

# 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	Rating Org.:	Holcombe Enterprises
Owner's Name:	WestCap	Phone No.:	715-585-6461
Property:	E4043 550th Ave	Rater's Name:	Les Pintok
Address:	Menomonie, WI 54751	Rater's No.:	123
Builder's Name:			
Weather Site:	Eau Claire, WI	Rating Type:	Post Improvement
File Name:	123-0107 Upgraded big	Rating Date:	11/21/2009

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

	ENERGY STAR	As Designed
Heating:	40.5	16.3
Cooling:	7.4	3.0
Water heating:	12.3	3.0
Lighting & Appliances:	18.2	25.2
Total:	78.4	47.5
<b>HERS Index:</b>	<b>80</b>	<b>49</b>

ENERGY STAR Mandatory Requirements

- |   |  |
|---|--|
| <input checked="" type="checkbox"/> Thermal Bypass Inspection Checklist * | <input checked="" type="checkbox"/> ENERGY STAR Products *         |
| <input checked="" type="checkbox"/> Ductwork Requirements                 | <input checked="" type="checkbox"/> ENERGY STAR Scoring Exceptions |

\* Thermal Bypass Checklist and ENERGY STAR Products are not checked in REM/Rate at this time.

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

Pollution Prevented

Type of Emissions  
 Carbon Dioxide (CO2) - tons/yr  
 Sulfur Dioxide (SO2) - lbs/yr  
 Nitrogen Oxides (NOx) - lbs/yr

Reduction  
 11.3  
 81.2  
 31.9

Energy Cost Savings (\$/year)

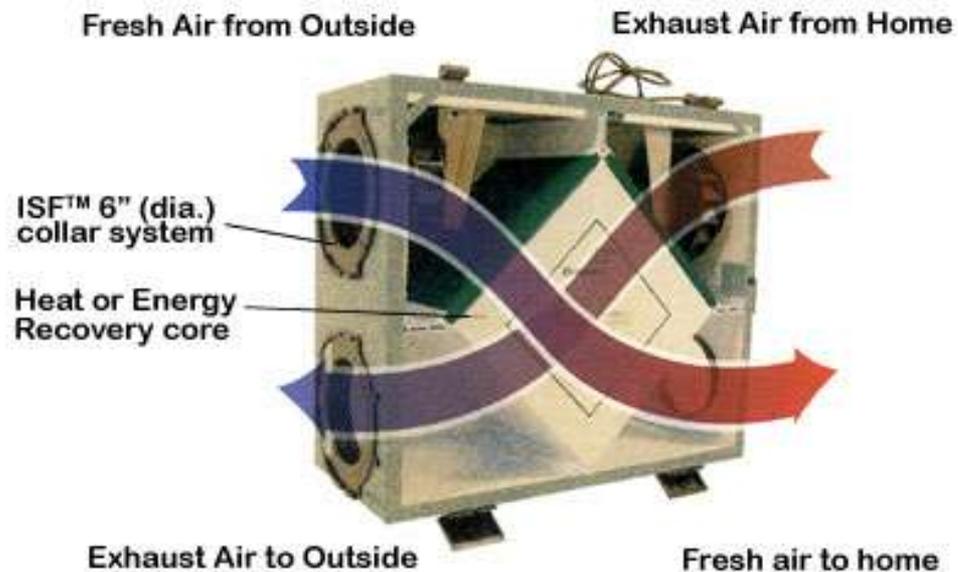
Heating: \$101  
 Cooling: \$7  
 Water Heating: \$45  
 Lights & Appliances: \$-8  
 Total: \$145

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.

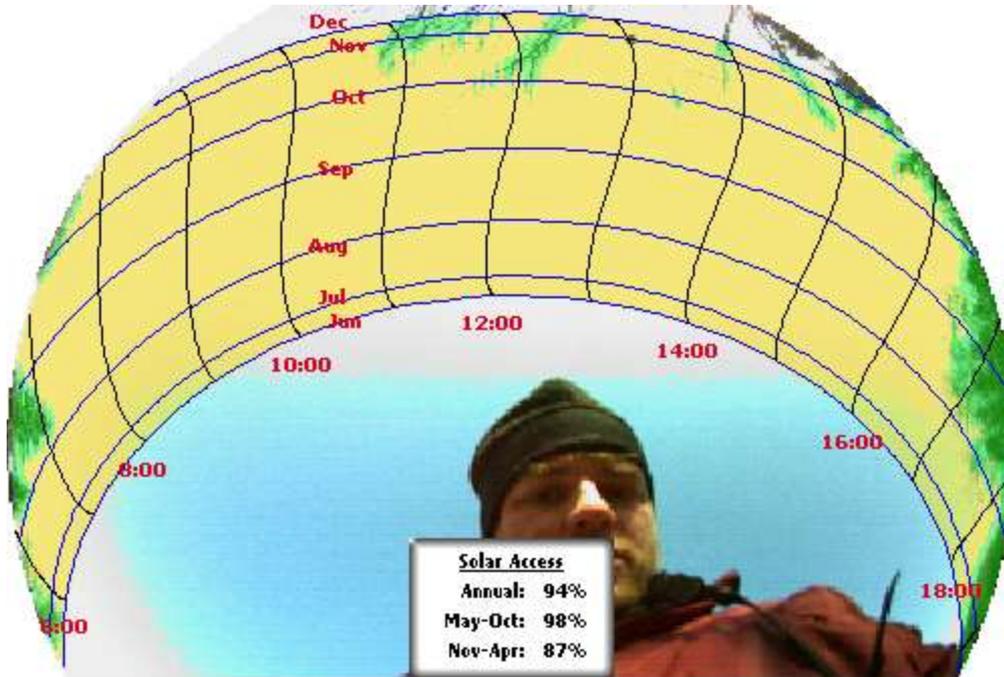
# Indoor Air Quality

## HRV/ERV system MODELS P, T AND S

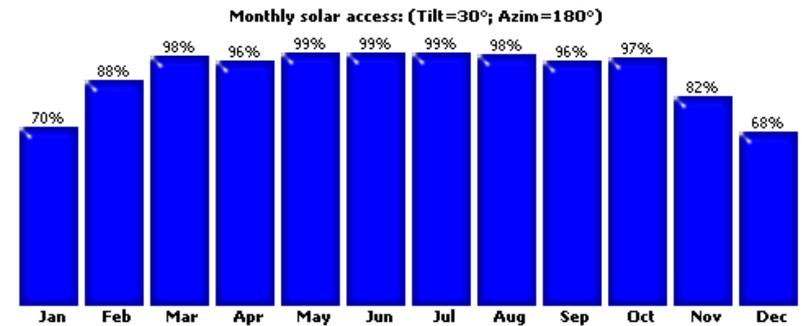
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# Solar Access

