

Solar Water Heating

Solar Thermal Fundamentals

Solar In floor Heating

Solar Domestic Water Heating

How this all started
What are 1,000 silver and black things on all those roofs



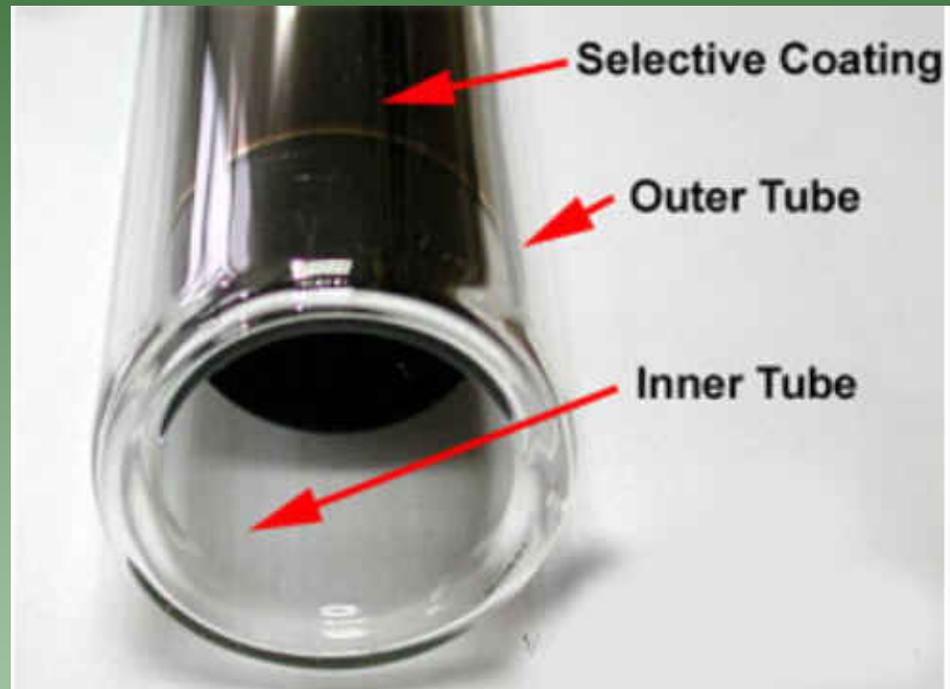
I had a chance to see these amazing solar water heating systems heating working at -20C in northern china

After that I started used them to heat my domestic hot water at my cabin in northern Saskatchewan

