Rob's Solar Domestic Hot Water Project With Space Heating and Cooling

This is my attempt to utilize the knowledge from Gary Reysa's Build it Solar site and from Tom of UP Truck Centre. I have to say thank you to both of them as they are both great resources in this project.

My system uses 80 sq feet of solar water heating collector to heat our domestic water, and will also provide some space heating. The system uses a large (300 gallon) non-pressurized water tank to store heat. The system is a drain back, so all of the water in the collector drains back to the tank for freeze protection.

For space heating, hot water is pumped from the storage tank through a water to air heat exchanger mounted in my furnace ducting. In the summer, I plan to use the same heat exchanger for cooling using well water.

A little history

My home was built in 1988 from a kit type home (Beaver Homes) I contracted the basement cement work, HVAC and plumbing work. The rest was done with the help of family and friends.

You buy the home kit and they provide blue prints and all the building materials. Walls and Roof Trusses are prebuilt.

My home was built as close to the R2000 standard of the day; R40 insulation value in the attic and R20+ in the walls. All outlets where sealed to the vapor barrier and windows with spray foam so it is a very, very tight home.

An Air to Air exchanger was recommended and installed after the fact.

I live in a rural area of Southwestern Ontario, Canada not far from Sarnia. Sarnia is a border city with Port Huron, Michigan.

Currently the house is heated with an Electric forced air furnace with an air heat pump for winter heat and summer cooling purposes. Our Hot water supply is via an electric hot water heater that is rented.

The rental tank made sense with the hard water as average life was about 5-8 years and then they were just too full of rust and sediment. I will be swapping in a purchased unit sometime in the future. The current tank is a Giant 33 gallon unit that was installed in 2011. The specification of this tank indicates an average Kilowatt usage per year is 3500KWh per year.

To get out of the rental agreement today it would cost me $200.00 removal fee. So we stay with the rented tank for now.

Our current electrical utility in Ontario has us on “time of use billing” with smart meters

Today there are 3 rate classes which change with the seasons.

In Ontario we also endure the Harmonized Sales Tax @ 13% today.

This tax is on just about everything we purchase including electricity and gas bills, motor fuels both diesel and gasoline. You cannot escape this tax if you live in Ontario.

My best calculation of what I pay for a kilowatt of electricity is somewhere between .12 and .14 cents because of the additional surcharges on our bill and the HST.

The current published rates are:

	Summer	Winter
Off peak:	5.9 cents/kWh	6.2 cents /kWh
Mid peak:	8.9 cents/ kWh	9.2 cents /kWh
On Peak:	10.7 cents/kWh	10.8 cents/KWh

The peak time periods move around from Summer season to Winter season.

This fall it was announced yet another rate increase which is reflected in the winter rates above.

I turned 55 years young in October and am looking at retirement straight in the eyes!

With these kinds of set costs it is hard to build a retirement plan when they keep escalating beyond my yearly pay increases!

So I went looking for some solutions to reduce my set costs.

I had already made the jump to a Hybrid vehicle in 2009 when we purchased a 2008 Camry Hybrid. That covered off my gasoline bill costs quite nicely. Downside was another car loan. Upside; just outstanding gas mileage and a very nice vehicle to drive and ride in.

I found Gary's site and set to reading everything I could about a solar hot water solution that I could adapt to provide some additional heat for my home as well.

Radiant floor heat is not going to work for my situation as we just added hardwood flooring in 2010 through the living room and a bedroom and the crown staples have gone right thru the 5/8" T&G floor decking. So adding something into the forced air furnace like the wood boiler folks use seems logical to me.

So after some discussions with Gary and doing the math and some convincing of my wife we started the project in the summer of 2011.

Designing and Building the System

My panels are horizontal as this was the best fit for the south facing front of my home. I looked at self supporting the panels to the rear of my home but with the tree wind breaks we have and the shadow of the house that just did not seem financially feasible. I am 3rd generation on this rural farm and we are not the type to spend on something that does not have a return on the investment. You can call me cheap if you like but I prefer fiscally responsible!

My home actually faces south to south west but the west end of my home had the space for the panels.

(You may wonder on why the south- south west angle. We look out over a creek valley. But it provided something that we did not foresee at the time of planning and building. The angle of the house does not allow summer sun in the south windows during the peak periods of day. During the winter months the sun hits the front of the house quite directly so we open the large living room window curtains and have a free solar gain in the centre of the house.)

I built two panels each just over 4 feet tall by 10 feet long. Construction of the panels was with 2x 6 pressured treated lumber and ¾ inch PT plywood. The panels where built such that I did not need to cut the plywood sheeting down or the glazing. I cut a groove in the back of the frame work for the plywood, and in the front for the glazing. These are oversized for just hot water production for my wife and I; but my intent was to pull some heat for the house as well. I insulated the collectors with 1.5" of polisocyanurate insulation in the back and attached the absorbers thru it to the ¾" back with deck screws. Do not use drywall screws. They will react with the Pressure treating chemicals.

I found a source in Capac, Michigan for the twin wall glazing 8mm.

My absorber is made up of ¾ inch vertical manifolds and ½ inch horizontal Risers all of copper.

I priced aluminum soffit material and honestly it was cheaper to purchase the aluminum absorbers from Tom at UP truck centre and ship it to Port Huron Michigan. I then crossed the Blue Water Bridge; pick it up and broker it across the border. Seems like extra trouble but in actuality most of the materials where

purchased in the USA. Funny part was once I received them things like the ¾ x ¾ x ½ copper T's … Made in Canada but for a fraction of the cost locally.