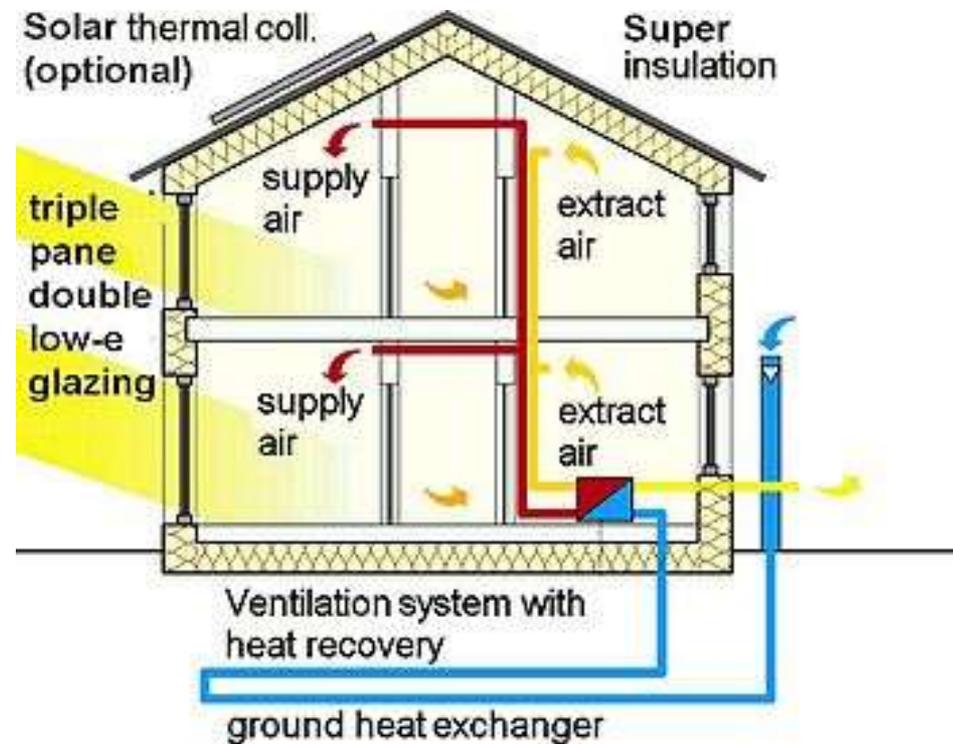


Data by Solmetric SunEye™ -- [www.solmetric.com](http://www.solmetric.com)



Data by Solmetric SunEye™ -- [www.solmetric.com](http://www.solmetric.com)

# Passive House Institute US

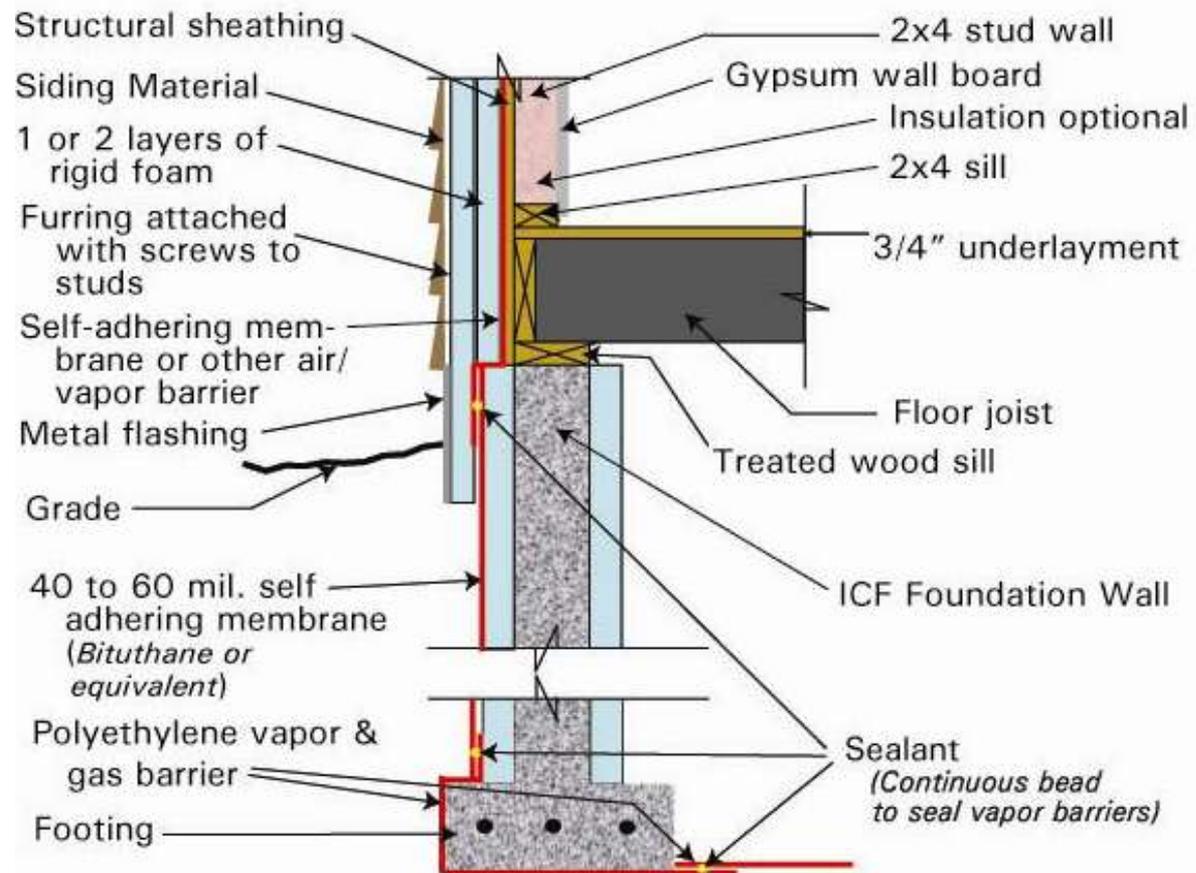


# Cold Climate Housing Research Center--Fairbanks, AK ([cchrc.org](http://cchrc.org))



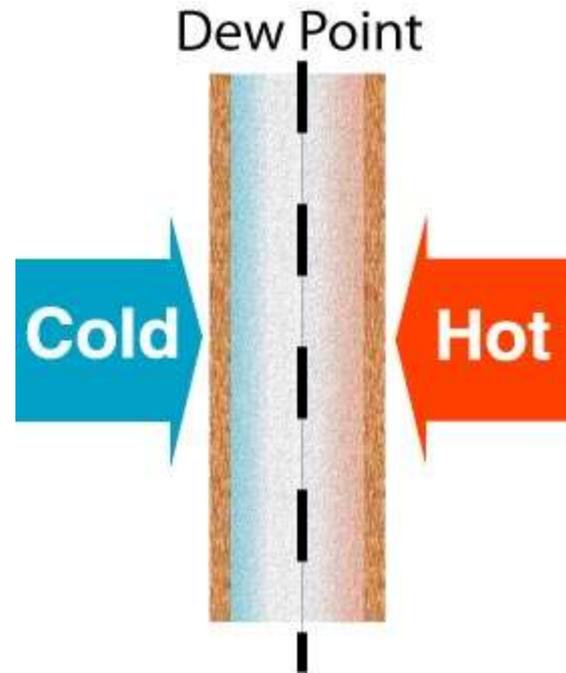
# Remote Wall

## REMOTE Detail: Foundation



**Ross DePaola:** Integrated Energy Services/WESTLab

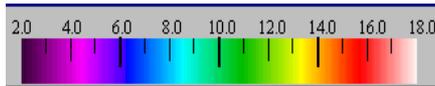
## Wall Temperature Study



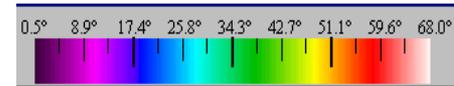
The dew point is the temperature at which water vapor condenses and turns to liquid water or frost.