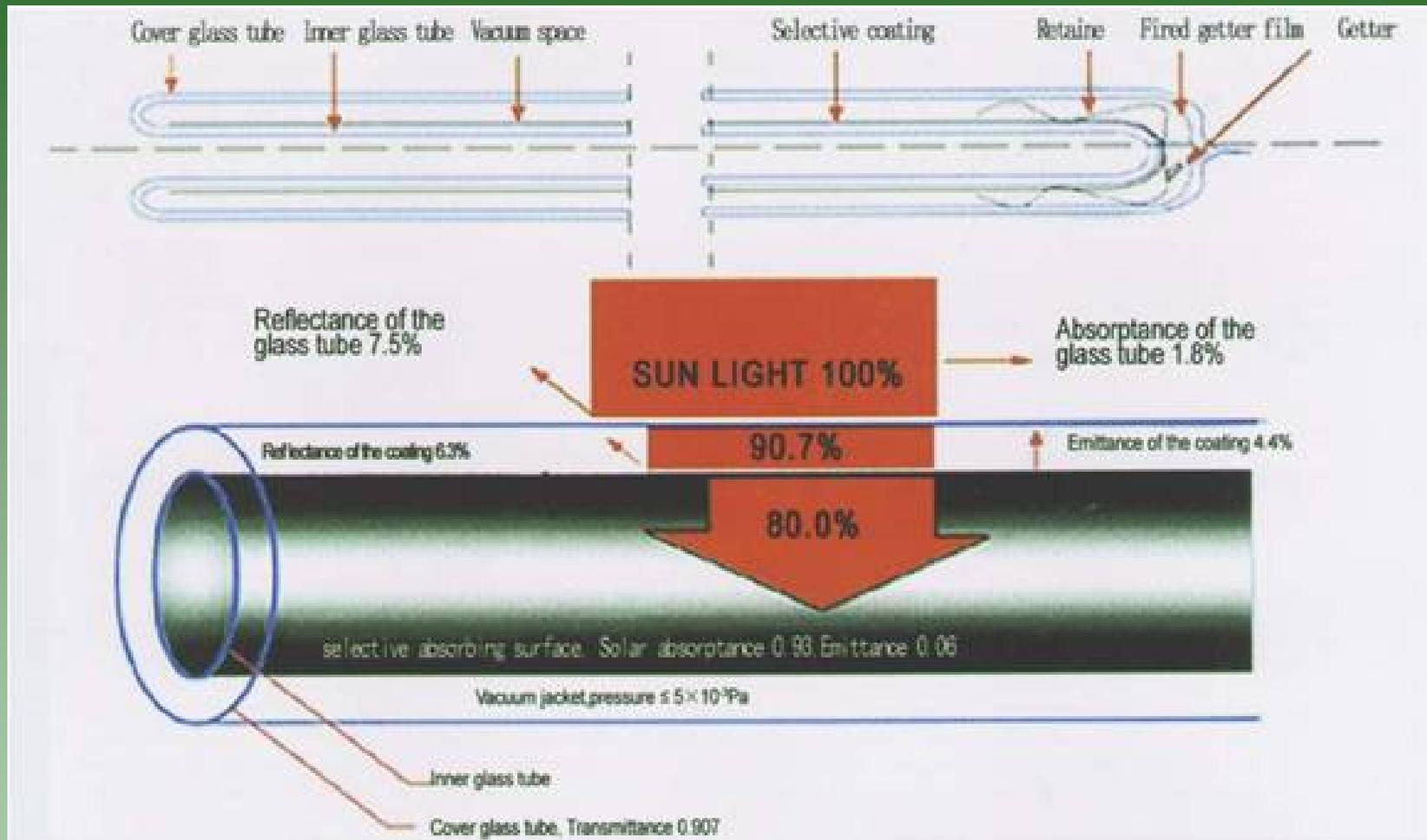
How Much Heat Can We Get

Sunshine at noon at the equator delivers radiant energy at a rate of approximately 1000 Watt or 3400 BTU/hr per square meter

WSE47



Evacuated Tube



WSE47 Non Pressurized Solar Collector

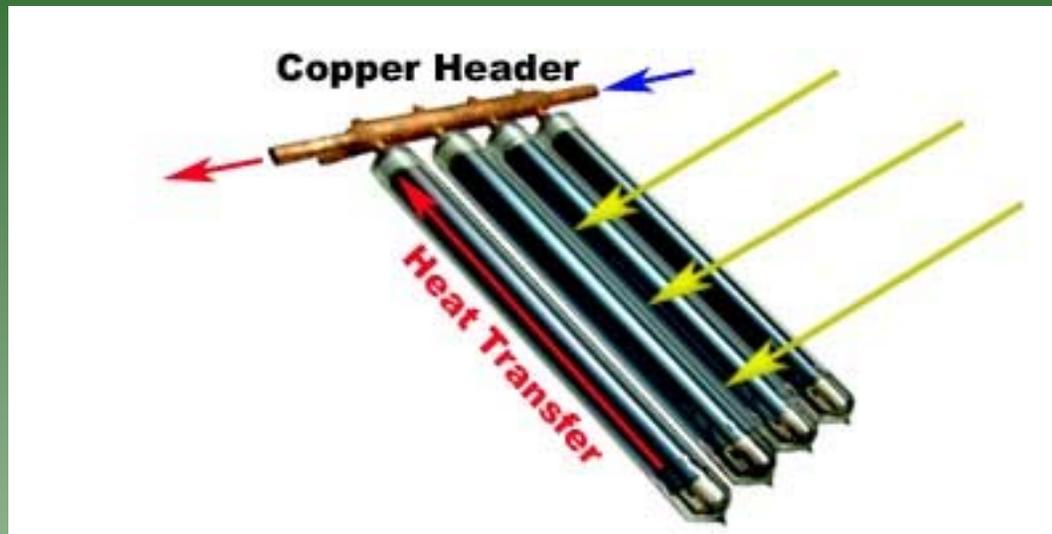


Overall Size 1.6 m x 1.4 m
Heat Output 2200 BTU/hr

Applications

- Solar Heating Homes, Cabins, Garages , Sheds, Commercial and Warehouse buildings
- Solar Heating swimming pools, Jacuzzis or the like
- Stainless steel manifold makes ideal for saltwater pools

