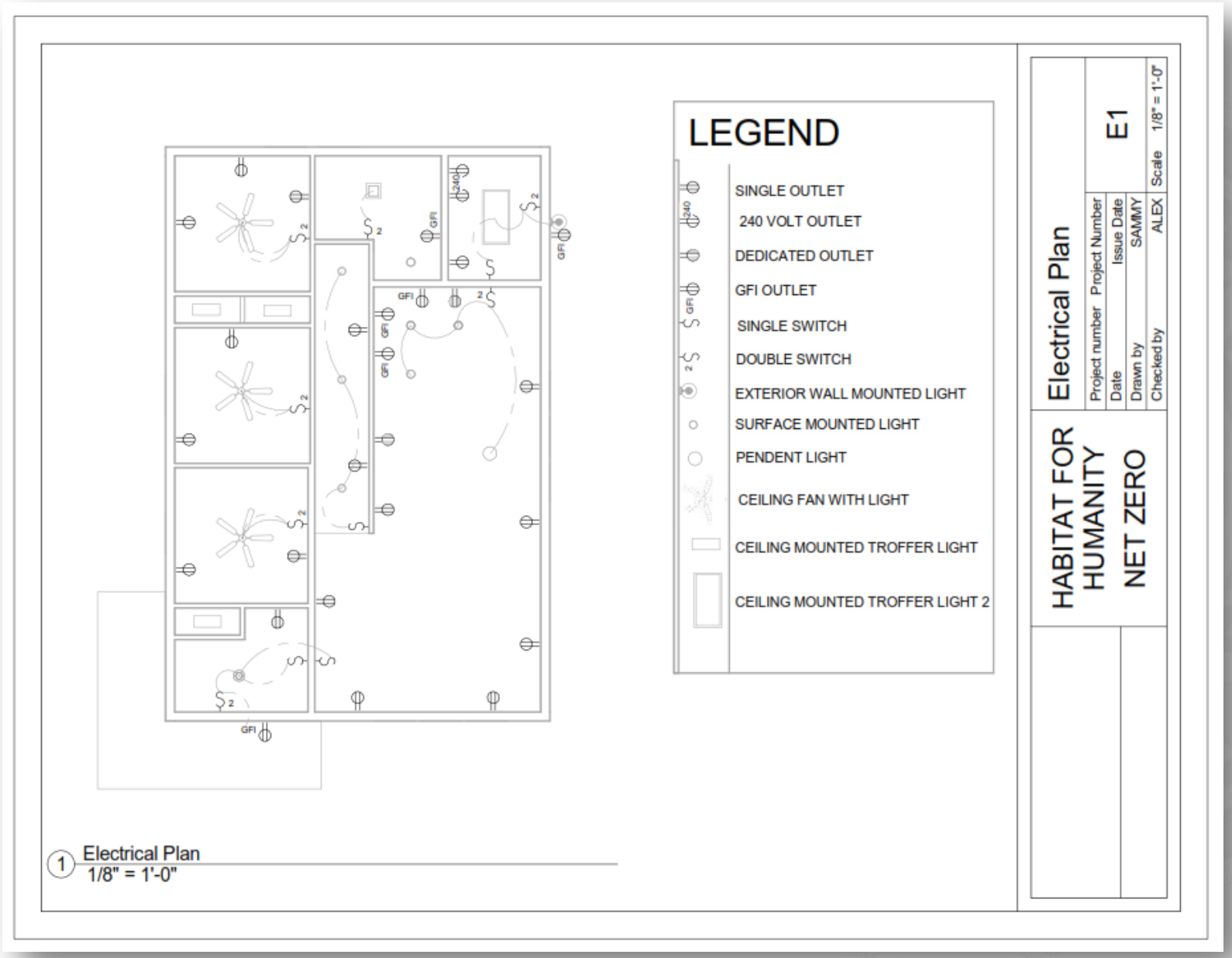
Project number	Project Number
Date	Issue Date
Drawn by	SAMMY
Checked by	ALEX
	Scale 1" = 30'-0"

