TEAM INTRODUCTION

Community Partners
Journey Women’s Center - Amy Voth

Industry Partners
Guaranteed Watt Saver – Kelly Parker
820 Solar – Cory Baitz
Standard Panel – John Pardue
AWAD Construction
Dolese
Lee Glass and Window

Special Thanks
Homestead School - Bruce & Barbra Johnson

Instructors
Khaled Mansy, Ph.D. – Architecture
Jay Yowell, AIA – Architecture
Christian Bach, Ph.D. – M. Engineering
Hebatalla Nazmy, Ph.D. – Interior Design

Christian Brack
Architecture

Abigail Richardson
Architecture

Emily Smith
Architecture

Pouria MoghimiGhadikolaei
Mechanical Engineering

Maggie Carathers
Architecture

Jahnia Wright
Interior Design

Ian Strickland
Architecture

Jacob Gore
Architecture

Whitney Waitsman
Architecture

Amr Abdelmoneim
Mechanical Engineering

Lia Jenson
Interior Design

Molly Hoback
Team Lead, Architecture
The location of the Journey House resides in the State of Oklahoma. Serving a nearby community within our state has drastically impacted the significance and relationship with Oklahoma State University.

Journey Women’s Center Headquarters is in the town of Enid, Oklahoma which is a 24-minute drive from our site of Hillsdale, Oklahoma for the Journey House.

The illustrated site focuses in on the intersection of streets in Hillsdale. Unit A and B of the Attached Housing project are displayed as well as the additional transitional Units C & D.
## BUDGET & TIMELINE

### Solar Decathlon Journey Women’s Center Construction Timeline

<table>
<thead>
<tr>
<th>Task Description</th>
<th>Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Document Review &amp; Revision</td>
<td>10 days</td>
</tr>
<tr>
<td>2. Mobilization &amp; Layout</td>
<td>3 days</td>
</tr>
<tr>
<td>3. Bid &amp; Contracts</td>
<td>10 days</td>
</tr>
<tr>
<td>4. Foundation Design</td>
<td>20 days</td>
</tr>
<tr>
<td>5. Reinforce Foundation</td>
<td>20 days</td>
</tr>
<tr>
<td>6. Concrete Slab</td>
<td>28 days</td>
</tr>
<tr>
<td>7. Plumbing &amp; Electrical Underground</td>
<td>15 days</td>
</tr>
<tr>
<td>8. Wood Framing</td>
<td>48 days</td>
</tr>
<tr>
<td>9. Shop Drawings</td>
<td>55 days</td>
</tr>
<tr>
<td>10. Installation of Wood Framing</td>
<td>15 days</td>
</tr>
<tr>
<td>11. Roofing</td>
<td>27 days</td>
</tr>
<tr>
<td>12. Design Roof Framing</td>
<td>30 days</td>
</tr>
<tr>
<td>13. Install Roofing</td>
<td>15 days</td>
</tr>
<tr>
<td>14. Set up Roof Equipment</td>
<td>2 days</td>
</tr>
<tr>
<td>15. HVAC Rough In</td>
<td>20 days</td>
</tr>
<tr>
<td>16. In-Wall and Underfloor Rough-Ins</td>
<td>10 days</td>
</tr>
<tr>
<td>17. Wall Close In Inspection</td>
<td>1 day</td>
</tr>
<tr>
<td>18. Insulate, Drywall &amp; Finish</td>
<td>20 days</td>
</tr>
<tr>
<td>19. Frame Ceilings</td>
<td>5 days</td>
</tr>
<tr>
<td>20. HVAC &amp; Electrical work to Grid</td>
<td>12 days</td>
</tr>
<tr>
<td>21. Ceiling Close In Inspection</td>
<td>1 day</td>
</tr>
<tr>
<td>22. Ceiling Close In</td>
<td>4 days</td>
</tr>
<tr>
<td>23. Cabinets &amp; Countertops</td>
<td>3 days</td>
</tr>
<tr>
<td>24. Sat Plumbing Fixtures</td>
<td>5 days</td>
</tr>
<tr>
<td>25. Toilet Accessories</td>
<td>5 days</td>
</tr>
<tr>
<td>26. Doors, Frames, &amp; Hardware</td>
<td>7 days</td>
</tr>
<tr>
<td>27. Paint Staged Ceilings</td>
<td>4 days</td>
</tr>
<tr>
<td>28. Wall Paint</td>
<td>12 days</td>
</tr>
<tr>
<td>29. Pipe Grid</td>
<td>3 days</td>
</tr>
<tr>
<td>30. Final Electrical &amp; HVAC</td>
<td>8 days</td>
</tr>
<tr>
<td>31. Final Inspections</td>
<td>3 days</td>
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<tr>
<td>32. Use &amp; Occupancy</td>
<td>3 days</td>
</tr>
<tr>
<td>33. Punch List</td>
<td>7 days</td>
</tr>
<tr>
<td>34. FINISH PROJECT</td>
<td>0 day</td>
</tr>
</tbody>
</table>

### Analysis

- **Model 1**:
  - Cost: ~$152.50/SF
  - Total Cost: $460,691.50
  - Estimated End Date: September
  - Net Saving: 6 weeks

- **Model 5**:
  - Cost: ~$180.02/SF
  - Total Cost: $545,049.57
  - Estimated End Date: September
  - Net Saving: 6 weeks

If we were to start construction in January of 2025, the estimated end date would land at the end of September totaling 36 weeks. However, with the integration of SIPs Panels, it would reduce the total construction time by 6 weeks.
**Services**

- **No-Cost Limited OB Ultrasounds**
- **Options Counseling**
- **No Cost Pregnancy Tests**

**Purpose of Design**

+ The maternity home will provide housing for 4 women and house parents in each unit

+ The goal of the maternity home is to provide safe housing and an encouraging environment for women

+ Women can live there during pregnancy all the way until the child is 1 year old

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"Journey Women's Center educates, supports, and empowers women facing unplanned pregnancies with compassionate, professional care."