WSE58 Pressurized Solar Collector



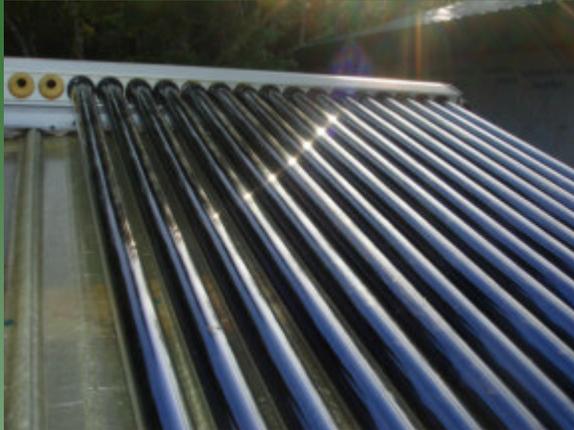
Overall Size 2.0 m x 1.4 m

Heat Output 2700 BTU/hr

Applications

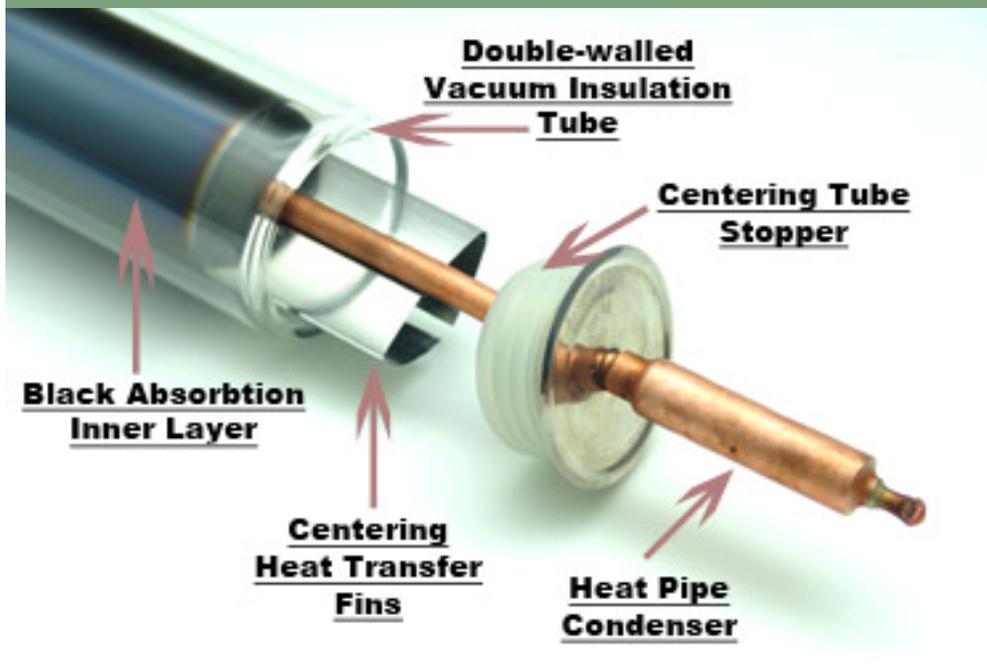
- Solar Heating Garage or Shed
- Solar Domestic Water Heating
- Solar Heating Homes and Cabins
- Solar Heating whether radiator or floor heating
- Solar heating Commercial and Warehouse building

WSE58 Pressurized Solar Water Heater



WSE58 System Benefits:

- System can be pressurized to regular • water mains pressure.
- Fluid does not enter the glass collection • tubes, meaning less volume of fluid in the system.



- Our WSE58 pressurized water heater • collectors put out 2,700 BTU per hour, or 692 Watts in full sun from a single 20 tube system

Couple Reasons Why Evacuated tubes are for Canada

Because the tubes are insulated by vacuum the wind and cold Canadian temperatures have minimal effect on the efficiency of the evacuated collector. Great on those -60 degree below days

Due to the cylindrical shape of the evacuated tube, the sun is perpendicular to the surface of the glass all day. This means that solar water heaters gives you maximum output all day long.

Energy Freedom

- Now you can produce your own energy for as little as \$3 per gigajoule for the next 20 years with no concern for rising energy costs

Cost of Energy per Gigajoule (based on Saskatchewan Prices)

Energy Source	2009	Projected 2029
Natural Gas	\$15.44	\$40.00
Electricity	\$45.00	\$100.00
WSE47 Solar Energy	\$2.00 - \$3.30	\$2.00 - \$3.30
WSE58 Solar Energy	\$3.50 - \$7.00	\$3.50 - \$7.00

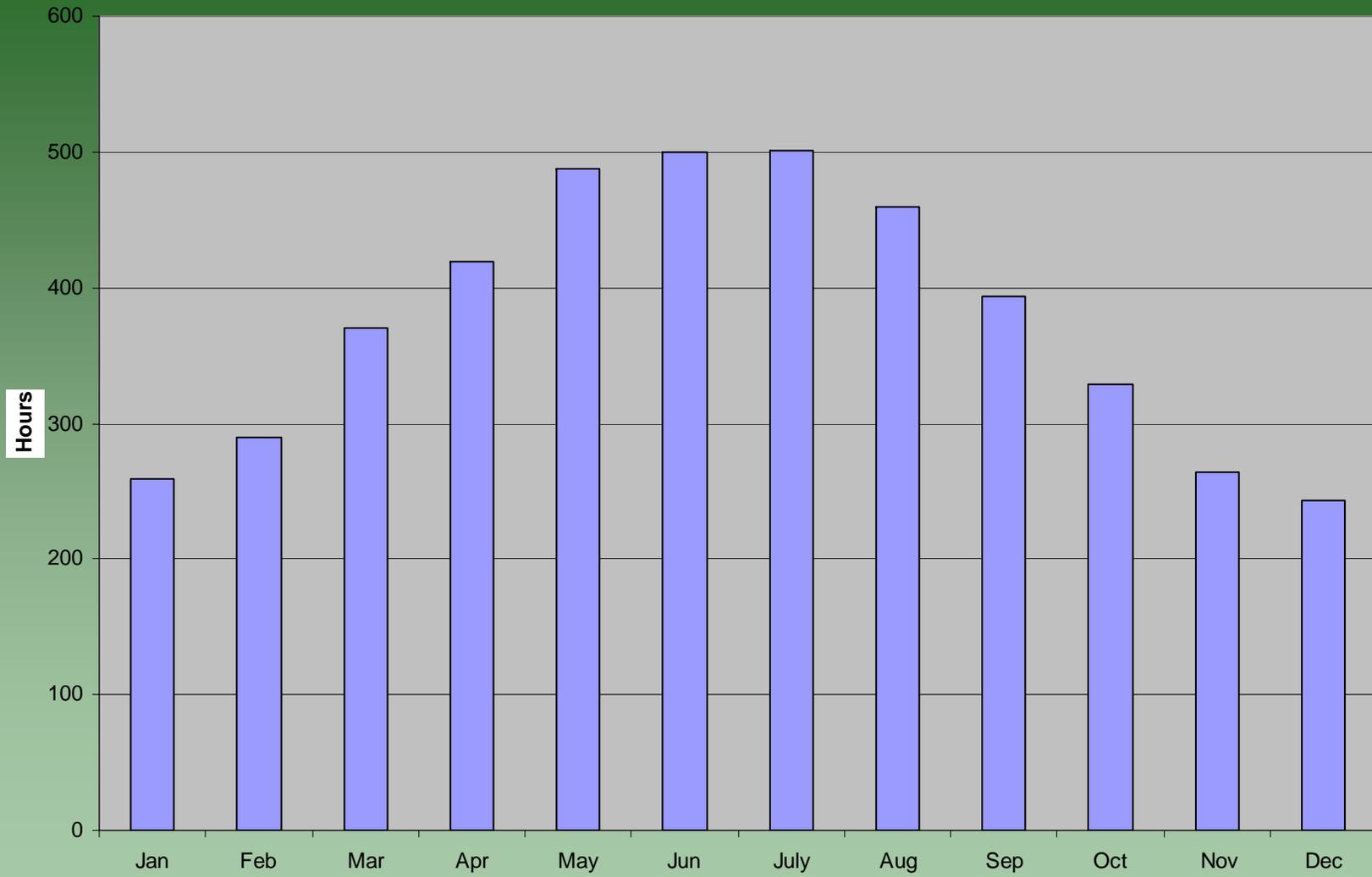
Also note the cost of solar energy is FREE, natural gas and electrical costs do not include the costs of the equipment, which we are including in our solar costs.