C1

HABITAT FOR HUMANITY NET ZERO

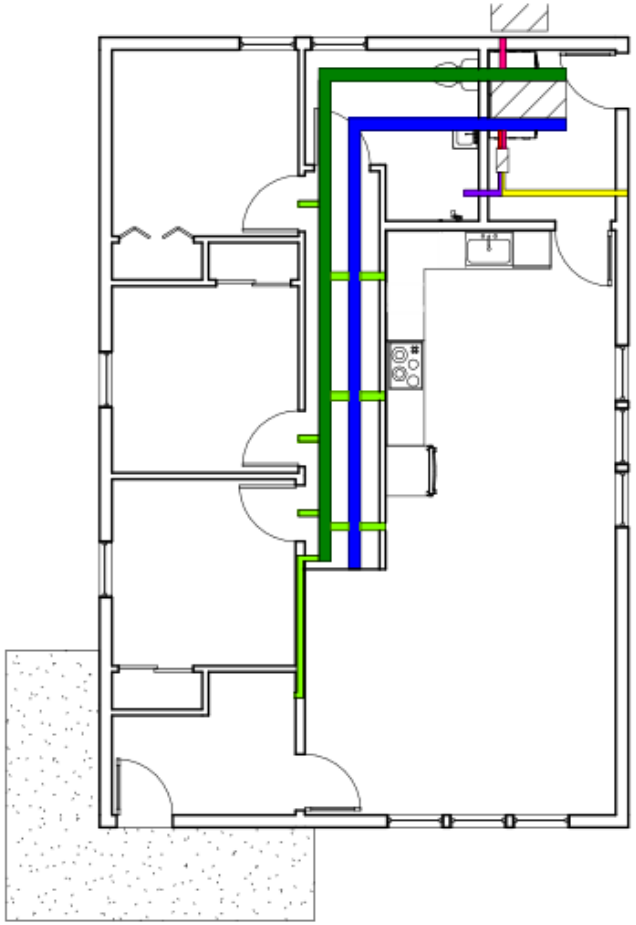
A B C D E F G H J

I. CONSTRUCTION DOCUMENTS



A B C D E F G H J

I. CONSTRUCTION DOCUMENTS



LEGEND

8" RETURN DUCT

8" SUPPLY DUCT

4" SUPPLY DUCT

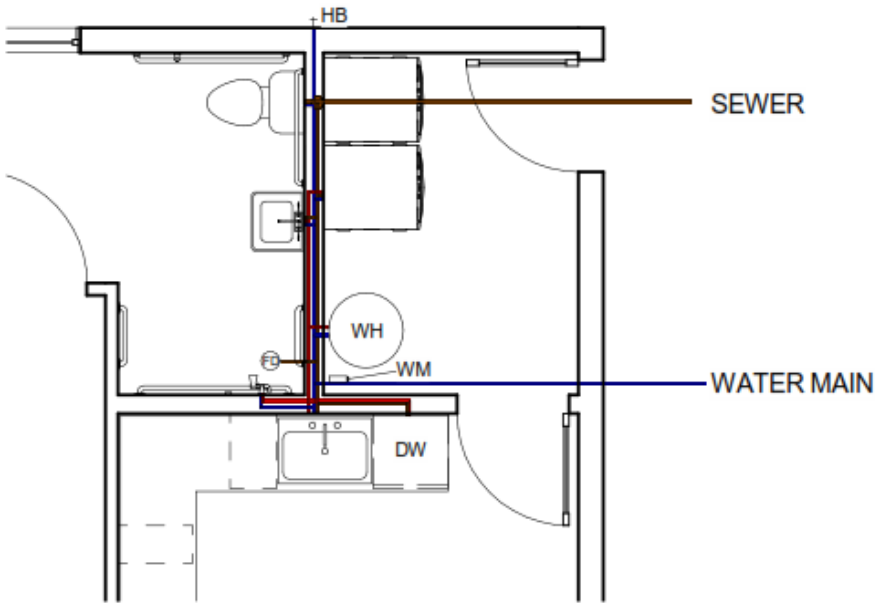
1 Mechanical Plan
1/8" = 1'-0"

Mechanical Plan

Project number	Project Number
Date	Issue Date
Drawn by	SAMMY
Checked by	SCOTT
Scale	1/8" = 1'-0"