# R-0 Wall Temperatures

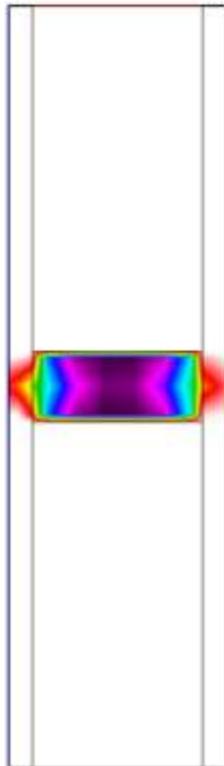
Color Flux (heat flow: Btu/hr-ft<sup>2</sup>)



Temperature (°F)



Outdoor  
Temp:  
0°F  
(all examples)



**Wall Type: R-0**

Wood Frame, 2x4 @ 16" OC

½" OSB & Sheetrock

**R-Total: 3.0 (U = 0.3359)**

Indoor  
Temp:

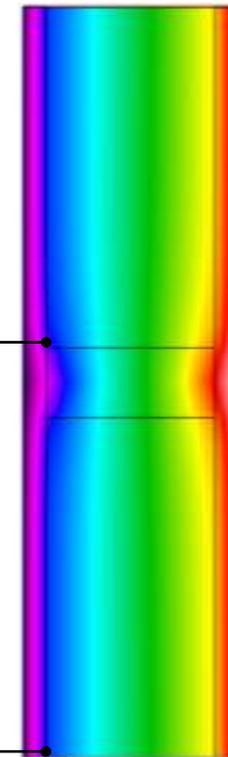
**70°F**

55.6°F

15.8°F

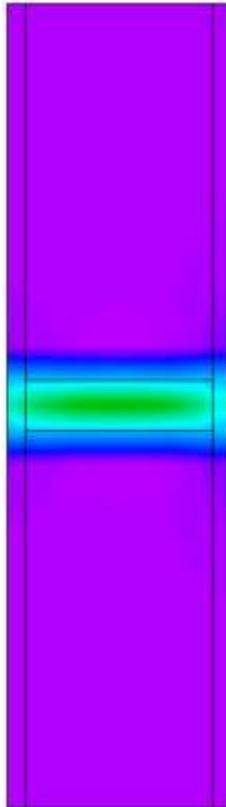
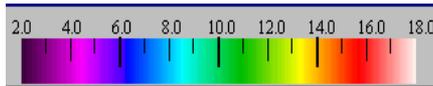
18.3°F

51.9°F



# R-19-24oc Wall Temperatures

Color Flux (heat flow: Btu/hr-ft<sup>2</sup>)



## Wall Type: R-19

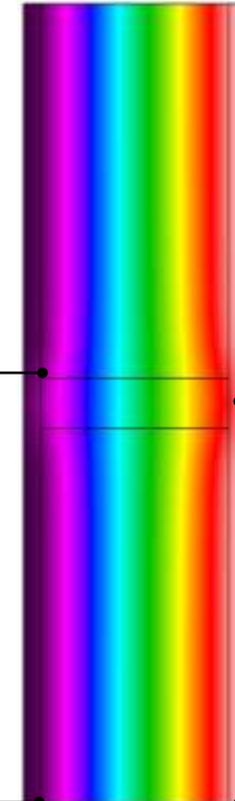
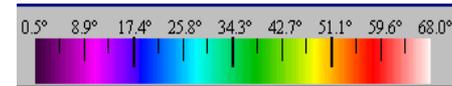
Wood Frame, 2x6 @ 24" OC

R-19 Fiberglass (6" R-19  
compressed into 5.5" cavity)

½" OSB & Sheetrock

R-Total: 17.8 (U = 0.0561)

Temperature (°F)



4.5°F

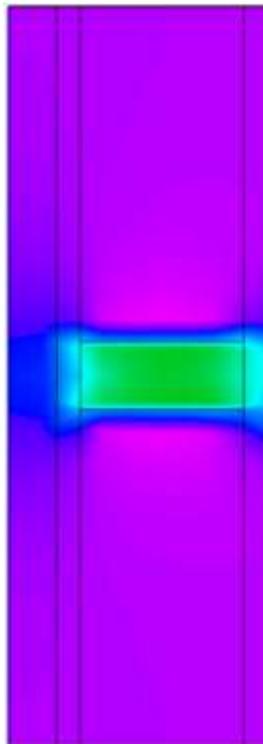
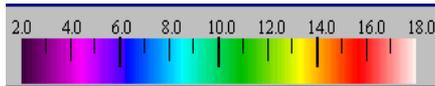
64.6°F

2.3°F

67.1°F

# R-13+5 Wall Temperatures

Color Flux (heat flow: Btu/hr-ft<sup>2</sup>)



## Wall Type: R-13+5

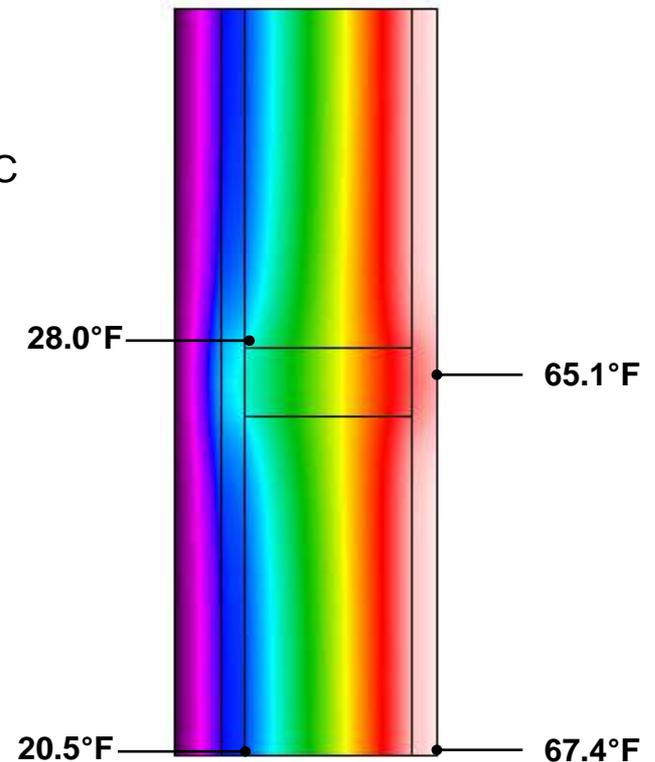
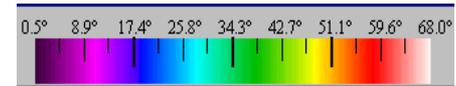
Wood Frame, 2x4 @ 16" OC