"Oklahoma has the second highest teen pregnancy rate in the nation."

(FocusForwardOK)
According to IECC 2021, Hillsdale, Oklahoma is located within Climate Zone 4A. Temperature range helped us in the design of passive solar heating, and the wind wheel helped us to design the natural ventilation and the fan-assisted ventilation. Our climate provides a high potential for passive heating and cooling. Additionally, resources such as the Psychrometric chart provided guidance in our desired condition of the air. The utilization of the Sun Path Solar Diagram allowed us to develop the necessary overhangs and window openings.
**Building Codes & Standards**

**Energy Code**
IECC 2009, IECC 2021, RESNET 301 (2019)
Envelope Values

**Building Code**
IBC 2018 (R-2), IRC 2009, IRC 2021
Building Classification & Req’s

**Mechanical Standard**
System Sizing & Ventilation

**Standards & Programs**
DOE ZERH, Phius, WELL
Envelope Values & Best Practices

---

**Model 5**

**R-14**
Slab & Perimeter

**R-43**
Wall

**R-65**
Roof

---

**IECC 2009**

**R-1**
Slab & Perimeter

**R-15**
Wall

**R-32**
Roof

**U**: 0.50
**SHGC**: 0.30
Glass

---

**IECC 2021+ZERH**

**R-10**
Slab & Perimeter

**R-32**
Wall

**R-60**
Roof

**U**: 0.30
**SHGC**: 0.40
Glass

---

**PHIUS**

**R-13**
Slab & Perimeter

**R-35**
Wall

**R-62**
Roof

**U**: 0.19
**SHGC**: 0.40
Glass

---

**Model 5**

**R-14**
Slab & Perimeter

**R-43**
Wall

**R-65**
Roof

**U**: 0.20
**SHGC**: 0.37
Glass
DESIGN GOALS

Hope  Community  Resiliency
Hope

+ 24/7 Care
+ Biophilic design
+ Natural light / shadow-free daylighting
  + Positive environment for healing & gaining life skills
+ Open views to outside
+ Rural living
+ Community greenhouse
Community + Design Justice

+ Local support
+ Cluster design
+ Funds from Enid/Hillsdale
+ Site donated by community member
+ Outdoor living
+ Open plan and shared bathrooms
**Resiliency + Sustainability + Climate Action**

**Sustainable materials**
**Passive systems**
**PV & Battery storage**
**Natural ventilation**
**Solar water heating with 80-gallon tank & backup electric coil/heating**
**FEMA-Approved above-ground storm shelter, easily accessible & close to exterior wall**
**Vegetable garden**
**Future community wind power**
Phase 3
A Compound of 3 Clusters

Phase 2
The North Cluster:
Units A + B = Maternity Homes
Units C + D = Transitional Units

Phase 1
4 Dwelling Units: A1 + A2 + B1 + B2

Climate Zone: 4A
Site EUI Before PV: 9.64 kBtu/SF/yr
Site EUI After PV: -2.81 kBtu/SF/yr
HERS Before PV: A1 = 26
A2 = 27
HERS After PV: A1 = -1
A2 = -3
Annual Savings: $1,248

4 Units
2 Maternity Units
2 Support Units
5,980 SF
12 Bedrooms
8 Bathrooms

Before PV: A1 = -1
A2 = -3

After PV: A1 = 26
A2 = 27

Annual Savings: $1,248

Site EUI Before PV: 9.64 kBtu/SF/yr
Site EUI After PV: -2.81 kBtu/SF/yr

OVERVIEW
CONTESTS DISCUSSION

- Architecture
- Engineering
- Envelope
- Efficiency
- Grid-Interactivity
- Life-Cycle
- Health
- Market
- Community
The architectural design improvements were motivated by a need to further improve the daylighting within the living space for the women as well as contribute to our passive heating design techniques. The site provides an opportunity to connect with the outside environment.
The architectural floor plan revolved around the goal of community. A deep desire for interactions between the mothers was an area that is highlighted through the shared bathrooms, living room, and kitchen space. Resiliency architecture is expressed through the operable windows, storm shelter, and fireplace. The spatial layout of every woman’s bedroom is catered to provide a beneficial and functional floor plan for the woman and child.
+ SIPs reduce construction time
+ Resilient in the wind
+ Withstands weight of solar heating water tubes/tanks
+ Reduction in construction waste
+ Slab on grade simplifies construction and provides easy access to the building (using a locally-available low-carbon concrete mix)
Models 1 & 2
+ Two systems for units A1 & A2
+ Basic, traditional setup for Oklahoma homes
+ One thermostat per dwelling unit
+ Low efficiency, SEER = 13 & HSPF = 7.7

Models 3 & 4
+ Three distribution boxes + nine thermostats
+ Individual control for occupants
+ High efficiency, SEER = 18.35 & HSPF = 15.8
+ Most Expensive
+ Ventilation through DOAS or ductless ERV
Final + 4 Pipe Fan Coil system + Passive Solar Heating System + Ductless ERV

+ Model 5
+ Individual control (9 zones)
+ Simultaneous heating and cooling
+ High efficiency hydronic system
+ Full integration with passive solar heating
+ Backup electric heater

+ District cooling with air-cooled chiller serving one cluster
+ No refrigerant within house
+ High efficiency heat pumps
+ Ventilation through ductless ERV per room
+ Ductless ERV controls relative humidity
+ High efficiency, SEER = 19.92 & HSPF = 15.4
Passive Solar Heating + Passive Cooling + Daylighting

Area of South Windows: 144 sf
Area of Exterior South Wall: 813 sf
Area of all other Windows: 120 sf
Area of all other Exterior Walls: 1,764 sf

Balance Point Temperature with Passive Heating (15.6)

Comfort with Natural Ventilation (83)

Vegetation on North Side of Building

Light Colored Concrete
Reflective Film
Night Insulation
Solar Collector Space
Solar Panels
Clerestory Windows
Gray Metal Seam Roofing
Single-Room Systems Integration + Comfort