Check out the Home Renovation Tax Credit ... at present there could be a 15% benefit to you

Solar In floor Heating

- Solar panels can supplement other sources of heat to reduce your overall heating costs and lower your contribution to greenhouse gas. While it is theoretically possible to design a system that could provide all your heating needs, it may not be economically practical because of the need to install large amounts of thermal storage for those times when the sun does not shine.
- In northern climates we receive the least hours of sun when we need it the most. If we design for these conditions we will end up with heat we don't know what to do with in the summer

Daylight hours for Saskatoon



Let's assume you want to heat your workshop. How many panels should you use?

The quantity of heat loss is a function of the building area, the temperature difference between indoor and outdoor and the resistance value R of the insulation and wall material.

Other factors might include leakage thru windows and doors.

The WSE heat loss calculator will help you determine how many panels you should install. This is an approximate value only.

Insert R value of your building

Insert the dimensions of your building. Choose feet or meters.

Insert desired temperature difference. This is the number of degrees above ambient that you would like to achieve in the building. Choose C or F.

Insert number of hours of daily sunshine for your area. You can obtain average numbers from the weather office or you can just take a guess. We suggest using a number that reflects operation in October-November or February-March instead of December-January.

To arrive at some design heat loss, we must correct for the hours of sun. This will mean that the temperature will overshoot the design conditions when the sun is shining and fall below design conditions when it is not. This fluctuation can be reduced by installing thermal storage if desired. If you happen to have in-floor heating and a concrete floor, the thermal storage is already there.

It is recommended that you install solar panels that will provide about 50% of design loss to start with.

Remember that it is very simple to add more panels in the future

We are going to use an actual installation we installed last year

Farm without natural gas services

Dimensions 30 ft by 40 ft with 20ft ceilings Machine Shed

Heated with Electric Water Heater

R12 insulations

Designed for a 20 deg. C above ambient (if - 20 deg C outside would heat to 0 deg C

8 hours of sunlight

Evacuated solar heating panels operate at about 50% or 1,100 btu/hr even on cloudy days, this will be illustrated later

Calculator recommended 11 WSE47 panels

Customer decided to go with 7 WSE47 panels, and then add more if necessary

Because the panels are easy to add on, this is a recommended approach

He did most of the installation himself , total cost was about \$4,500 including glycol.

WSE Calculator on the web

Insulation: R value: 12

Structure dimensions:

Length: 40 ft

Width: 30 ft

Ceiling Height: 20 ft

Units of measurement: feet

Temperature:

Desired temperature change: 20 deg C above outside temperature

Sunlight:

Hours of sunlight: 8 hrs

Heat:

