West CAP’s Residential Renewable Energy and Conservation Program

- **MISSION**: To use energy efficiency techniques and alternative energy systems with low-income housing rehab in order to significantly reduce fossil fuel use and carbon emissions.

- **OVERALL POLICY GOAL**: To inform policy by demonstrating innovative energy-saving strategies for homes in West CAP’s NSP, HOME-buyer, HOME-Rehab, and Weatherization programs, and West CAP managed rental units.
Main Strategies:

- #1 Reduce Energy Load SIGNIFICANTLY.

- #2 Source as much of that energy load as possible from renewable, carbon neutral sources.
Deep Energy Reduction PROCESS
**ENERGY STAR HOME REPORT**

**Date:** November 29, 2009  
**Rating No.:** 123-0107

**Building Name:** 123-0107  
**Owner's Name:** WestCap  
**Property:** E4043 550th Ave  
**Address:** Menomonie, WI 54751  
**Builder's Name:**  
**Weather Site:** Eau Claire, WI  
**File Name:** 123-0107 Upgraded bg  
**Rating Org.:** Holcombe Enterprises  
**Phone No.:** 715-595-6461  
**Rater's Name:** Les Pintok  
**Rater's No.:** 123  
**Rating Type:** Post Improvement  
**Rating Date:** 11/21/2009

### Normalized, Modified End-Use Loads (MMBtu/year)

<table>
<thead>
<tr>
<th>Type</th>
<th>ENERGY STAR</th>
<th>As Designed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>40.5</td>
<td>16.3</td>
</tr>
<tr>
<td>Cooling</td>
<td>7.4</td>
<td>3.0</td>
</tr>
<tr>
<td>Water heating</td>
<td>12.3</td>
<td>3.0</td>
</tr>
<tr>
<td>Lighting &amp; Appliances</td>
<td>18.2</td>
<td>25.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>78.4</td>
<td>47.5</td>
</tr>
<tr>
<td><strong>HERS Index</strong></td>
<td>80</td>
<td>49</td>
</tr>
</tbody>
</table>

**ENERGY STAR Mandatory Requirements**

- [X] Thermal Bypass Inspection Checklist *  
- [X] ENERGY STAR Products *  
- [X] Ductwork Requirements  
- [X] ENERGY STAR Scoring Exceptions

* Thermal Bypass Checklist and ENERGY STAR Products are not checked in REMRate at this time.

**This home MEETS OR EXCEEDS the energy efficiency requirements for designation as an EPA ENERGY STAR Qualified Home.**

<table>
<thead>
<tr>
<th>Type of Emissions</th>
<th>Reduction</th>
<th>Heating</th>
<th>Energy Cost Savings ($) (year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon Dioxide (CO2) - tons/yr</td>
<td>11.3</td>
<td>Heating: $101</td>
<td></td>
</tr>
<tr>
<td>Sulfur Dioxide (SO2) - lbs/yr</td>
<td>81.2</td>
<td>Cooling: $7</td>
<td></td>
</tr>
<tr>
<td>Nitrogen Oxides (NOx) - lbs/yr</td>
<td>31.9</td>
<td>Water Heating: $45</td>
<td></td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td>Lights &amp; Appliances: $8</td>
<td></td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td></td>
<td><strong>$145</strong></td>
<td></td>
</tr>
</tbody>
</table>

The energy savings and pollution prevented are calculated by comparing the Rated Home to the Reference Home as defined in the "Mortgage Industry National Home Energy Rating Systems Standards" as promulgated by the Residential Energy Services Network (RESNET). In accordance with these guidelines, building inputs affecting setpoints, infiltration rates, window shading and the existence of mechanical systems may have been changed prior to calculating loads.

REMRate - Residential Energy Analysis and Rating Software v12.71 Wisconsin

This information does not constitute any warranty of energy cost or savings.

Indoor Air Quality

HRV/ERV system
MODELS P, T AND S

Fresh Air from Outside
Heat or Energy Recovery core
Exhaust Air to Outside

ISF™ 6” (dia.) collar system

Exhaust Air from Home
Fresh air to home
Solar Access

Annual: 94%
May-Oct: 98%
Nov-Apr: 87%

Monthly solar access (Tilt=30°; Azim=180°)

- Jan: 78%
- Feb: 88%
- Mar: 93%
- Apr: 99%
- May: 99%
- Jun: 99%
- Jul: 98%
- Aug: 95%
- Sep: 97%
- Oct: 82%
- Nov: 68%
- Dec: 50%