- Natural Ventilation Duct
- Fan-Assisted Natural Ventilation Intake
- 4-Pipe System Water Piping
- Plenum Air Return Grill
- LED Luminaries
- Fan Coil Terminal Unit
- Baby Changing Area
- Insulated Ceiling (SIPS)
- PV Panels
- Soffit Vent for the attic
- Ceiling Fan for humid hours & natural ventilation
- Ductless ERV (fresh air inlet)
- Night Insulation
- Operable Window
- Natural Ventilation Inlet
Although the exterior building form is relatively simple, the configuration of the thermal enclosure allows for a dynamic interior, which is ideal for the programmatic uses of the associated spaces. A clerestory window illuminates the Mothers’ Rooms, the Solar Collector warms the Common Space, and the Vented Attic ensures natural ventilation in the House Parent Suite.
ENVELOPE / SECTION B DETAILING

Standing Seam Metal Roof
High Temp Ice and Water Shield
2x4 Red Cedar Framing
9” Polyisocyanurate

2x6 Top Plate
2x10 End Plate
2x10 Base Plate
Insect Screen
Aluminum Drip Edge

Foam Filler
Foam Sealant
2x10 Ledger Spline
2” Polyisocyanurate
12” SIPs Panel
½” Gypsum

Cedar Rainscreen Assembly
10” SIPs Panel
½” Gypsum

4” Concrete Slab
Polyethylene Vapor Barrier
2” Polyisocyanurate
4” Gravel Layer

Section B
ENVELOPE / SECTIONS A & C DETAILING

Section A

- 3x5 Gutter
- Snow Guard
- PV Panel
- Rain Chain
- 4" Soffit Vent

Section C

- Static Roof Vent
- 2x4 Top Plate
- Sound Reducing Gypsum
- TimberBatt Insulation

Architecture
Engineering
Envelope
Efficiency
Grid-Interactivity
Life-Cycle
Health
Market
Community
ENVELOPE / WALL SECTION MODEL

Solar Collector

Wall Section

Wall Detailing
Energy Demand (kWh/yr)

Annual Energy Use & EUI Decrease = 72%

<table>
<thead>
<tr>
<th></th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>Furnace</td>
<td>Furnace</td>
<td>Ductless Mini-Split</td>
<td>Ductless Mini-Split</td>
<td>Water to Water Heat Pump</td>
</tr>
<tr>
<td>Efficiency - HSPF</td>
<td>7.7</td>
<td>9.2</td>
<td>15.8</td>
<td>15.8</td>
<td>15.4</td>
</tr>
<tr>
<td>Cooling</td>
<td>AC Unit</td>
<td>AC Unit</td>
<td>Ductless Mini-Split</td>
<td>Ductless Mini-Split</td>
<td>Water to Water Heat Pump</td>
</tr>
<tr>
<td>Efficiency - SEER</td>
<td>13</td>
<td>16</td>
<td>18.35</td>
<td>18.35</td>
<td>19.92</td>
</tr>
</tbody>
</table>
### Appliance Loads (kWh/yr)

- **Model 1 (DW A1)**
- **Model 2 (A1)**
- **Model 3 (DW A2)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Model 1</th>
<th>Model 2</th>
<th>Model 3</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lights</strong></td>
<td>100% Fluorescent</td>
<td>100% Fluorescent</td>
<td>100% LED</td>
<td>100% LED</td>
<td>100% LED + Improvements</td>
</tr>
<tr>
<td><strong>Appliances</strong></td>
<td>HERS Reference</td>
<td>HERS Reference</td>
<td>HERS Reference</td>
<td>HERS Reference</td>
<td>Energy Star + Improvements</td>
</tr>
</tbody>
</table>

**Overall Load Reduction = 20%**
Efficiency / Parametric Analysis + Combined Measures

Architecture
Engineering
Envelope
Efficiency
Grid-Interactivity
Life-Cycle
Health
Market
Community

Ekotrope to Open Studio

Occupancy Schedule
Room-by-Room Thermal Zones
Detailed Hourly Outputs
Daylighting Integration
Passive Systems Integration

Open Studio Model Improvements

Energy Use & EUI Decrease = 36.5%

<table>
<thead>
<tr>
<th>Iteration</th>
<th>Heating</th>
<th>Cooling</th>
<th>Lighting</th>
<th>Appliances</th>
<th>EUI</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 4 Ekotrope</td>
<td>0.71</td>
<td>1.81</td>
<td>1.05</td>
<td>9.53</td>
<td>13.1</td>
<td></td>
</tr>
<tr>
<td>Model 4 Open Studio</td>
<td>1.04</td>
<td>1.81</td>
<td>2.34</td>
<td>9.99</td>
<td>15.2</td>
<td></td>
</tr>
<tr>
<td>Improved Lighting</td>
<td>1.17</td>
<td>1.71</td>
<td>1.14</td>
<td>9.99</td>
<td>14.0</td>
<td>-7.8%</td>
</tr>
<tr>
<td>Daylighting</td>
<td>1.05</td>
<td>1.77</td>
<td>1.97</td>
<td>9.99</td>
<td>14.8</td>
<td>-2.6%</td>
</tr>
<tr>
<td>Interior Shading</td>
<td>0.95</td>
<td>1.77</td>
<td>2.34</td>
<td>9.99</td>
<td>15.1</td>
<td>-0.8%</td>
</tr>
<tr>
<td>Improved Appliances</td>
<td>1.20</td>
<td>1.57</td>
<td>2.34</td>
<td>7.65</td>
<td>12.8</td>
<td>-15.8%</td>
</tr>
<tr>
<td>Model 4 (Combined)</td>
<td>1.33</td>
<td>1.28</td>
<td>0.95</td>
<td>7.65</td>
<td>11.22</td>
<td>-26.1%</td>
</tr>
<tr>
<td>Model 5 (Combined + Passive Solar)</td>
<td>0.16</td>
<td>1.80</td>
<td>0.95</td>
<td>7.65</td>
<td>10.6</td>
<td>-30.5%</td>
</tr>
<tr>
<td>Model 5 (Combined + Passive Solar + Natural Ventilation)</td>
<td>0.16</td>
<td>0.88</td>
<td>0.95</td>
<td>7.65</td>
<td>9.6</td>
<td>-36.5%</td>
</tr>
</tbody>
</table>