R-13 Fiberglass, R-5 Rigid

½" OSB & Sheetrock

R-Total: 17.8 (U = 0.0561)

Temperature (°F)



# 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









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Tyve  
Home

ONT  
Ty  
tom





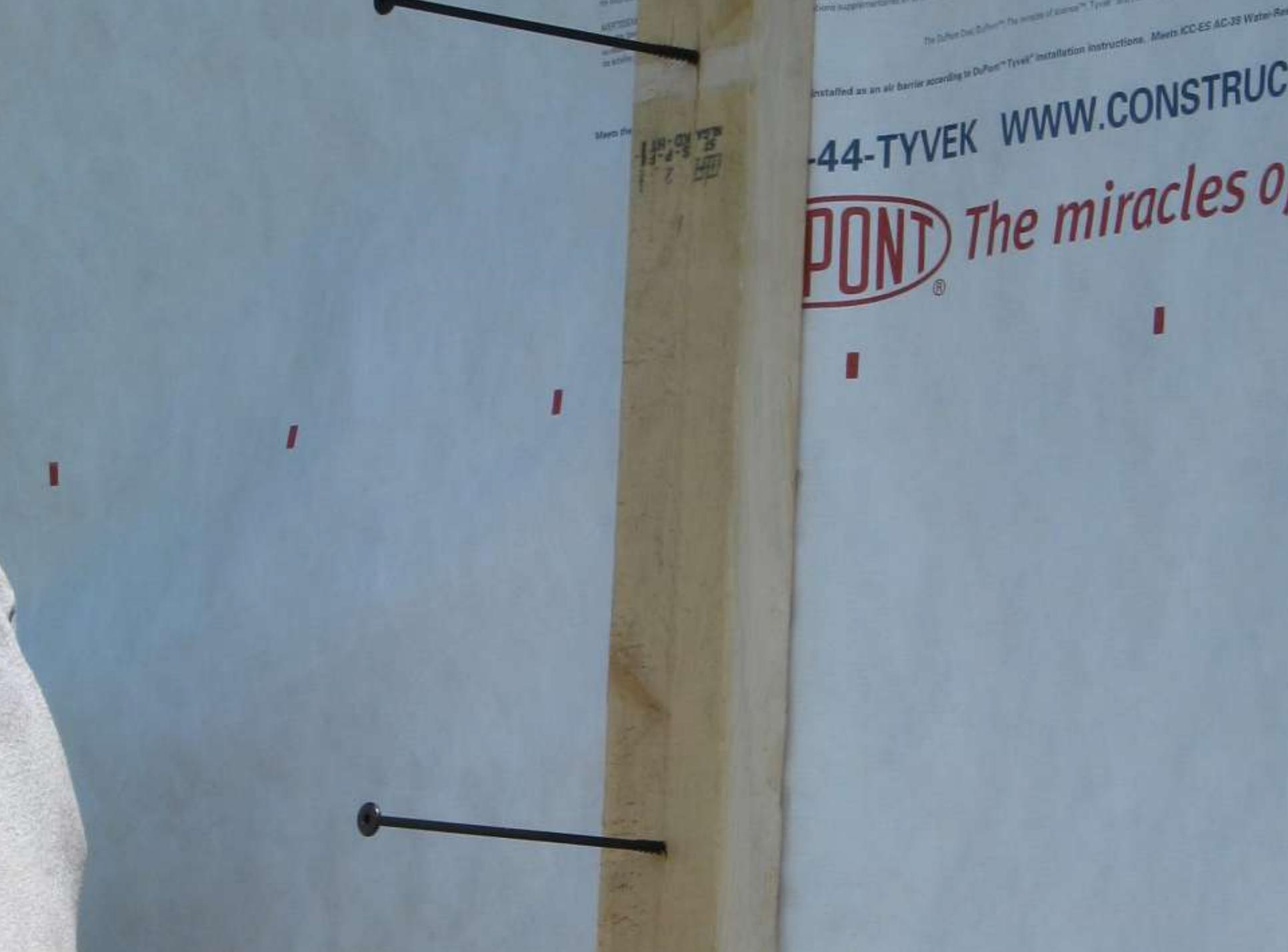


11-01-01  
S  
5-2-8-1  
2

Some supplemental...  
The DuPont Dac...  
installed as an air barrier according to DuPont Tyvek® installation instructions. Meets ICC-ES AC-95 Water-Resistive Barrier (WRB) Requirements.