Heat loss: 14,400 BTU/hr

Design loss: 43,200 BTU/hr

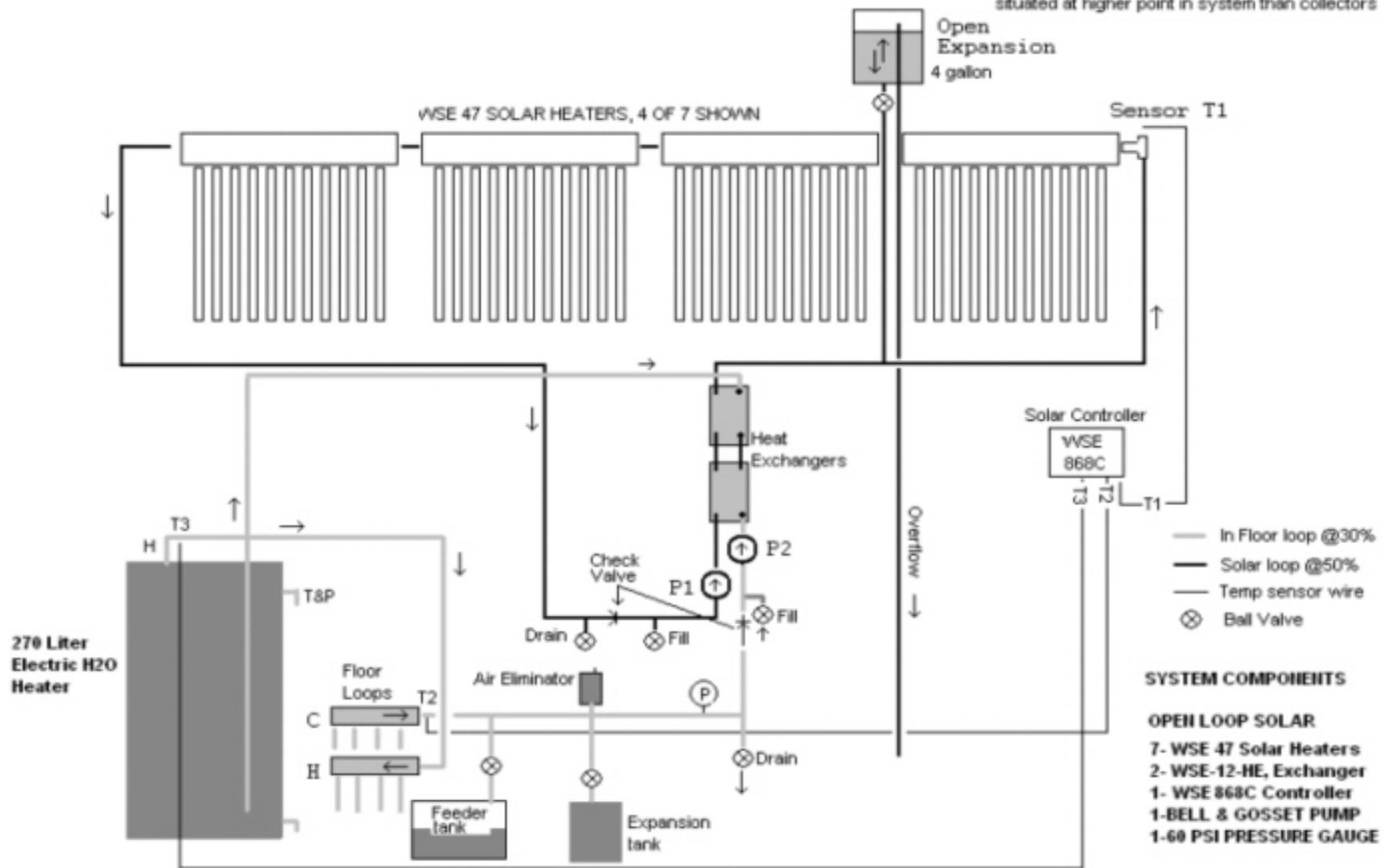
Suggested Panel:

Required heat: 21,600 BTU/hr

Number of panels required: WSE47 -11 panels

IN FLOOR HYDRONIC HEATING WITH SOLAR SUPPLIMENT

***Expansion tank and tank supply line must be situated at higher point in system than collectors





Here is what Don has to say about system

I installed 7 - WSE47 panels on my 30 by 40 ft machine shed this fall. I have in floor heating with electric heat. During the month of December 08 we had lots of -30 deg C days. The system worked amazing heating the water tank over 30 deg. C. With about a 15 deg drop returning to the water tank after returning thru the floor. I estimate that this system will pay for itself in about two years and will save me about \$60,000 in heating bills over the life of the system which should be about 20 years

Carbon Footprint

What is this project doing for the environment ?

Electricity = 150lbs of CO₂ per Million btu

Natural gas = 140lbs of CO₂ per Millionbtu

Based on 7 panels this is about 50,000,000 btu per year
or 7000 lbs of CO₂ per year

Saving 7,000 pounds of carbon is equivalent to recycling about 2,200 pounds of waste instead of sending it to a landfill, or removing the emissions of 2 automobiles on the roads each year

In Floor heating using WSE 58 heat pipe pressurized panels

Understanding difference between WSE47 and WSE58

The WSE 47 panels are an open loop system that do requires an overflow reserve must be used along with proper venting and they do hold 36L of glycol per 20 tube panel.

The WSE 58 is a closed loop pressurized system only holding 1.5L of glycol per panel.

WSE58 has an output of 2,700 btu/hr with a cost around \$1,000

WSE47 has an output of 2,200 btu/hr with a cost around \$400

The WSE58 is currently in for SRCC with expected approval June 2009

We will now analyze an Industrial Project that we received an order for last fall using WSE58

Insulation:R value: 20

Structure dimensions:

Length: 216

Width: 82

Ceiling Height: 20

Units of measurement: feet

Temperature:

Desired temperature change: 30 deg C

Sunlight:

Hours of sunlight: 7

Heat:

Heat loss: 96,008 BTU/hr

Design loss: 321,169 BTU/hr

Suggested Panel:

Required heat: 164,585 But/ht

Select a panel: WSE58

required: 64

Industrial Solar In Floor Heating using WSE58 panels

Qty	Description	Price	Total
64	WSE 58 Solar Water Heaters	\$897.00	\$57,408
64	WSE 58 Support Frames	\$70.00	\$4,480
9	WSE 12HE Heat Exchangers	\$133.00	\$1,197
3	Bell and Gossett pumps	\$378.00	\$1,134
3	Solar Water Heater Controller	\$197.00	\$591
30 hrs	Installation of Panels on roof	\$76.00	\$2,280
150 liters	Solar Glycol 50	\$10.00	\$1,500
30hrs	Installation of glycol and commish	\$76.00	\$2,280
	Total		\$70,870

We based the sale on receiving our certification, so a 50% rebate could be realized . Cost \$35,000

Let's do the math....