M1

HABITAT FOR HUMANITY
NET ZERO



LEGEND

HOT WATER

DOMESTIC WATER

WASTE

1 Plumbing Plan
1/4" = 1'-0"

PLUMBING FIXTURE SCHEDULE		
QUANTITY	DESCRIPTION	MODEL #
1	SHOWERHEAD	MODEL: 8346EP15
1	BATHROOM FAUCET	MODEL: B3596LF-SS
1	TOILET	MODEL: N2316
1	KITCHEN FAUCET	MODEL: 87499SRS
1	WASHING MACHINE	MODEL: WFW72HEDW
1	GEOSPRING HYBRID WATER HEATER	MODEL: GEH50DEEDSR

Plumbing Plan

M2

Project number
Project Number
Date
Issue Date
Drawn by
SAMMY
Checked by
SCOTT
Scale
1/4" = 1'-0"

HABITAT FOR HUMANITY
NET ZERO

A B C D E F G H J

I. CONSTRUCTION DOCUMENTS

Financial Analysis

McLean County	2014-2015	Construction Cost	
Single Family Detached	1120 SF	Roof 1472 SF	
Category	Base Model Price	Modified Price	Difference
Site Work	$1,000.00	$1,000.00	$-
Fees and Permits	$3,500.00	$3,500.00	$-
Utilities	$1,000.00	$1,077.00	$77.00
Excavation	$2,800.00	$3,016.00	$216.00
Foundation	$4,400.00	$4,739.00	$339.00
Flatwork	$4,800.00	$5,169.00	$369.00
Material	$20,000.00	$21,539.00	$1,539.00
Plumbing Labor	$4,000.00	$4,308.00	$308.00
Plumbing Material	$3,500.00	$3,770.00	$270.00
Electrical Labor	$3,000.00	$3,231.00	$231.00
Electrical Material	$4,242.00	$4,794.00	$552.00
HVAC Labor	$2,500.00	$2,692.00	$192.00
HVAC Material	$2,500.00	$2,692.00	$192.00
Insulation	$3,000.00	$3,231.00	$231.00
Drywall Labor	$3,000.00	$3,231.00	$231.00
Paint Material	$400.00	$431.00	$31.00
Appliances	$4,834.00	$10,395.00	$5,561.00
Landscape	$1,800.00	$1,938.00	$138.00
Misc.	$2,500.00	$2,692.00	$192.00
Conctracted Labor	$2,000.00	$2,154.00	$154.00
Land Acquisiont Cost	$15,000.00	$16,154.00	$1,154.00
CM Salary	$4,000.00	$4,308.00	$308.00
Carport	$4,500.00	$5,940.00	$1,440.00
Total Cost (without lot)	$98,276.00	$112,001.00	$13,725.00

Financing (Principle and Interest)	
4.5%, 30-year Fixed Rate	
Baseline (Per Year)	$8,047.68
Modified (Per Year)	$7,062.40
Modified + Solar (Per Year)	$10,666.21

Construction Cost Estimate	**Base Model**	**Modified**	**Modified + Solar**
2015 Median Family Income (McLean County, IL)	$86,800.00	$86,800.00	$86,800.00
Home Ownership Affordability	See Attached Table	See Attached Table	See Attached Table
Standardized Home Ownership Cost Estimates	See Attached Table	See Attached Table	See Attached Table
Utility Costs	See Attached Table	See Attached Table	See Attached Table
Financing Per Year (Principle and Interest; 4.5%, 30-yr fixed)	$8,047.68	$7,062.40	$10,666.21
Property Tax Per Year (3.0% of MFI)	$2,604.00	$2,604.00	$2,604.00
Insurance	$780.00	$780.00	$780.00
Down Payment (Habitat Doesn't Require Down Payments)	N/A	N/A	N/A
Mortgage Insurance Per Year (2.5% of MFI)	$2,170.00	$2,170.00	$2,170.00
Monthly Household Debt Per Year (.05% of MFI)	$434.00	$434.00	$434.00
Direct Construction Cost Reference Comparison	See Attached Table	See Attached Table	See Attached Table