44-TYVEK WWW.CONSTRUC

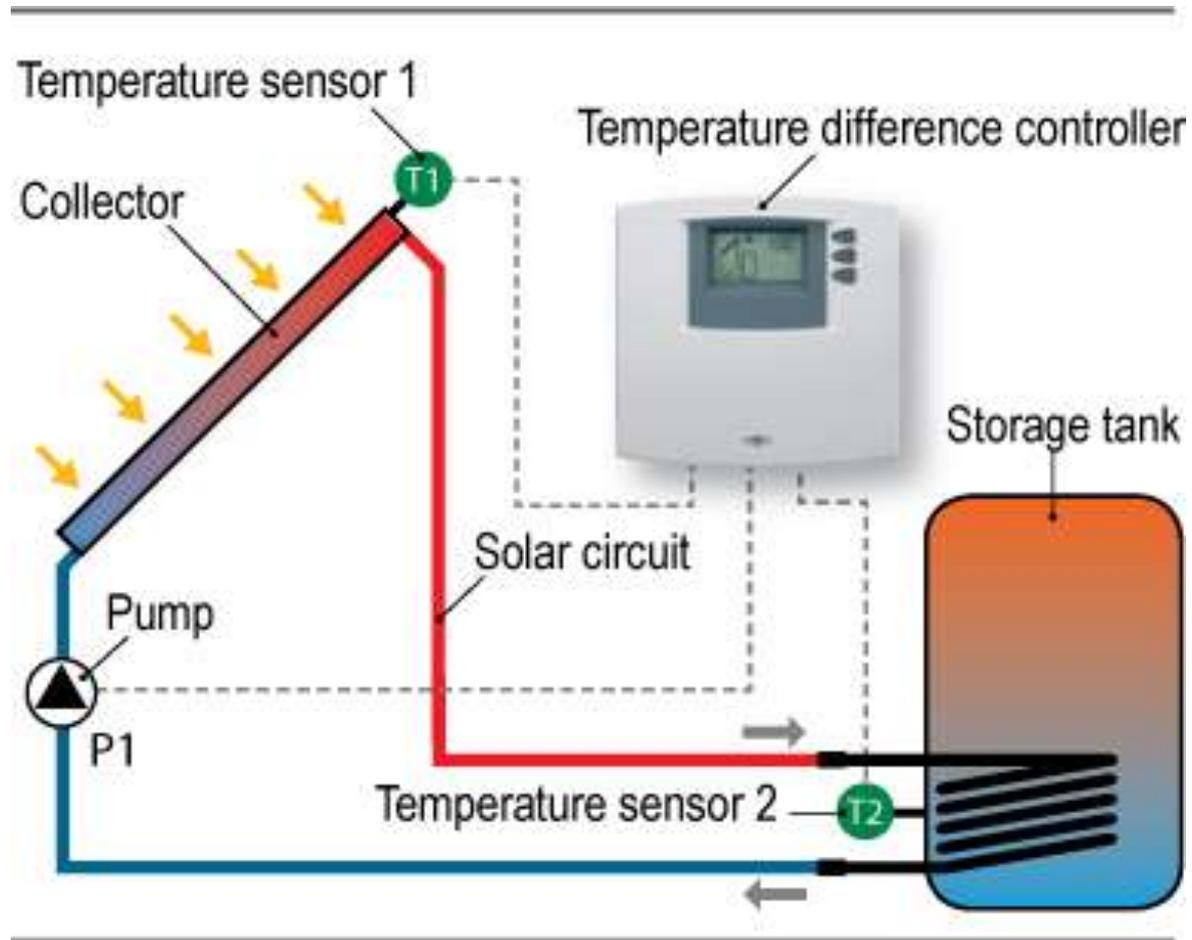
**DUPONT**® *The miracles of*



# Solar Domestic Hot Water



# Solar Hot Water



# Retscreen.net



Solar water heater

- Swimming pool
- Hot water

Unit	Base case	Proposed case
Occupant	House	
%	4	
gal/d	100%	
gal/d	63	63
*F	120	120
d	7	7

Unit	Base case	Proposed case
Temperature method	Formula	
Temperature - minimum	33.8	
Temperature - maximum	53.8	

Unit	Base case	Proposed case	Energy saved	Incremental Initial costs
million Btu	14.6	14.6	0%	

Operating mode	Fixed
	45.0
	0.0

Collector type	Glazed	
Manufacturer	Bubbling Springs Solar	
Model	Main Stream MS 32	
Area per solar collector	ft <sup>2</sup>	32.02
Area per solar collector	ft <sup>2</sup>	29.93
(U <sub>a</sub> ) coefficient		0.71
Efficiency coefficient	(Btu/h)/ft <sup>2</sup> /°F	0.90
Performance coefficient for Fr UL	(Btu/h)/ft <sup>2</sup> /°F <sup>2</sup>	0.000
Number of collectors		2
Collector area	ft <sup>2</sup>	64.05
Collector capacity	kW	3.89
Collector losses	%	2.0%

[See technical note](#)  
[See product database](#)

Other system & miscellaneous	Yes
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	tCO2	0.8
	tCO2	0.3
mission reduction	tCO2	0.6
fee	%	<input type="text"/>
ion reduction	tCO2	0.6
	\$/tCO2	<input type="text"/>

is equivalent to 0.6

	%	<input type="text" value="6.0%"/>
	yr	<input type="text" value="40"/>
	%	<input type="text"/>

	\$	0	0.0%
	\$	<input type="text" value="8,400"/>	100.0%
	\$	8,400	100.0%

	\$	<input type="text" value="2,500"/>	29.8%
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payments

	\$	<input type="text" value="30"/>
--	----	---------------------------------

	\$	134
--	----	-----

	\$	<input type="text"/>
--	----	----------------------

	\$	164
--	----	-----

income

	\$	428
--	----	-----

	\$	<input type="text"/>
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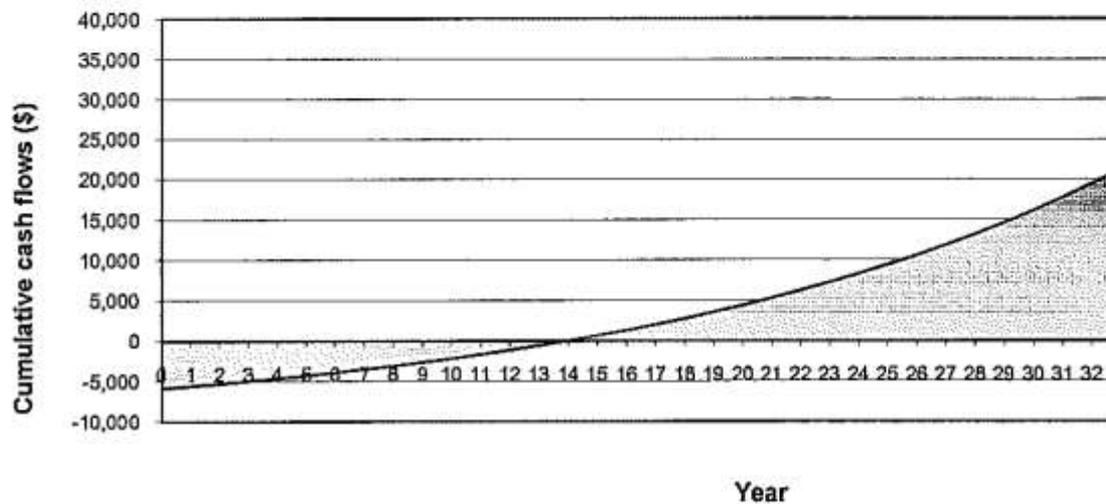
nd income	\$	428
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	%	9.4%
--	---	------