EUI Decrease from Model 4 Open Studio

Site EUI

-3
-2
-1
0
1

-3
-2
-1
0
1

Narrative 17
20% Roof Coverage

PV System

<table>
<thead>
<tr>
<th>Total Area of Unit</th>
<th>616 s.f.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conversion Efficiency</td>
<td>19.7%</td>
</tr>
<tr>
<td>Power Rating</td>
<td>525 W</td>
</tr>
<tr>
<td>System Size</td>
<td>7 kW DC</td>
</tr>
<tr>
<td>Number of Panel Attachment</td>
<td>22 (+2)</td>
</tr>
<tr>
<td>Battery Module Type</td>
<td>Roof Mounted Lithium-ion Thin Film</td>
</tr>
</tbody>
</table>

Electric Off-Grid w/ Battery System

First Solar Series 7 TR1 525 W Thin Film

Battery Inverter Meter Grid

Battery Storage Energy Path Building Usage Energy Path

22°
PV Electric Output vs Demand

PV Panel Carbon

<table>
<thead>
<tr>
<th>PV Panel Embodied CO₂</th>
<th>Grid Emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>LCA A-D</td>
<td>0.258</td>
</tr>
<tr>
<td></td>
<td>kg CO₂ eq/W</td>
</tr>
<tr>
<td>SPSO Emission Factor</td>
<td>138</td>
</tr>
<tr>
<td></td>
<td>kg CO₂/MBtu</td>
</tr>
<tr>
<td>Wattage/Panel</td>
<td>525 W</td>
</tr>
<tr>
<td>SPSO Emission Factor</td>
<td>0.4701</td>
</tr>
<tr>
<td></td>
<td>kg CO₂/kWh</td>
</tr>
<tr>
<td>Initial Panel</td>
<td>22</td>
</tr>
<tr>
<td>Final + Energy</td>
<td>8,540 kWh/yr</td>
</tr>
<tr>
<td>Demand</td>
<td></td>
</tr>
<tr>
<td>Replacement Panels</td>
<td>2</td>
</tr>
<tr>
<td>GWP/yr</td>
<td>4,015</td>
</tr>
<tr>
<td></td>
<td>kg CO₂ eq</td>
</tr>
<tr>
<td>GWP/60 yrs</td>
<td>3,251</td>
</tr>
<tr>
<td></td>
<td>kg CO₂ eq</td>
</tr>
<tr>
<td>GWP/60 yrs</td>
<td>240,881</td>
</tr>
<tr>
<td></td>
<td>kg CO₂ eq</td>
</tr>
</tbody>
</table>

PV vs Grid Only Electricity = -99%

PV Life Cycle Savings

Payback Period: 11 Years
Total Net Savings: $61,054

Cumulative Savings
Yearly Savings
Initial Cost
LIFE-CYCLE / EMBODIED CARBON / SUMMARY

Life Cycle Stages

Product (A1-A3)  Construction (A4-A5)  Use (B1-B7)  End of Life (C1-C4)  Beyond (D)

Cradle-to-Gate  Use  Cradle-to-Cradle

Total Embodied Carbon

Model 1  Model 2  Model 3  Models 4 & 5

Percent Reduction b/w Model 1 and 4&5
A1-A3 = -168%
B2-B5 = -29%
A-D = -27%
**LIFE-CYCLE / EMBODIED CARBON / MATERIALS**

**Carbon for Material Substitutions (A-D)**

- Cladding
- Roof
- Slab

<table>
<thead>
<tr>
<th>Model 1</th>
<th>Models 4 &amp; 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>20,000</td>
<td>0</td>
</tr>
<tr>
<td>0</td>
<td>197%</td>
</tr>
<tr>
<td>-29%</td>
<td>-67%</td>
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</tbody>
</table>

**Improve Materials & Location**

- Slab provides better heat retention
- Local manufacturer
- Sequesters carbon
- Low carbon concrete mix
- Better support for PV
- Lower long-term cost
- Recycled standing seam metal roofing
- Biophilic positivity

**Eastern Red Cedar Availability**

2000: Invasive Eastern Red Cedar Expansion

2018: Sequesters carbon

Local and invasive species

Biophilic positivity

- Eastern Red Cedar cladding
- Slab provides better heat retention
- Local manufacturer
- Sequesters carbon
- Lower long-term cost
- Recycled standing seam metal roofing

**Narrative 21**
Sequestered Carbon from Trees

- Cercis canadensis
- Celtis occidentalis
- Fraxinus pennsylvanica
- Catalpa speciosa
- Junglans nigra

Carbon by Building Category

<table>
<thead>
<tr>
<th>Material</th>
<th>Model 1</th>
<th>Models 4 &amp; 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Foundation</td>
<td>29,767</td>
<td>20,293</td>
</tr>
<tr>
<td>3 Framing</td>
<td>-2,081</td>
<td>-14,319</td>
</tr>
<tr>
<td>4 Exterior Walls</td>
<td>7,645</td>
<td>14,677</td>
</tr>
<tr>
<td>5 Roofing + Ceiling</td>
<td>25,210</td>
<td>19,018</td>
</tr>
<tr>
<td>6 Interiors</td>
<td>9,137</td>
<td>16,832</td>
</tr>
<tr>
<td>7 Specialties</td>
<td>219</td>
<td>165</td>
</tr>
<tr>
<td>Total GWP</td>
<td>69897</td>
<td>56666</td>
</tr>
<tr>
<td>GWP per SF</td>
<td>23.14</td>
<td>18.76</td>
</tr>
</tbody>
</table>