Home Ownership Affordability (Not Including Debt)			
PITIU	**Base Model**	**Modified**	**Modified + Solar**
Principle + Interest	$5,975.40	$6,809.91	$7,919.66
Property Taxes	$2,604.00	$2,604.00	$2,604.00
Home Insurance	$780.00	$780.00	$780.00
Mortgage Insurance	$2,170.00	$2,170.00	$2,170.00
Utilities (Water + Electricity)			
Water	$952.82	$749.52	$749.52
Electricity	$1,433.28	$832.68	$-
Total	**$13,914.68**	**$13,946.11**	**$14,223.18**
Summary	Affordable	Affordable	Affordable

**Water Fee of $11.10 Bi-Monthly Included

Annual Cash Flow Analysis				
Topic	**Sub-Topic**	**Base Price**	**Modified Price**	**Modified + PV**
Property	(Principle + Interest)	$5,975.40	$6,809.91	$7,919.66
Tax, Insurance, Mortgage	Property Tax	$2,604.00	$2,604.00	$2,604.00
	Insurance	$780.00	$780.00	$780.00
	Mortgage Insurance	$2,170.00	$2,170.00	$2,170.00
Utilities	Water	$952.82	$749.52	$749.52
	Power	$1,433.28	$832.68	$-
Subotal Tax, Insurance, Mortgage, and Property		**$11,529.40**	**$12,363.91**	**$13,473.66**
Subtotal Utilities		**$2,386.10**	**$1,582.20**	**$749.52**
Total Annual Payment (Not including Monthly Household Debt)		**$13,915.50**	**$13,946.11**	**$14,223.18**

Solar Panel System Compared to Utility Cost for 25 Years

Line Items	Modified	Modified + Solar	Difference
Solar Panel	$-	$18,251.80	$-
Utility Cost @ $0.10/ KWH (Per Year)	$1,582.20	$749.52	$832.68
Total	$39,555.00	$18,738.00	$20,187.00

*Utility Cost is measured at a fixed rate of $0.10 per KWH for 2015. The solar panel is on a 25 year warranty.

Energy Consumption of Base Home

@.10¢/kWh
Energy Cost: $1433.27/yr

	Quantity	Monthly kWh	Yearly kWh
Refrigerator	1	24.67	296.00
Dishwasher	1	24.58	295.00
Microwave (No Energystar)	1	3.00	36.00
Bathroom Fan Lights 18W Sunlite	2	1.10	13.14
Bathroom Fan/Fixture	1	5.48	65.70
Laundry Room Strip Light Bulbs Sylvania	2	0.12	1.39
Lights Interior (60W-->13W Equivalent)	22	15.82	189.80
Lights Exterior 13 W CFL	2	0.08	0.95
Ceiling Fan [w/ 2 lights (26 W)* Included in Interi	3	7.18	86.14
Cooktop Vent	1	10.80	129.60
In Wall Oven (No Energystar)	1	22.81	273.75
Electric Range(No Energystar)	1	28.25	339.00
Space and Water Controls			20.00
Clothes Washer	1	7.50	90.00
Electric Clothes Dryer	1	53.67	644.00
Misc Electric Loads		8.33	100.00
Gas Water Heater (Converted from BTU to Kwh)	1	222.25	2667.05
Toaster Oven	1	3.75	45.00
Computer	1	24.94	299.30
Printer	1	2.11	25.30
TV	1	8.25	99.00
Heating (Converted from BTU to Kwh)		647.23	7766.71
Cooling		70.83	849.94
	Total kWh=	1194.40	14332.77

Newell Instruments Zeros Program (Base Home)

North Window (sq feet)	Ceiling Height (feet)	Roof Area (sq feet)	Roof Insulation (inches)
50	9	1400	8

Solar PV Panel area(sq feet)	Solar PV Panel tilt (degrees)
0	35

Solar PV Article

South Window (sq feet)	Floor Area (sq feet)	Wall Area (sq feet)	Wall Insulation (inches)
30	1200	1200	8

Ground Loss (Watts/sq yard)
1

Foundation Article

Window Article

Wall and Roof Insulation Article

Results Summary

House Cost ($) =	108000
Wall Insulation Cost ($) =	800
Roof Insulation Cost ($) =	933
PV System Cost ($) =	0
South Window Cost ($)=	1200
North Window Cost ($)=	2000
Total House Cost ($) =	112933