Data by Solmetric SunEye™ -- www.solmetric.com
Remote Wall

REMOTE Detail: Foundation

- Structural sheathing
- Siding Material
- 1 or 2 layers of rigid foam
- Furring attached with screws to studs
- Self-adhering membrane or other air/vapor barrier
- Metal flashing
- Grade
- 40 to 60 mil. self adhering membrane (Bituthane or equivalent)
- Polyethylene vapor & gas barrier
- Footing
- 2x4 stud wall
- Gypsum wall board
- Insulation optional
- 2x4 sill
- 3/4” underlayment
- Floor joist
- Treated wood sill
- ICF Foundation Wall
- Sealant (Continuous bead to seal vapor barriers)
The dew point is the temperature at which water vapor condenses and turns to liquid water or frost.
R-0 Wall Temperatures

**Outdoor Temp:** 0°F (all examples)

**Indoor Temp:** 70°F

**Wall Type: R-0**

Wood Frame, 2x4 @ 16" OC

½" OSB & Sheetrock

R-Total: 3.0 (U = 0.3359)
Wall Type: R-19
Wood Frame, 2x6 @ 24" OC
R-19 Fiberglass (6” R-19 compressed into 5.5” cavity
½” OSB & Sheetrock
R-Total: 17.8 (U = 0.0561)
R-13+5 Wall Temperatures

Wall Type: R-13+5
Wood Frame, 2x4 @ 16" OC
R-13 Fiberglass, R-5 Rigid
½" OSB & Sheetrock

R-Total: 17.8 (U = 0.0561)
Massive Amounts of Exterior Insulation!
Super Insulation R20-R40-R60

• Reduce Heating System Size Significantly
• New Air Barrier Opportunity
• Noise Pollution
• Moderates Wall Temperature
• Buffer Against Power Outages
Solar Domestic Hot Water
Solar Hot Water
Solar water heater

Unit characteristics
- Swimming pool
- Hot water

<table>
<thead>
<tr>
<th>Unit</th>
<th>Base case</th>
<th>Proposed case</th>
</tr>
</thead>
<tbody>
<tr>
<td>Occupant</td>
<td>House</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>gal/d</td>
<td>63</td>
<td>63</td>
</tr>
<tr>
<td>&quot;F</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>d</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

Month used
- Temperature method
  - "F: 33.8
  - "F: 53.8

Energy assessment
- Heating mode
  - Fixed
  - 45.0
  - 0.0

Solar heater
- Type: Glazed
- Bubbling Springs Solar
  - Main Stream MS 32

<table>
<thead>
<tr>
<th>Area per solar collector</th>
<th>ft²</th>
<th>29.93</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Btu/h)/ft²/F°F</td>
<td>0.90</td>
<td></td>
</tr>
<tr>
<td>(Btu/h)/ft²/F°F²</td>
<td>0.000</td>
<td>2</td>
</tr>
<tr>
<td>ft²</td>
<td>64.05</td>
<td></td>
</tr>
<tr>
<td>kW</td>
<td>3.89</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>2.0%</td>
<td></td>
</tr>
</tbody>
</table>

System & miscellaneous
- Yes
Solar Electric
Grid-Connected Solar Electric
**Billing Summary**

<table>
<thead>
<tr>
<th>Account Number</th>
<th>Date Due</th>
<th>Amount Enclosed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>09/23/2010</td>
<td>Do Not Return</td>
</tr>
</tbody>
</table>

**Residential**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Previous Balance 06/25</td>
<td>$0.00</td>
</tr>
<tr>
<td>No Payment Through 09/02</td>
<td>$0.00</td>
</tr>
<tr>
<td>Balance As Of 09/02</td>
<td>$0.00</td>
</tr>
<tr>
<td>Total</td>
<td>$354.62 CR</td>
</tr>
</tbody>
</table>

**Averages for Billing Period**

<table>
<thead>
<tr>
<th>Description</th>
<th>This Year</th>
<th>Last Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Temperature</td>
<td>74°</td>
<td>67°</td>
</tr>
<tr>
<td>Electric/kwh per Day</td>
<td>0.4</td>
<td>0.0</td>
</tr>
<tr>
<td>Cost per Day</td>
<td>$5.21 CR</td>
<td>$0.00</td>
</tr>
</tbody>
</table>
Solar Hot Air
RREAL Solar Hot Air Panels
Off-Peak Thermal Storage Heating
Peak Rate for Solar Production
Geothermal

Closed Loop Systems
Horizontal
Pre-temper fresh air on HRV/ERV
“Fresh Air Furnace”
Direct Exchange—No Refrigerant
Wood Heating
NSP Project: Menomonie, Wisconsin
Duplex Heating/Cooling/Hot Water