Total Sequestered Carbon from Landscape

- Unit A: 7,548.76 kg CO2 per year
- Full Landscape: 22,646.28 kg CO2 per year

Net Carbon Cradle-to-Cradle

- 18.76 kgCO2/SF / 60 yrs = 0.31 kgCO2/SF/yr
- -7549 kgCO2/yr / 3021 SF = -2.5 kgCO2/SF/yr
- = -2.19 kg CO2 eq/SF/yr

86% more carbon sequestered than produced

Research found with the help of the Center for Urban Forest Research and Gardenia
The incorporation of biophilic design elements within the site aims to cultivate a sense of tranquility and connection with nature for its occupants. Biophilic design fosters a safe and nurturing environment. The design concept prioritizes organic elements that facilitate both communal gatherings and solitary moments of reflection. The bioswale on the north side of the site serves dual purposes by creating gathering spaces and harvesting rainwater.
**Health / Interior**

### Appliances
- Induction cooktop
- Filtered water
- Closed Insert fireplace

### Fresh Air
- 30 CFM per person for 100 sq ft
- Operable windows
- Natural ventilation

### Clean Air
- Low VOC materials
- MERV 13 air filtration
- ERV

### Comfort Controls
- Individual room thermal control
- Natural ventilation
- Ceiling fans

### Privacy
- Acoustic privacy (STC = 49)
- Private rooms
- Rural site

---

### Interior Elevations + Health

- **Bedroom**
  - Baby Changing Room
  - Sink
  - Operable Windows
  - Ceiling Fan
  - Acoustic Gyp Bd

- **Living Area**
  - Fireplace Insert
  - Elevated Hearth
  - Wall Oven
  - Induction Cooktop
  - Operable Windows
  - Exhaust Hood

---

### Material Selection Criteria
- Biophilic effects on wellbeing
- Local availability
- Reduction of water use
- Low VOC materials
- Healthy indoor air quality

---

**Material Selection Criteria**

- Energy Star
- Green LakePlus
- Certified cradle to cradle
- WaterSense
- Greenguard Gold
<table>
<thead>
<tr>
<th>Building Information</th>
<th>Model 1</th>
<th>Model 4</th>
<th>Model 5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total Cost ($)</td>
<td>Replacement</td>
<td>Total Cost ($)</td>
</tr>
<tr>
<td>2 Foundation</td>
<td>$37,456.60</td>
<td>$0.00</td>
<td>$39,365.28</td>
</tr>
<tr>
<td>3 Framing</td>
<td>$42,365.22</td>
<td>$0.00</td>
<td>$37,133.95</td>
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<tr>
<td>4 Exterior Walls</td>
<td>$39,950.16</td>
<td>$37,306.32</td>
<td>$70,332.37</td>
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<tr>
<td>5 Roofing + Ceiling</td>
<td>$21,690.78</td>
<td>$35,859.27</td>
<td>$32,116.07</td>
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<tr>
<td>6 Interiors</td>
<td>$97,690.30</td>
<td>$120,113.97</td>
<td>$101,491.14</td>
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<tr>
<td>7 Specialties</td>
<td>$18,130.11</td>
<td>$0.00</td>
<td>$27,018.73</td>
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<tr>
<td>8 Mechanical</td>
<td>$51,488.87</td>
<td>$0.00</td>
<td>$55,043.68</td>
</tr>
<tr>
<td>9 Electrical</td>
<td>$20,293.32</td>
<td>$48,292.45</td>
<td>$20,465.62</td>
</tr>
</tbody>
</table>

Subtotal | $329,065.36 | $241,572.01 | $382,966.84 | $271,212.17 | $389,321.12 | $271,212.17 |
Contractor Fees (General Conditions, Overhead, Profit) | $131,626.14 | $96,628.80  | $153,186.74 | $108,484.87 | $155,728.45 | $108,484.87 |
Architectural Fees | $0.00       | $0.00       | $0.00       | $0.00       | $0.00       | $0.00       |
User Fees | $0.00       | $0.00       | $0.00       | $0.00       | $0.00       | $0.00       |
Total | $460,691.50 | $338,200.81 | $536,153.58 | $379,697.04 | $545,049.57 | $379,697.04 |
Cost Per SF | $152.50     | $177.48     | $180.42     | $180.42     | $180.42     | $180.42     |

Total Life Span Cost | $798,892.32 | $915,850.61 | $924,746.61
MARKET / COST ESTIMATION

Model 1
- ~$152.50/SF
- Total Cost: $460,691.50

Model 4
- ~$177.48/SF
- Total Cost: $536,153.58

Model 5
- ~$180.02/SF
- Total Cost: $543,837.94

COST PER SF

<table>
<thead>
<tr>
<th>Model</th>
<th>Cost Per SF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model 1</td>
<td>~$152.50</td>
</tr>
<tr>
<td>Model 4</td>
<td>~$177.48</td>
</tr>
<tr>
<td>Model 5</td>
<td>~$180.02</td>
</tr>
</tbody>
</table>

16% Increase

18% Cumulative Increase
Cumulative Cost = Upfront Cost (Construction) + Cost of Operational Energy
Cumulative Cost = Upfront Cost (Construction) + Cost of Operational Energy
Cumulative Carbon = Embodied Carbon + Operational Carbon

Number of P.V. panels required would not fit on this roof

20% P.V. roof coverage
"We recognize that an unplanned pregnancy is a complex issue that must be met with compassion and a loving approach."