- WSE 58 out is $2,700 \text{ BTU/hr} \times 7 \text{ hr/day} \times 365 \text{ day/year} = 6,900,000 \text{ BTU/year}$
- $1 \text{ BTU} = 1,055 \text{ joules}$ therefore....
- WSE58 produces $7,300,000,000 \text{ joules}$ per year or 7.3 gigajoules per year.
- Natural gas costs $.40$ per cubic meter
- $27 \text{ cubic meters of natural gas} = 1 \text{ gigajoule}$.
- Based on water heater efficiency of 70% , $1 \text{ gigajoule} (.40 \times 27 \times 1/.70) = \15.44
- Let's say the life of the WSE58 is 20 years . $35,000/20 \text{ years} = \$1750/\text{year cost}$.
- Therefore $\$1750/(64 \text{ WSE58} \times 7.3 \text{ gigajoules}) = \3.70 for 1 gigajoule .

Summary

- Current cost of 1 gigajoule of natural gas = $\$15.44$
- Current cost of equivalent to 1 gigajoule using electricity = $\$45.00$
- Current cost of 1 gigajoule of solar energy = $\$03.70$

Carbon Footprint

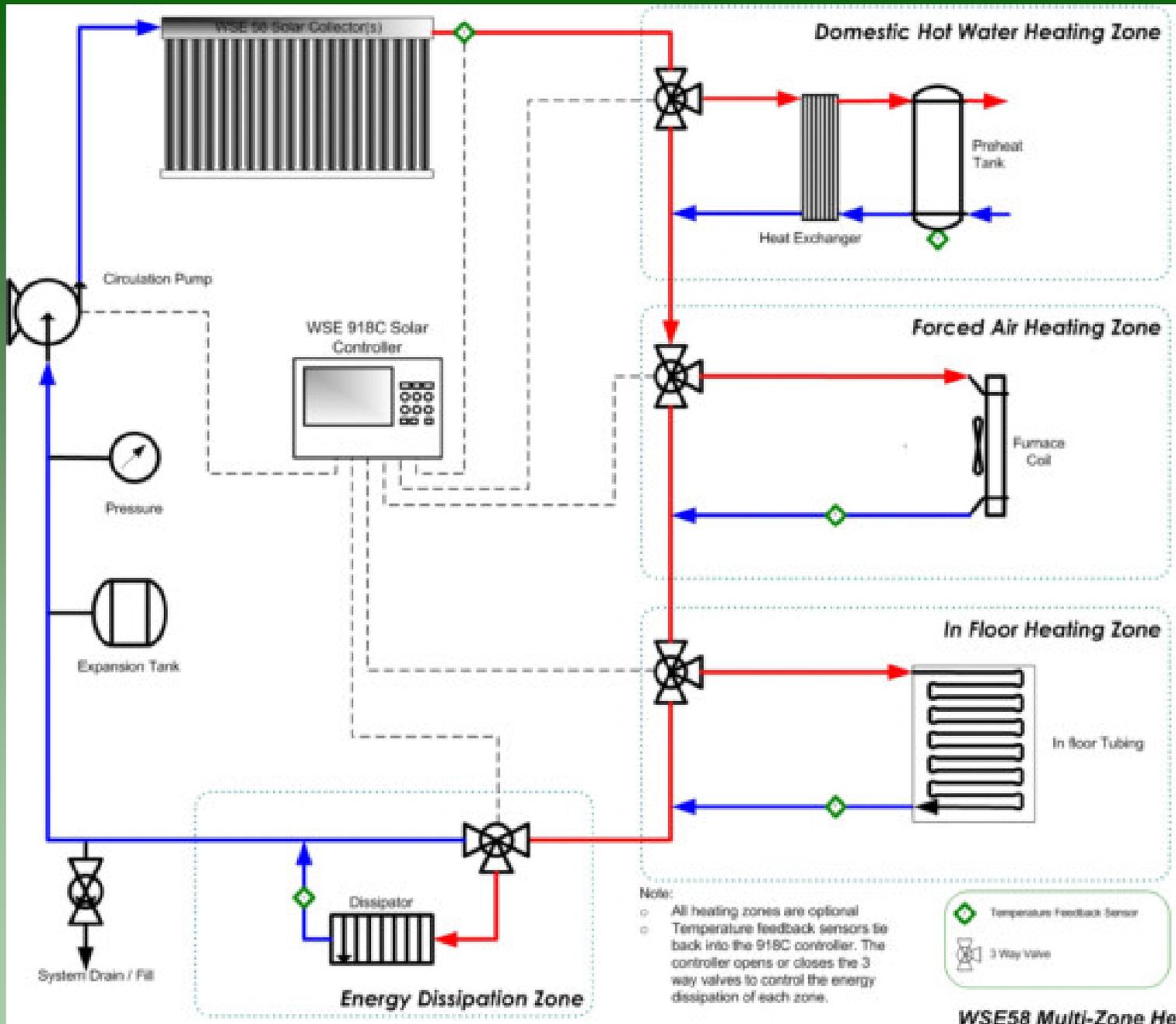
What is this project doing for the environment ?