- **Base Load Before Insulation and upgrades:** 120 MMBtu/annually
- **Hot Water Load Offset from the Sun:** 20 MMBtu/annually
- **Heating/Cooling Load After Insulation:** 71.2 MMBtu/annually
- **Heating/Cooling Offset from the Earth:** 26.6 MMBtu/annually
- **Heating/Cooling Offset from the Sun:** 45 MMBtu/annually

**NEW Heating/Cooling/Hot Water Load for Duplex:** -0.4 MMBtu/annually
Net Mortgage

- Duplex Cost and Rehabilitation: $150,000
  30 year, fixed rate mortgage at 4.5% would be a mortgage of $760 per month per side

Deduct Energy Bills:

$200 per month is subtracted, the “net mortgage” comes to $560, a reasonable monthly mortgage payment for a four bedroom, two bath duplex half.
NSP Project: Glenwood City, WI
Air-Source Heat Pump
Harness BTU’s in Surrounding Environment for Heating and Cooling
NSP Project: Connorsville, WI
2kW PV System offsets
7mmBtu/Year
=21mmBtu Source Energy.

### Source Energy Consumption (MMBtu/year)

<table>
<thead>
<tr>
<th></th>
<th>All Electric</th>
<th></th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reference Home</td>
<td>As Designed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heating:</td>
<td>110.2</td>
<td>57.3</td>
<td>-52.9</td>
<td>-48.0%</td>
</tr>
<tr>
<td>Cooling:</td>
<td>10.4</td>
<td>3.2</td>
<td>-7.2</td>
<td>-69.1%</td>
</tr>
<tr>
<td>Water heating:</td>
<td>20.6</td>
<td>19.0</td>
<td>-1.6</td>
<td>-7.7%</td>
</tr>
<tr>
<td>Lights &amp; Appliances:</td>
<td>74.8</td>
<td>68.7</td>
<td>-6.1</td>
<td>-8.1%</td>
</tr>
<tr>
<td>Photovoltaics:</td>
<td>0.0</td>
<td>0.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total:</td>
<td>216.1</td>
<td>148.4</td>
<td>-67.7</td>
<td>-31.4%</td>
</tr>
</tbody>
</table>

### Total Emissions

<table>
<thead>
<tr>
<th>Type of Emissions</th>
<th>All Electric</th>
<th></th>
<th>Difference</th>
<th>% Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Reference Home</td>
<td>As Designed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon Dioxide (CO2) - tons/year</td>
<td>14.3</td>
<td>10.0</td>
<td>-4.3</td>
<td>-30.1%</td>
</tr>
<tr>
<td>Sulfur Dioxide (SO2) - lbs/year</td>
<td>69.0</td>
<td>52.3</td>
<td>-16.7</td>
<td>-24.2%</td>
</tr>
<tr>
<td>Nitrogen Oxides (NOx) - lbs/year</td>
<td>38.8</td>
<td>27.3</td>
<td>-11.5</td>
<td>-29.6%</td>
</tr>
</tbody>
</table>
NSP Project: New Richmond, WI
vanguard Window
Frame: Vinyl Extruded with UltraCore
Panes: 3 Glaz, Triple Glaze, 9/16 AR
Product Type: Horizontal Slider Window

ENERGY PERFORMANCE RATINGS

<table>
<thead>
<tr>
<th></th>
<th>U - Factor (U.S.A. - P)</th>
<th>Solar Heat Gain Coefficient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.18</td>
<td>0.22</td>
</tr>
</tbody>
</table>

ADDITIONAL PERFORMANCE RATINGS

<table>
<thead>
<tr>
<th></th>
<th>Air Leakage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visible Transmittance</td>
<td>0.42</td>
</tr>
</tbody>
</table>

ENERGY STAR® Qualified
In All 50 States
Heat Pump Water Heater
• Home Features: Menomonie, WI
• Total Square Feet: 1300, Slab on Grade, 3 bedroom/2 bath
• Superinsulated house: R20 under slab, R40 Walls R60 Ceiling
• Heating/cooling:
  1) Carrier Infinity Air-Source heat pump
  2) Earth loop system for pre tempering fresh air brought into house for ventilation
  3) 92% efficient Heat Recovery Ventilation
• Siding: Seamless Steel
• Roofing: Raised-Seam Steel
• Solar: 2-panel hot water system
• 3 kilowatt solar electric system
• Passive Solar: Aim for 30% window to wall ratio on South Side
Resources

- CCHRC.org
- Buildingscience.com
- Greenbuildingadvisor.com
- Passivehouse.us
- Thousandhomechallenge.org
- Affordablecomfort.org

Contact: mschmidt@wcap.org