**Goals Within Design**

**Hillsdale Community**
- Land is donated by community member
- House parents are Hillsdale residents
- Local church offering support

**Journey Community**
- Cluster Design
- Outdoor living space
- Open plan Interiors

**Resilient Construction**
- Local Material Choices
- Passive Solar Heating and Cooling
- Maintaining Human Thermal Comfort

**Site**
*Future Expansion*
- PV Array
- Pizza Oven
- Butterfly Garden
- Wind Turbine
- Garden
- Hammocks
- Greenhouse

---

**Hillsdale Community + Land**
- Donated by community member
- House parents are Hillsdale residents
- Local church offering support

**Journey Community + Cluster Design**
- Outdoor living space
- Open plan Interiors

**Resilient Construction + Local Material Choices**
- Passive Solar Heating and Cooling
- Maintaining Human Thermal Comfort

---

**Community / GOALS + SITE**

---

**Narrative 31**
COMMUNITY / SITE MODEL

Site Model

Site Axon
CONCLUSION

Hope  Community  Resiliency
THANK YOU!

QUESTIONS?
Baseline: 30112 kWh/yr

Improved: 9346 kWh/yr
Acoustic Partitions Plan, Units A1 & A2

STC Rating of 49

International Well Building Institute recommends a minimum STC rating of 40 between circulation zones and regularly occupied spaces.
Door and Window Schedules

1. South Elevation
   1/16" = 1'-0"

2. North Elevation
   1/16" = 1'-0"

3. West Elevation
   1/16" = 1'-0"

---

**WINDO W SCHEDULE**

<table>
<thead>
<tr>
<th>MARK</th>
<th>DOOR TYPE</th>
<th>COMMENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>A</td>
<td>EXT.</td>
</tr>
<tr>
<td>A2</td>
<td>A</td>
<td>INT.</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>INT.</td>
</tr>
<tr>
<td>C</td>
<td>C</td>
<td>INT.</td>
</tr>
<tr>
<td>D</td>
<td>D</td>
<td>INT.</td>
</tr>
<tr>
<td>E</td>
<td>E</td>
<td>INT.</td>
</tr>
<tr>
<td>F</td>
<td>F</td>
<td>INT.</td>
</tr>
<tr>
<td>G</td>
<td>G</td>
<td>EXT.</td>
</tr>
<tr>
<td>H</td>
<td>H</td>
<td>EXT.</td>
</tr>
<tr>
<td>I</td>
<td>I</td>
<td>EXT.</td>
</tr>
</tbody>
</table>

**DOOR SCHEDULE**

<table>
<thead>
<tr>
<th>MARK</th>
<th>COMMENTS</th>
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</thead>
<tbody>
<tr>
<td>A1</td>
<td>Single Hung</td>
</tr>
<tr>
<td>A2</td>
<td>Single Hung</td>
</tr>
<tr>
<td>B</td>
<td>Fixed</td>
</tr>
<tr>
<td>C</td>
<td>Fixed</td>
</tr>
</tbody>
</table>
Mechanical Plan / 4-Pipe Fan Coil + Passive Solar + Ductless ERV
Plumbing Plan

Water Consumption: 110,000 gal/year

H2Optimum 1.1 gpf 12" Rough Tank
Origin 21 2-handle WaterSense Bathroom Sink Faucet with Drain
Niagara Conservation HealthGuard 1.5-gpm
Allen + Roth Single Handle Pull-down Kitchen Faucet with Sprayer
Premium Drinking Water Safe Garden Hose
AET – EagleSun DX: DX-80-64
Electric Lighting Design

AVERAGE ILLUMINANCE WORKSHEET - ELECTRIC LIGHTING LUMEN METHOD [SIMPLIFIED]

1 PHOTOMETRIC DATA
IECC Lighting Power Allowance = 0.45 Watt/SF

IESNA Illumination Category
IESNA Recommended Illuminance: fc

Lamp type: 
Lamp lumen output: Lumens
Lamp wattage: Watt
Lamp efficacy: Lumens/Watt

Recommended spacing, 0° (between parallel rows)
Recommended spacing, 90° (within the same row)

Number of lamps per fixture
Lamp type:
Lamp lumen output:
Lamp wattage:
Lamp efficacy:

Recommended spacing, 0° (between parallel rows)
Recommended spacing, 90° (within the same row)

Number of lamps per fixture
Lamp type:
Lamp lumen output:
Lamp wattage:
Lamp efficacy:

2 ROOM DESIGN
Height of the three cavities
Length of space (L) = ft
Width of space (W) = ft
Height of space (H) = ft

Ceiling cavity reflectance (CCR)
Room cavity reflectance (RCR)
Floor cavity reflectance (FCR)

CU interpolation
Room cavity reflectance (RCR)

3 SIZING THE LIGHTING SYSTEM

A: Effect of room geometry: determine the equivalent-square room length (W_sq) and the room cavity ratio (RCR).

W_sq = W + [(L-W) / 3]

RCR = (10 x H) / W_sq

B: Effect of maintenance conditions of the space and the system (cleaning, lumen depreciation, relamping, ... etc.)

Light Loss Factor (LLF) = 0.85 for good conditions, 0.75 for average conditions, and 0.65 for poor conditions

C: Calculate useful lumens from one luminaire reaching the workplane

Useful lumens from one luminaire

D: Calculate total lumens needed on the workplane

Total lumens on the workplane

Number of luminaires

4 DESIGN EVALUATION

Actual number of luminaires used
Actual illumination level provided
Light load
Light load index
Percent lamps covered per luminaire
Luminaire's overall efficacy
Passive Solar Heating Information

Values: South Windows: 0.44
Solar Collector: 0.6

Values: South Windows: 0.22
Solar Collector: 0.21

ERV: 93% recovery efficiency
Rise.com

Changes for Design:

Triple Pane vs. Double Pane Glass

- Due to the utilization of night insulation, isolated solar heat gain space, roof and wall insulation, and energy recovery ventilator, we were able to choose double pane to save on cost while still be close to the Phius Passive House U-Value of 0.19. The values we chose were 0.21 and 0.22. The value of the SHGC (Solar Heat Gain Coefficient) was originally 0.4. However, we are wanting more solar transmission to the solar heat collector space for the water tubes, so that was increased to 0.6.