Negative requires additional energy per year

Positive indicates oversupply of renewable energy per year

Net Zero?
-10386.1
kWh imbalance
Utility Cost
-$1,038.61

Summary of Thermal Energy, Latent (moisture) Energy and Electrical Energy Loads per Month

Thermal Loads (per month)	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Month Number	1	2	3	4	5	6	7	8	9	10	11	12	
Qwall(kW-hr)=	-371	-336	-242	-143	-60	13	40	17	-37	-128	-227	-329	-1803
Qroof(kW-hr)=	-433	-392	-283	-167	-69	15	46	20	-43	-149	-265	-384	-2104
Qwindheat_south(kW-hr)=	-68	-62	-45	-26	-11	2	7	3	-7	-23	-42	-61	-332
Qwind solar_south (kW-hr)=	140	153	135	38	35	34	35	37	42	158	134	120	1060
Qwindheat_non-south(kW-hr)=	-114	-103	-74	-44	-18	4	12	5	-11	-39	-70	-101	-553
Qair infil (kW-hr)=	-96	-87	-63	-37	-15	3	10	4	-10	-33	-59	-85	-467
Qair vent (kW-hr)=	-145	-131	-95	-56	-23	5	15	7	-14	-50	-88	-128	-703
Qrefrig (kW-hr)=	11	11	11	11	11	11	11	11	11	11	11	11	130
Qfrz (kW-hr)=	22	22	22	22	22	22	22	22	22	22	22	22	259
Qwater heater (kW-hr)=	-102	-102	-102	-102	-102	-102	-102	-102	-102	-102	-102	-102	-1221
People (kW-hr)=	216	216	216	216	216	216	216	216	216	216	216	216	216
Other energy generation (kW-hr)=	36	36	36	36	36	36	36	36	36	36	36	36	432
Ground Heat Transfer (kW-hr)=	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-1152
Net Thermal Loads (kW-hr)=	-1001	-871	-579	-349	-75	163	252	180	7	-177	-530	-881	-6238
Latent Loads (per month)	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
Infiltration Latent load (kW-hr)	-56.4	-52.1	-40.3	-25.0	-2.2	25.8	43.6	38.5	13.1	-19.1	-36.9	-50.4	-161.5
Ventilation latent load (kW-hr)	-424.7	-392.8	-303.4	-188.6	-16.3	194.2	328.2	289.9	98.5	-143.9	-277.9	-380.0	-1216.7
People latent load (kW-hr)	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	2419.2
Total latent load (kW-hr)	-279.4	-243.3	-142.1	-12.0	183.1	421.6	573.4	530.0	313.2	38.6	-113.2	-228.8	1041.0
Electric Energy (per month)	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
PV panel production (kW-hr)=	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
House heat pump (kW-hr)=	-858.2	-746.5	-496.6	-299.3	-64.4	0.0	0.0	0.0	0.0	-151.9	-454.0	-755.2	-3826.1
House AC (kW-hr)=	0.0	0.0	0.0	0.0	0.0	-34.8	-54.1	-38.6	-1.4	0.0	0.0	0.0	-129.0
House Dehum (kW-hr)=	0.0	0.0	0.0	0.0	-91.6	-210.8	-286.7	-265.0	-156.6	-19.3	0.0	0.0	-1029.9
House Humid (kW-hr)=	-139.7	-121.6	-71.1	-6.0	0.0	0.0	0.0	0.0	0.0	0.0	-56.6	-114.4	-509.5
Qrefrig (kW-hr) =	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-129.6
Qfrz (kW-hr) =	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-259.2
Qwater heater (kW-hr) =	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-339.2	-4070.8
Other elect energy (kW-hr) =	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-432.0
Total Electric Required (kW-hr)=	-1405.6	-1275.8	-975.3	-712.9	-563.6	-653.3	-748.4	-711.3	-565.7	-578.8	-918.3	-1277.2	-10386.1
Net Electric (kW-hr)=	-1405.6	-1275.8	-975.3	-712.9	-563.6	-653.3	-748.4	-711.3	-565.7	-578.8	-918.3	-1277.2	-10386.1