Electricity = 150lbs of CO₂ per million btu

Natural gas = 140lbs of CO₂ per million btu

Based on 64 panels this is about 448 million btu per year
or 62,000 lbs of CO₂ per year

Saving 62,000 pounds of carbon is equivalent to recycling about 20,000 pounds of waste instead of sending it to a landfill, or removing the emissions of 18 automobiles on the roads each year



WSE58 Multi-Zone Heating System

Solar Domestic Water Heating

- **Water** Consumes 30-40% of home heating energy
- 75 liter/day per person
- 15,000 BTU/day per person

One to two person solar water heating system

1 WSE 58 panel \$1031

1 controller \$341

circulation pump \$182,

1 heat exchanger \$152

1 expansion tank \$51

Cost \$1757

Three to four person solar water heating system (2 WSE58) Cost \$2788

Five to six person solar water heating system (3 WSE58) Cost \$3819

Let's do the math regarding Solar Domestic Water Heating

- WSE 58 output is $2,700 \text{ BTU/hr} \times 7 \text{ hr/day} \times 365 \text{ day/year} = 6,900,000 \text{ BTU/year}$
- $1 \text{ BTU} = 1,055 \text{ joules}$ therefore....
- WSE58 produces $7,300,00,000 \text{ joules}$ per year or 7.3 gigajoules per year.
- Natural gas costs $.40$ per cubic meter
- 27 cubic meters of natural gas = 1 gigajoule .
- Based on water heater efficiency of 70% , $1 \text{ gigajoule} (.40 \times 27 \times 1/.70) = \15.44
- Life of the WSE58 is 20 years .
One to Two Person System $1757/20 \text{ years} = \$88/\text{year cost}$.
 - Therefore $\$88 / (1 \text{ WSE58} \times 7.3 \text{ gigajoules}) = \12 for 1 gigajoule .
- Three to Four Person System $2788/20 \text{ years} = \$139/\text{year cost}$.
 - Therefore $\$139 / (2 \text{ WSE58} \times 7.3 \text{ gigajoules}) = \9.50 for 1 gigajoule .
- Five to Six Person System $3819/20 \text{ years} = \$190/\text{year cost}$.
 - Therefore $\$190 / (3 \text{ WSE58} \times 7.3 \text{ gigajoules}) = \8.60 for 1 gigajoule .

Summary

	Cost per gigajoule
Current cost of natural gas	= \$15.44
Current cost of equivalent using electricity	= \$45.00
One to Two Person System	= \$12.00
Three to Four Person System	= \$09.50
Five to Six Person System	= \$08.60

Thoughts

Remember the price per natural gas and electricity does not include the equipment. In actual fact solar energy is free, the cost is the equipment.

These prices do not include rebates that vary from Province to Province
With expected certification this June of our WSE58, this will for example drop the price by \$1,000

This will bring a one to two person system to \$5.00 per gigajoule



Dissipate Heat excess heat to radiator



2009 New Year Confession

Happy New Year to you. Today in the Yukon it was -41c warming to -33c the sun was out nice. The solar system was heating the water at 35c. Nice and hot. Who would have known that one can get that kind of heat out of the sun on a cold Yukon day.

Comments on February 12th 2009

Hope all is well on your end. We are seeing more sun these days. Today started at -33c warming to -25c I watched the heat in the system go up to 72c it was so hot one could not put your hand near any of the lines.
Wow!

Scott Jamieson

Solar Flat Panels

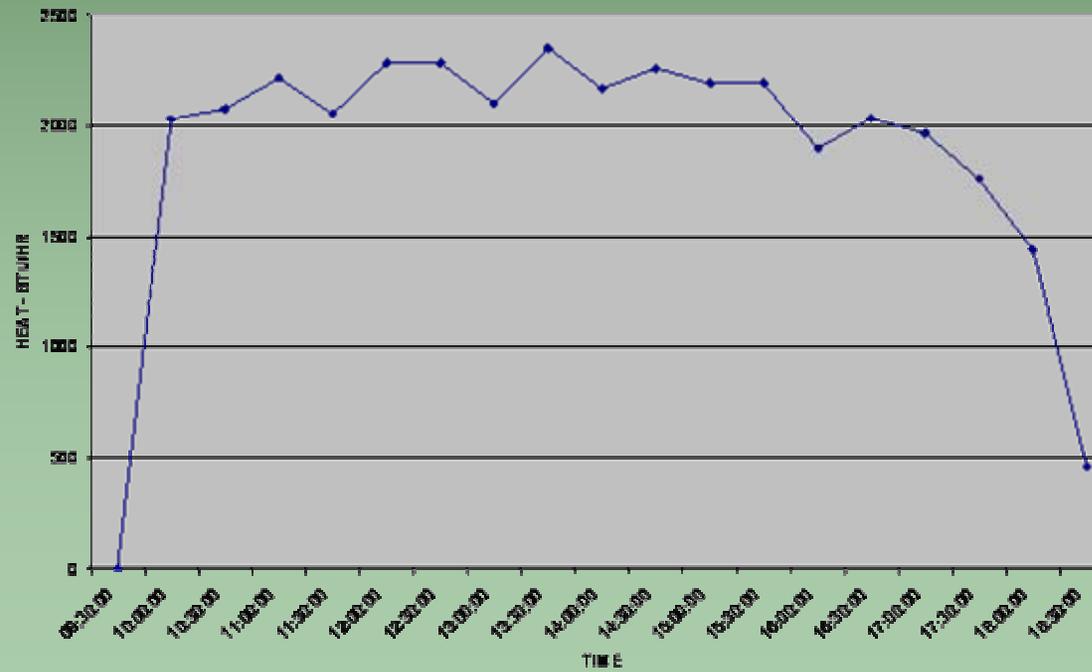
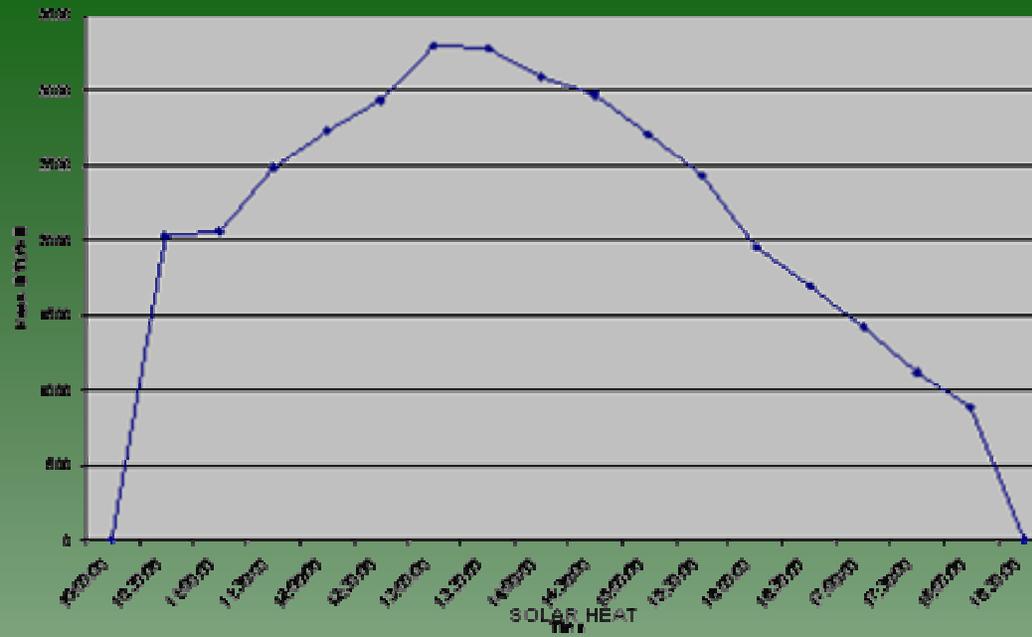