Table from Pella.com
Passive Solar Heating / Baseline vs Improved

Average Outdoor Temperature for December 21st: 15.6 °F

BEFORE IMPROVEMENTS:

- No Night Insulation
- Phius Glass Value Requirements
- No Solar Collector Space
- No Thermal Mass

Result: Building’s Balance Point Temperature: 34.5 °F > 15.6 °F

Code-compliant design cannot provide 100% passive solar heating

AFTER IMPROVEMENTS:

- Night Insulation – Double Cell Black Out Cellular Shades on Tracks
- Glass Values: (Utilized Viracon)
- Solar Collector Space
- Thermal Mass

Result: Building’s Balance Point Temperature: 15.6 °F (exceeds necessary)

Due to the deep overhang, February was the critical month (design condition).
The Heliodon was beneficial in determining the percentage of light intake the overhang and window combination. The created model was tracked for every hour of sunlight during the day. We were able to alter the form and distance of windows to bring more light for passive solar heating.
### LIVING ROOM:

**Type of space:** Residential  
**Location:** Hillsdale, OK  
**Month:** May, 21st  
**Thermostat Temp:** 85°F

#### STEP 1: INPUT DATA

<table>
<thead>
<tr>
<th>Location &amp; Climate:</th>
<th>Design:</th>
<th>Occupancy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Temperature: 21.0°C</td>
<td>Area of space (in sq. ft): 170.00</td>
<td>Number of people: 1.00</td>
</tr>
<tr>
<td>Wind Speed at nearest rural: 38.0mph</td>
<td>Light load (sq. ft): 1.00</td>
<td>Btuh: 83.00</td>
</tr>
<tr>
<td>Wind Effective Factor due to building height: 0.55</td>
<td>Equipment load (sq. ft): 0.12</td>
<td>Btuh/person: 90.00</td>
</tr>
<tr>
<td>Wind Effective Factor due to building height: 0.55</td>
<td>Effective Wind Speed at Window: 10.59</td>
<td>Top of stack opening type (air outlet): Top of Stack</td>
</tr>
</tbody>
</table>

**Formula:**  
\[
Btuh = \text{area} \times \text{light load} \times 3.41 
\]

**Total Peak Heat Gain:** 798.97 Btuh

#### Cross Ventilation:

Works with ambient temp of 83 degrees F

#### Forced Stack Ventilation:

Cools space when wind speeds inadequate  
Up to 83 degrees F

Air is drawn in from windows and exhausted through stack. A fan array proportionally activates based on how many spaces turn on their inlet fans.

### BEDROOMS:

**Type of space:** Residential  
**Location:** Hillsdale, OK  
**Month:** May, 21st  
**Thermostat Temp:** 85°F

#### STEP 1: INPUT DATA

<table>
<thead>
<tr>
<th>Location &amp; Climate:</th>
<th>Design:</th>
<th>Occupancy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside Air Temperature: 21.0°C</td>
<td>Area of space (in sq. ft): 260.00</td>
<td>Number of people: 1.00</td>
</tr>
<tr>
<td>Wind Speed at nearest rural: 38.0mph</td>
<td>Light load (sq. ft): 0.46</td>
<td>Btuh: 90.00</td>
</tr>
<tr>
<td>Wind Effective Factor due to building height: 0.55</td>
<td>Equipment load (sq. ft): 0.30</td>
<td>Btuh/person: 270.00</td>
</tr>
<tr>
<td>Wind Effective Factor due to building height: 0.55</td>
<td>Effective Wind Speed at Window: 10.59</td>
<td>Top of stack opening type (air outlet): Top of Stack</td>
</tr>
</tbody>
</table>

**Formula:**  
\[
Btuh = \text{area} \times \text{light load} \times 3.41 
\]

**Total Peak Heat Gain:** 1,470.00 Btuh

### Passive Cooling / Natural Ventilation

**Thermostat Temp:** 85°F

#### Ceiling Fan:

Operative Temp: 85°F

**Standard**

**Kitchen**

**Top of Stack**
Natural Ventilation / Sizing

**Hunter Aerodyne 52" Smart LED Indoor Ceiling Fan**

**Adjusted Thermal Comfort for Ceiling Fan: Low Speed**

**Thermal Comfort for No Ceiling Fan in Space**

**Adjusted Thermal Comfort for Ceiling Fan: High Speed**

---

**Table 1: Design Parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor area (sq. ft.)</td>
<td>1000</td>
</tr>
<tr>
<td>Ceiling height (feet)</td>
<td>8</td>
</tr>
<tr>
<td>Outside temperature</td>
<td>Lower than inside</td>
</tr>
<tr>
<td>Average height of space</td>
<td>8</td>
</tr>
<tr>
<td>Gross area of windows</td>
<td>200</td>
</tr>
<tr>
<td>Gross area of air inlet</td>
<td>100</td>
</tr>
<tr>
<td>Air speed</td>
<td>3.5 mph</td>
</tr>
<tr>
<td>CFM</td>
<td>120</td>
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</tbody>
</table>

**Table 2: Energy Calculations**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal efficiency factor</td>
<td>0.4</td>
</tr>
<tr>
<td>Fan efficiency factor</td>
<td>0.8</td>
</tr>
<tr>
<td>Efficiency of window type</td>
<td>0.7</td>
</tr>
<tr>
<td>Net effective area</td>
<td>30%</td>
</tr>
<tr>
<td>Btu/hr</td>
<td>3000</td>
</tr>
<tr>
<td>Btu/ft^2</td>
<td>3</td>
</tr>
<tr>
<td>Btu/ft^2/sq.ft</td>
<td>3</td>
</tr>
</tbody>
</table>

*Note 1: Actual area of windows must not be smaller than the calculated gross area of air inlet.*

---

**Figure 1: Correction factor for wind speed for height and context**

**Figure 2: Effectiveness open area of different window types**

Energy Recovery Ventilator Information

- Serves up to rooms up to 500 sq. ft
- Efficient supply and exhaust single-room ventilation up to 30 CFM.
- Silent Operation from 0.3 Sones
- ERV: 93% recovery efficiency
Daylight Analysis

Artificial Sky Dome

The Artificial Daylighting Dome was an integral component in designing an even level of illuminance distribution within the central living space. Several tests were examined to alter the form and window openings.