	yr	22.4
--	----	------

	yr	14.1
--	----	------

Cumulative cash flows graph







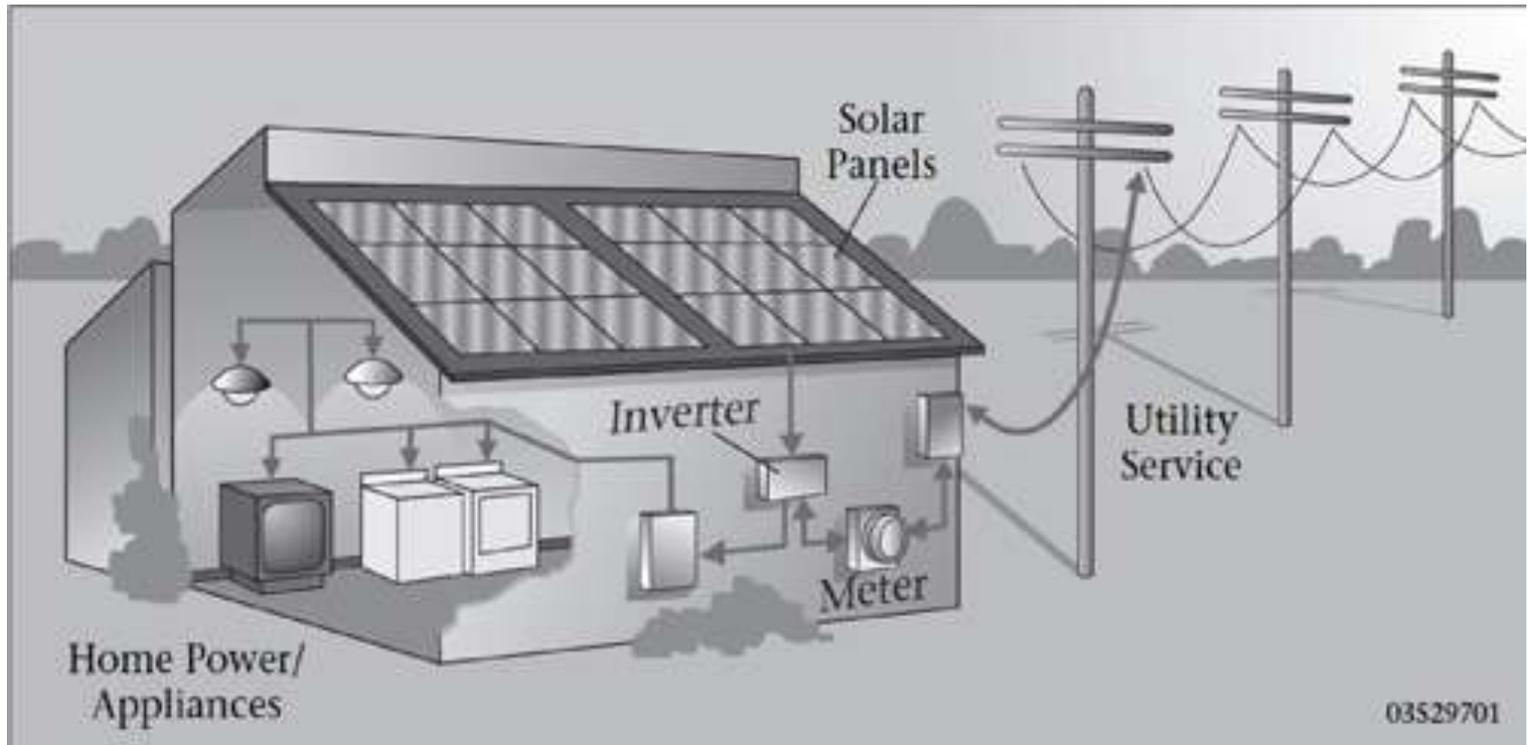




# Solar Electric



# Grid-Connected Solar Electric





**Northern States Power Company**

Please Return This Portion With Your Payment.

Your Account Number	Date Due	Please Pay	Amount Enclosed
[REDACTED]	09/23/2010	\$354.62 CR Thank You!	Do Not Return

AT 01 010285 59701E 36 A\*\*3DGT



WEST CAP  
PO BOX 308  
GLENWOOD CITY WI 54013-0308

P.O. BOX 9477  
MPLS, MN 55484-9477

520923104959980714\*0000035462\*0000035462

Detach and Retain This Portion For Your Records

**Questions: Call 24 Hours 7 Days A Week**

Please Call: (800) 895-4999 Fax: (800) 895-2895  
Hearing Impaired: (800) 895-4949 (800) 895-2895  
Español: (800) 687-8778

or write to us at:  
Northern States Power Company  
PO BOX 8  
EAU CLAIRE WI 54702-0008

Tired of writing checks? Sign up for PaySmart! Call Xcel Energy at 1-800-895-4999 or visit us at [www.xcelenergy.com](http://www.xcelenergy.com) for more info.

**Billing Summary**

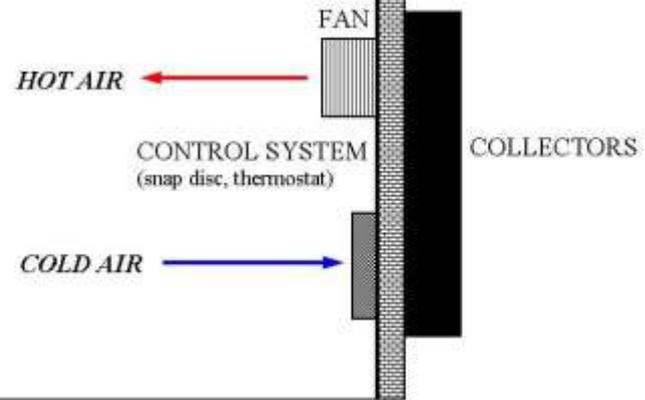
<b>Residential</b>	
Previous Balance 06/25	\$0.00
No Payment Through 09/02	\$0.00
Balance As Of 09/02	\$0.00
<b>Total</b>	<b>\$354.62 CR</b>

Averages for Billing Period	This Year	Last Year
Average Temperature	74*	67
Electric/kwh per Day	0.4	0.0
Cost per Day	\$5.21 CR	\$0.00