Results Summary

House Cost ($) =	108000
Wall Insulation Cost ($) =	800
Roof Insulation Cost ($) =	933
PV System Cost ($) =	0
South Window Cost ($)=	1200
North Window Cost ($)=	2000
Total House Cost ($) =	112933

A B C D E G H I J

Energy Consumption of Net Zero Home

@.10¢/kWh
Energy Cost: $832.68/yr

	Quantity	Monthly kWh	Yearly kWh
Refrigerator	1	24.67	296.00
Dishwasher	1	24.58	295.00
Microwave (No Energystar)	1	3.00	36.00
Bathroom Fan Lights 18W Sunlite	2	1.10	13.14
Bathroom Fan/Fixture	1	5.48	65.70
Laundry Room Strip Light Bulbs Sylvania	2	0.12	1.39
Lights Interior (60W-->13W Equivalent)	22	15.82	189.80
Lights Exterior 13 W CFL	2	0.08	0.95
Ceiling Fan [w/ 2 lights (26 W)*Included in Interior Lighting]	3	7.18	86.14
Cooktop Vent	1	10.80	129.60
In Wall Oven (No Energystar)	1	22.81	273.75
Electric Range(No Energystar)	1	28.25	339.00
Space and Water Controls		1.67	20.00
Clothes Washer	1	7.50	90.00
Electric Clothes Dryer	1	53.67	644.00
Misc Electric Loads		8.33	100.00
Geospring Hybrid Water Heater	1	152.50	1830.00
Heat Recovery Ventilator	1	43.07	516.84
Air Source Heat Pump (Load in Heating/Cooling)	1		
Toaster Oven	1	3.75	45.00
Computer	1	24.94	299.30
Printer	1	2.11	25.30
TV	1	8.25	99.00
Heating		166.08	1993
Cooling		78.16	937.86
	Total kWh=	693.90	8326.77

Newell Instruments Zeros Program (Net Zero Home)

North Window (sq feet)	Ceiling Height (feet)	Roof Area (sq feet)	Roof Insulation (inches)
50	9	1400	18

Solar PV Panel area(sq feet)	Solar PV Panel tilt (degrees)
440	35

Solar PV Article

South Window (sq feet)	Floor Area (sq feet)	Wall Area (sq feet)	Wall Insulation (inches)
30	1200	1200	8

Ground Loss (Watts/sq yard)
1

Foundation Article

Window Article

Wall and Roof Insulation Article

Results Summary

House Cost ($) =	108000
Wall Insulation Cost ($) =	800
Roof Insulation Cost ($) =	2100
PV System Cost ($) =	22000
South Window Cost ($)=	1200
North Window Cost ($)=	2000
Total House Cost ($) =	136100

Negative requires additional energy per year

Positive indicates oversupply of renewable energy per year

Net Zero?

456.9

kWh imbalance

Utility Cost

$45.69

Summary of Thermal Energy, Latent (moisture) Energy and Electrical Energy Loads per Month