Daylight Analysis

Multi-Purpose Hall, Stillwater, OK, 36° NL

Assumptions

Type of space: Sports Facility

Potential annual energy savings (all seasons) 94.56%
Potential annual energy savings (excluding summer) 82.76%

Illuminance Distribution @ Solar Noon

Summary for the four seasons

Potential saving is calculated under overcast sky conditions

Summary

Type of space: Sports Facility

Daylight Analysis

Multi-Purpose Hall, Stillwater, OK, 36° NL

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Illuminance Distribution @ Solar Noon

Summary for the four seasons

Potential saving is calculated under overcast sky conditions

Summary

Type of space: Sports Facility

Potential annual energy savings (all seasons) 94.56%
Potential annual energy savings (excluding summer) 82.76%
## Summarized Model Inputs

<table>
<thead>
<tr>
<th>Energy Demand</th>
<th>Total kWh</th>
<th>Heating Demand</th>
<th>9083</th>
<th>2606</th>
<th>11689</th>
<th>4496</th>
<th>1328</th>
<th>5824</th>
<th>3665</th>
<th>11461</th>
<th>11612</th>
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</thead>
<tbody>
<tr>
<td>Heating E Demand</td>
<td>17479</td>
<td>4469</td>
<td>1328</td>
<td>5824</td>
<td>441</td>
<td>70</td>
<td>511</td>
<td>7973</td>
<td>3639</td>
<td>11612</td>
<td></td>
</tr>
<tr>
<td>Cooling E Demand</td>
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<td>880</td>
<td>3207</td>
<td>2770</td>
<td>1099</td>
<td>474</td>
<td>1573</td>
<td>1140</td>
<td>466</td>
<td>1606</td>
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<tr>
<td>Hot Water E Demand</td>
<td>3938</td>
<td>1666</td>
<td>5604</td>
<td>3938</td>
<td>1666</td>
<td>5604</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Lights + Appliances E Demand</td>
<td>6371</td>
<td>3243</td>
<td>9614</td>
<td>7076</td>
<td>3461</td>
<td>10537</td>
<td>6256</td>
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<td>9378</td>
<td>6256</td>
<td>3122</td>
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<tr>
<td>Renewables</td>
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<tr>
<td>Photovoltaic Panels</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
<td>7 kw DC system (22 panels)</td>
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<td>Heating</td>
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<tr>
<td>Furnace</td>
<td>7.7</td>
<td>9.2</td>
<td>15.8</td>
<td>15.8</td>
<td></td>
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<tr>
<td>Heating Efficiency - HSPF</td>
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<td>Cooling</td>
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<tr>
<td>Cooling Efficiency - SEER</td>
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<tr>
<td>Tank Size (gallons)</td>
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<td></td>
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<tr>
<td>Ventilation</td>
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<tr>
<td>Infiltration Only</td>
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<td>36</td>
<td>151</td>
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<td>36</td>
<td>162</td>
<td>126</td>
<td>36</td>
<td>162</td>
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<tr>
<td>Ventilation (cfm)</td>
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<tr>
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<td>R-62</td>
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**HERS Reference**

Before PV = 9.64 | After PV = -2.81

**Site EUI**

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<th>Model 4</th>
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**Ekotrope**

Open Studio

Model 1 Model 2 Model 3 Model 4 Model 5

7 kw DC system (22 panels)

- Ekotrope
- Model 1
- Model 2
- Model 3
- Model 4
- Model 5

Energy Demand

Before PV = 8540 | After PV = -2489

Before PV = 9.64 | After PV = -2.81

**Renewables**

- Photovoltaic Panels
- -
- 7 kw DC system (22 panels)
Energy source = Energy site \times Conversion Factor_{site to source}

\[ E_{source, \ Final} = 11,541 \text{ kWh/yr} \times 2.21 = 25,506 \text{ kWh/yr} \]

\[ E_{source, \ Final} = 8,540 \text{ kWh/yr} \times 2.21 = 18,874 \text{ kWh/yr} \]
HERS Ratings

**HERS® Index Score:** Your home's HERS score is a relative performance score. The lower the number, the more energy efficient the home. To learn more, visit www.HERSIndex.com.

**Your Home’s Estimated Energy Use:**

<table>
<thead>
<tr>
<th>Use (MMdf)</th>
<th>Cost ($)</th>
<th>Annual Cost ($)</th>
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<tr>
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**Annual Savings:** $3,749

**This home meets or exceeds the criteria of the following:**

2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

**Your Home’s Estimated Energy Use:**

<table>
<thead>
<tr>
<th>Use (MMdf)</th>
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<th>Annual Cost ($)</th>
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<tr>
<td>Heating</td>
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**Annual Savings:** $1,275

**This home meets or exceeds the criteria of the following:**

2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

**Your Home’s Estimated Energy Use:**

<table>
<thead>
<tr>
<th>Use (MMdf)</th>
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</thead>
<tbody>
<tr>
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<tr>
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**Annual Savings:** $4,885

**This home meets or exceeds the criteria of the following:**

2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

**Your Home’s Estimated Energy Use:**

<table>
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<tr>
<th>Use (MMdf)</th>
<th>Cost ($)</th>
<th>Annual Cost ($)</th>
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<tr>
<td>Heating</td>
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**Annual Savings:** $1,696

**This home meets or exceeds the criteria of the following:**

2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

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<table>
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<th>Use (MMdf)</th>
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**Annual Savings:** $4,885

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2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

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**Annual Savings:** $1,696

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**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

**Your Home’s Estimated Energy Use:**

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**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC

**HERS® Index Score:**

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**Annual Savings:** $4,885

**This home meets or exceeds the criteria of the following:**

2013 International Energy Conservation Code

**Rating Completed by:**

Energy Rater: Holly Holcomb
Ratings Company: CRI SOC
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**EUI Performance Summary**