# Solar Hot Air

Basic Solar Air Heat Operation

Your House



# RREAL Solar Hot Air Panels



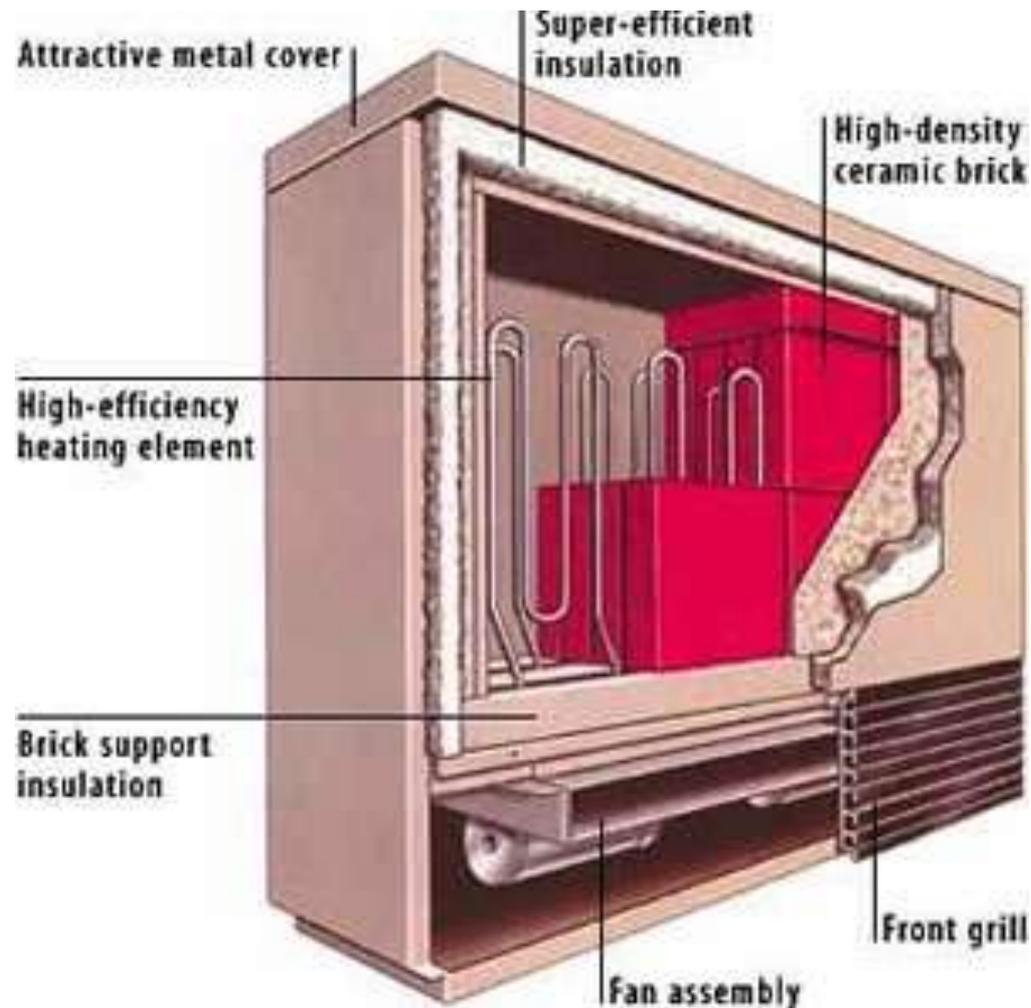
# Solar Hot Air



# Solar Hot Air



# Off-Peak Thermal Storage Heating



# Peak Rate for Solar Production



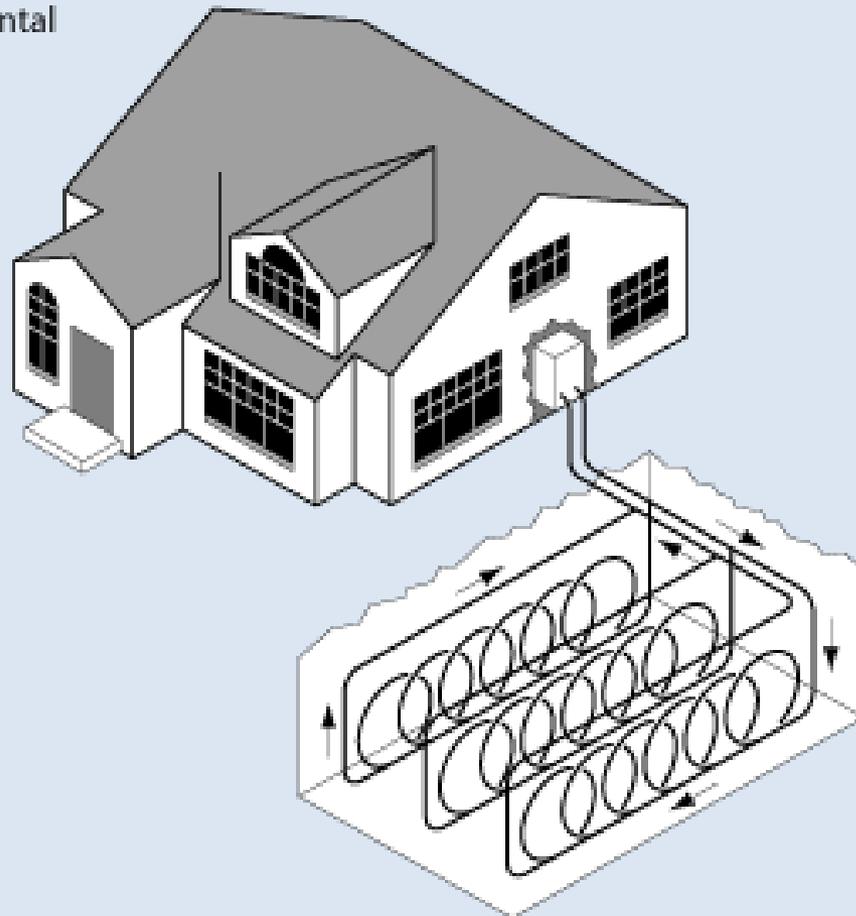
# GEOHERMAL HEATING



# Geothermal

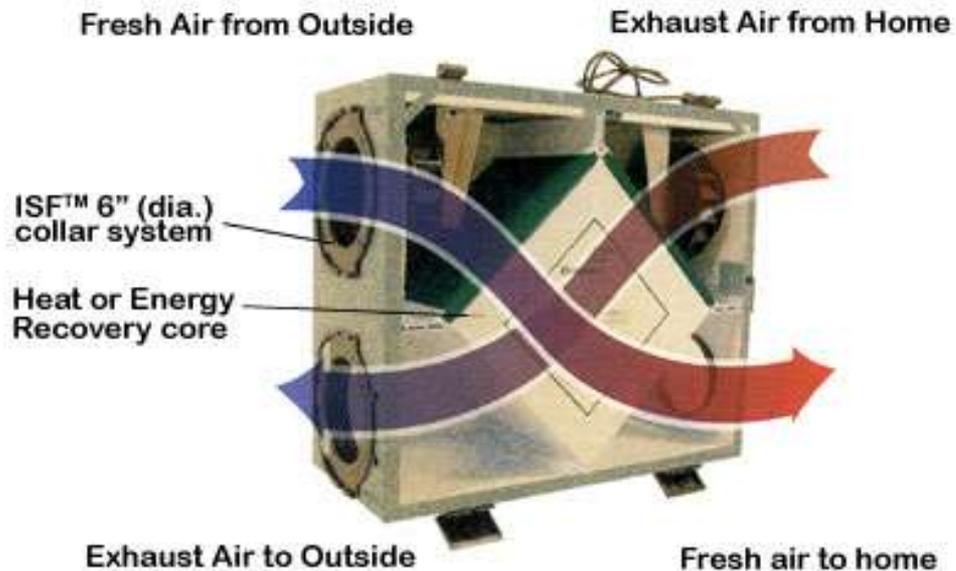
## Closed Loop Systems

Horizontal



# Pre-temper fresh air on HRV/ERV

## HRV/ERV system MODELS P, T AND S



# “Fresh Air Furnace”



# Direct Exchange—No Refrigerant



# Wood Heating



# NSP Project: Menomonie, Wisconsin



# Duplex Heating/Cooling/Hot Water

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

NEW Heating/Cooling/Hot Water Load for Duplex: -.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.

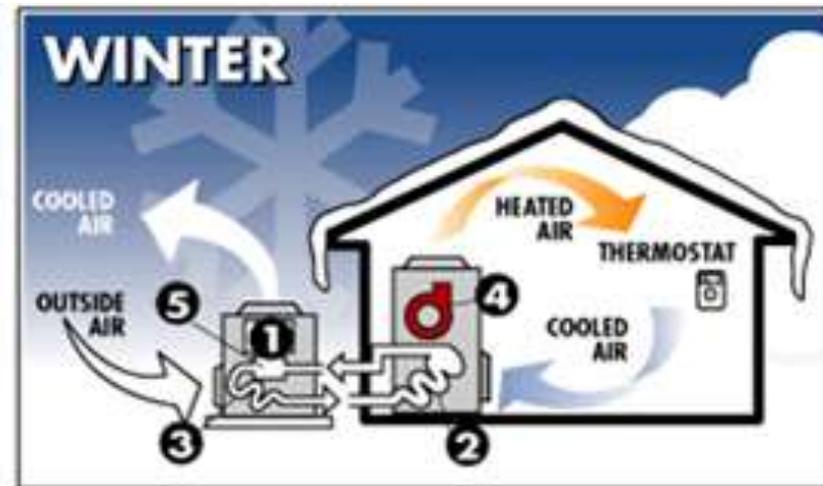
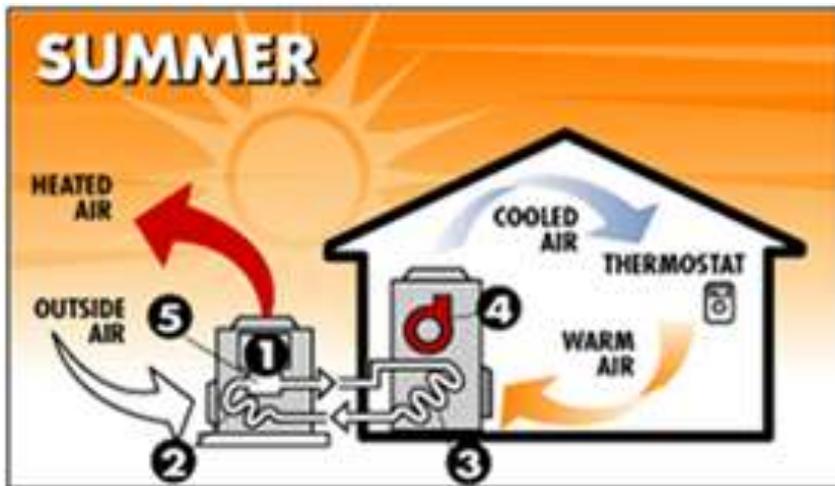
# NSP Project: Glenwood City, WI