Thermal Loads (per month)	Jan	Feb	Mar	April	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
Month Number	1	2	3	4	5	6	7	8	9	10	11	12	
Qwall(kW-hr)=	-371	-336	-242	-143	-60	13	40	17	-37	-128	-227	-329	-1803
Qroof(kW-hr)=	-193	-174	-126	-74	-31	7	21	9	-19	-66	-118	-171	-935
Qwindheat_south(kW-hr)=	-68	-62	-45	-26	-11	2	7	3	-7	-23	-42	-61	-332
Qwind solar_south (kW-hr)=	140	153	135	38	35	34	35	37	42	158	134	120	1060
Qwindheat_non-south(kW-hr)=	-114	-103	-74	-44	-18	4	12	5	-11	-39	-70	-101	-553
Qair infil (kW-hr)=	-96	-87	-63	-37	-15	3	10	4	-10	-33	-59	-85	-467
Qair vent (kW-hr)=	-145	-131	-95	-56	-23	5	15	7	-14	-50	-88	-128	-703
Qrefrig (kW-hr)=	11	11	11	11	11	11	11	11	11	11	11	11	130
Qfrz (kW-hr)=	22	22	22	22	22	22	22	22	22	22	22	22	259
Qwater heater (kW-hr)=	-249	-249	-249	-249	-249	-249	-249	-249	-249	-249	-249	-249	-2991
People (kW-hr)=	216	216	216	216	216	216	216	216	216	216	216	216	216
Other energy generation (kW-hr)=	36	36	36	36	36	36	36	36	36	36	36	36	432
Ground Heat Transfer (kW-hr)=	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-96	-1152
Net Thermal Loads (kW-hr)=	-908	-801	-570	-404	-184	7	79	22	-117	-242	-530	-815	-6839
Latent Loads (per month)	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
Infiltration Latent load (kW-hr)	-56.4	-52.1	-40.3	-25.0	-2.2	25.8	43.6	38.5	13.1	-19.1	-36.9	-50.4	-161.5
Ventilation latent load (kW-hr)	-424.7	-392.8	-303.4	-188.6	-16.3	194.2	328.2	289.9	98.5	-143.9	-277.9	-380.0	-1216.7
People latent load (kW-hr)	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	201.6	2419.2
Total latent load (kW-hr)	-279.4	-243.3	-142.1	-12.0	183.1	421.6	573.4	530.0	313.2	38.6	-113.2	-228.8	1041.0
Electric Energy (per month)	**Jan**	**Feb**	**Mar**	**April**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	**Total**
PV panel production (kW-hr)=	412.3	505.6	548.7	632.1	688.8	723.4	721.9	691.7	636.7	563.0	409.3	346.3	6879.7
House heat pump (kW-hr)=	-345.9	-305.0	-217.1	-153.8	-70.1	0.0	0.0	0.0	-44.5	-92.2	-202.0	-310.6	-1741.3
House AC (kW-hr)=	0.0	0.0	0.0	0.0	0.0	-1.3	-15.1	-4.1	0.0	0.0	0.0	0.0	-20.5
House Dehum (kW-hr)=	0.0	0.0	0.0	0.0	-91.6	-210.8	-286.7	-265.0	-156.6	-19.3	0.0	0.0	-1029.9
House Humid (kW-hr)=	-139.7	-121.6	-71.1	-6.0	0.0	0.0	0.0	0.0	0.0	0.0	-56.6	-114.4	-509.5
Qrefrig (kW-hr) =	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-10.8	-129.6
Qfrz (kW-hr) =	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-21.6	-259.2
Qwater heater (kW-hr) =	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-191.7	-2300.9
Other elect energy (kW-hr) =	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-36.0	-432.0
Total Electric Required (kW-hr)=	-745.8	-686.8	-548.3	-420.0	-421.8	-472.2	-561.9	-529.3	-461.3	-371.6	-518.7	-685.2	-6422.8
Net Electric (kW-hr)=	-333.4	-181.3	0.4	212.1	267.0	251.2	160.0	162.4	175.4	191.4	-109.4	-338.9	456.9

Results Summary

House Cost ($) =	108000
Wall Insulation Cost ($) =	800
Roof Insulation Cost ($) =	2100
PV System Cost ($) =	22000
South Window Cost ($)=	1200
North Window Cost ($)=	2000
Total House Cost ($) =	136100

A B C D E G H I J

Energy Consumption and PV System Production

Month	Monthly Energy Consumption (kWh)	Monthly Energy Production 8 kW PV System (kWh)	Net Energy Production (kWh)	Cost of Electricity ($)
Jan	693.92	178.03	515.89	($51.59)
Feb	693.92	379.30	314.62	($31.46)
Mar	693.92	806.19	112.27	$11.23
Apr	693.92	998.39	304.47	$30.45
May	693.92	1145.29	451.37	$45.14
Jun	693.92	1144.40	450.48	$45.05
Jul	693.92	1167.02	473.11	$47.31
Aug	693.92	1070.62	376.70	$37.67
Sep	693.92	940.28	246.36	$24.64
Oct	693.92	611.43	82.49	($8.25)
Nov	693.92	180.72	513.20	($51.32)
Dec	693.92	110.85	583.06	($58.31)
Annual	8,327.00	8,732.51	405.51	$40.56

8 kW system to supply enough electricity to support an annual energy usage of 8,326.77 kWh per year. The total system cost is $26,074 but with the 30% Federal Credit it incentivizes the cost to $18,251.80.