WSE sells Flat Panels
Testing Flat in Saskatchewan

The system was operated over a one month period in March and April when temperatures were at times lower than -20°C .

Figure 3 shows typical results from March 10, 2008

TRIP HEAT



Reason Solar Flat Panels Don't Work In Cold Temperatures

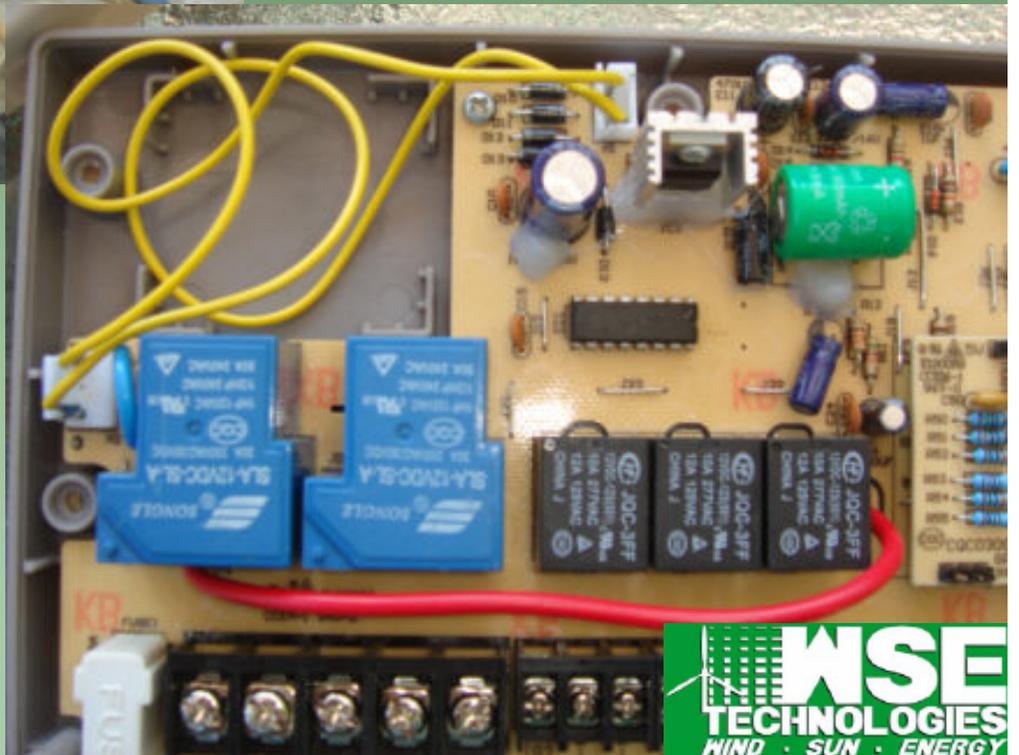
A number of conclusions can be reached from this test:

- The peak solar efficiency of the flat panel is about 66%. This is lower than the evacuated tube panels which can reach 85%.
- The heat output is dependant on the solar angle during the day as previous chart
- The heat output is extremely independent of ambient temperature (It is like having single pane windows in your house in the winter)
- We know flat panel customer that bought 40 flat panels last year who would be happy be why you shouldn't buy flat panels in Canada

WSE Research and Development Center









Future Solar Heating

WSE is currently testing a new concept in solar water heating, that will be manufactured by WSE.

Our goal is to have a certified Canadian system with a cost of 60 – 70% of our current system

We anticipate product introduction end 2009

Current working with Intertek for CSA F378 Approval in 2009