# 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)

*All Electric*

	<i>Reference Home</i>	<i>As Designed</i>	<i>Difference</i>	<i>% Difference</i>
Heating:	110.2	57.3	-52.9	-48.0%
Cooling:	10.4	3.2	-7.2	-69.1%
Water heating:	20.6	19.0	-1.6	-7.7%
Lights & Appliances:	74.8	68.7	-6.1	-8.1%
Photovoltaics:	0.0	0.0		
<b>Total:</b>	<b>216.1</b>	<b>148.4</b>	<b>-67.7</b>	<b>-31.4%</b>

## Total Emissions

*All Electric*

<i>Type of Emissions</i>	<i>Reference Home</i>	<i>As Designed</i>	<i>Difference</i>	<i>% Difference</i>
Carbon Dioxide (CO2) - tons/year	14.3	10.0	-4.3	-30.1%
Sulfur Dioxide (SO2) - lbs/year	69.0	52.3	-16.7	-24.2%
Nitrogen Oxides (NOx) - lbs/year	38.8	27.3	-11.5	-29.6%

# NSP Project: New Richmond, WI





**vanguard**

vanguard Window  
 Frame: Vinyl Extruded w/Ultimate  
 Foam Fill Glass: Triple Glaze, VEG KR  
 Product Type: Horizontal Slider Window

**ENERGY PERFORMANCE RATINGS**

U-Factor (U.S.I. - Ft)	Solar Heat Gain Coefficient
<b>0.18</b>	<b>0.22</b>

**ADDITIONAL PERFORMANCE RATINGS**

Visible Transmittance	Air Leakage
<b>0.42</b>	<b>0.1</b>

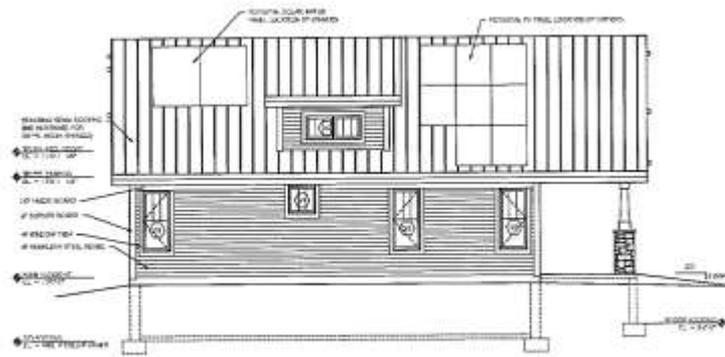
Manufacturer requires that these ratings comply to applicable local provisions for performance, which control performance. Some ratings are dependent on other, not all applicable provisions and a specific product type. All ratings are based on a standard test procedure and may vary from the actual performance of the product. For more information, visit [www.energystar.gov](http://www.energystar.gov).

**ENERGY STAR® Qualified**  
 In All 50 States

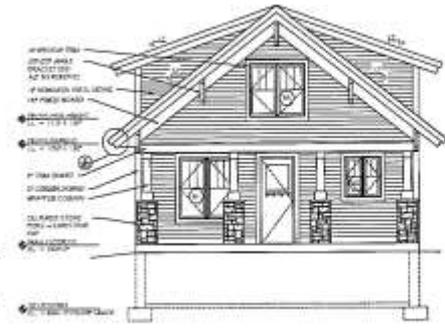


# Heat Pump Water Heater

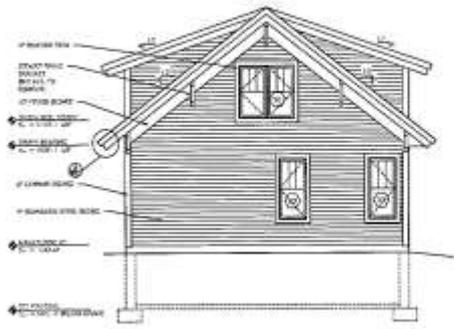




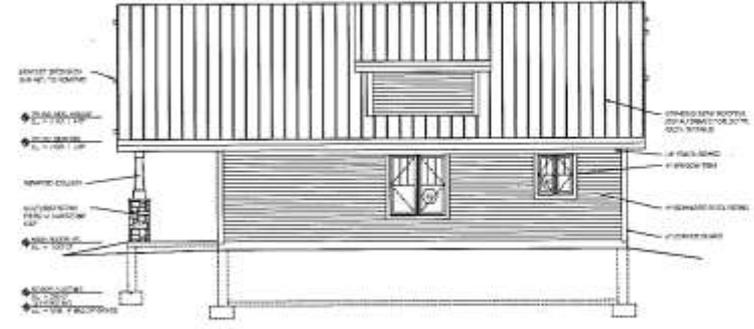
**SOUTH ELEVATION**  
1/4" = 1'-0"



**EAST ELEVATION**  
1/4" = 1'-0"



**WEST ELEVATION**  
1/4" = 1'-0"



**NORTH ELEVATION**  
1/4" = 1'-0"



**LIRN & PETERSON ARCHITECTS, INC.**  
 429 MENOMONIE STREET  
 WAUCLAIR, WI 53086  
 414.224.4478  
 admin@zdp.com

**WESTCAP SINGLE FAMILY HOME**  
**2010 'NET-ZERO' NEW HOME**  
 500 127th STREET  
 WAUKESHA, WISCONSIN 53091

ELEVATIONS
















- 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](http://CCHRC.org)
- [Buildingscience.com](http://Buildingscience.com)
- [Greenbuildingadvisor.com](http://Greenbuildingadvisor.com)
- [Passivehouse.us](http://Passivehouse.us)
- [Thousandhomechallenge .org](http://Thousandhomechallenge.org)
- [Affordablecomfort.org](http://Affordablecomfort.org)
  
- Contact: [mschmidt@wcap.org](mailto:mschmidt@wcap.org)