After doing the math from Gary's site to get the flow rate and pipe resistances the connection from Tank to Collector ended up being 1" pex tubing as ¾" was not going to give me enough flow rate.

I purchased a Grundfos 3 speed pump and that was one of my best decisions. It gives me some control of the flow rate.

My Tank is oversized as well. Tank outside dimensions are 5 feet long x 4 feet wide x 4 feet tall; not including the lid.

The tank is insulated with 2 x 1" layers of polyisocyanurate on the inside of the tank and 1 layer on the outside. This gives me an R value of about 20 on the tank.

The Lid has 3 layers of polyiso with a ¾ inch piece of plywood as the top. This is all wrapped with pond liner. I made the lid in two pieces for a couple of reasons. All my piping in and out of the tank is in the 2 foot long x 4 foot wide piece and the 3 foot long by 4 foot wide is removable if need be. Second reason was to reduce the overall weight when moving the lid down to the basement.

Tank is in my basement fairly close to the hot water tank and next to my forced air furnace and right next to the lines that connect to my unused water well. (We were able to connect to city water piped in from Lake Huron in 2000)

I built all the components in my attached garage and had the assistance of my brother in law the day we mounted the panels on the outside of the house.

My son Mike assisted me with the disassembly of the tank and moving it down to the basement and assembling it again there.

I have the suction line angled to the south end and down towards the bottom of the tank to try and keep the tank mixed somewhat. The feed in line drops into the North end of the tank about 3 inches off the tank water surface. I have utilized a 300 foot spool of 1" pex tubing as my heat exchanger for our hot water tank intake. I have insulated the heat exchanger line ends that run to the hot water tank and a small section of the cold water intake.

The lines running to the solar panels have not been insulated beyond directly at the tank. My plan is to insulate these over the next year.

So I completed all the plumbing connections and tank lid modifications during the week of October 16th, 2011.

The first week started with 1 full sun day and then a partial day. On Tuesday evening the tank had reached 84*F. Tank start temperature was about 66*F.

My tank capacity is about 300 US gallons.

Then it rained from Tuesday evening thru Friday early morning. Friday had little sun. Saturday morning the tank was down to 78*F. Saturday was a full sun day and Sunday was as well. Sunday evening the tank reached 93*F in the evening. My wife and I have been each taking a shower a day, washing dishes both with the dish washer and by hand. Laundry is normally a cold wash but I believe it is blending the rinse with some warm water. So it is looking like we are losing about 2*F per day when we have no solar gain.

Monday October 24th started with rain but cleared off again for the day. The pump is kicking on around 11:00am; and still running after 6:30pm. At 8:00pm the tank was at 102*F with a total of 1 week in service but with no Solar due to rain for 3.5 of those days.

I am using a SHEM controller and have T1 connected to the collector, T2 connected to my tank near the bottom, and T3 though not designed for this function is connected to the cold water line just before my Heat exchanger. It gives me the delta on the water temp in.

Phase 2 of this project is the house hold heat function

I have located an air conditioning A frame coil for the right price and once I am able to make the purchase of a small pump I will be connecting it to the tank for the heat function for my home. Still working thru the connection to either plumb the tank water directly thru it or use a small heat exchanger in the tank.

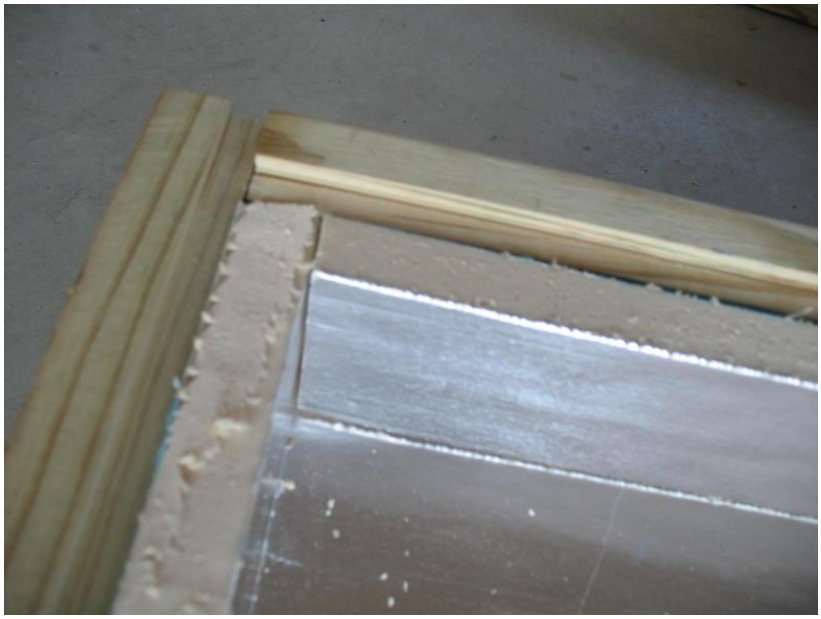
Phase 3 of this project will be in the spring as I intend to use the same A Frame coil and pump but plumb the lines from the unused water well in for a cooling function.

Construction Pictures

The two panels framed and insulated. The panels are all screwed and glued together. The insulation is glued to the back.

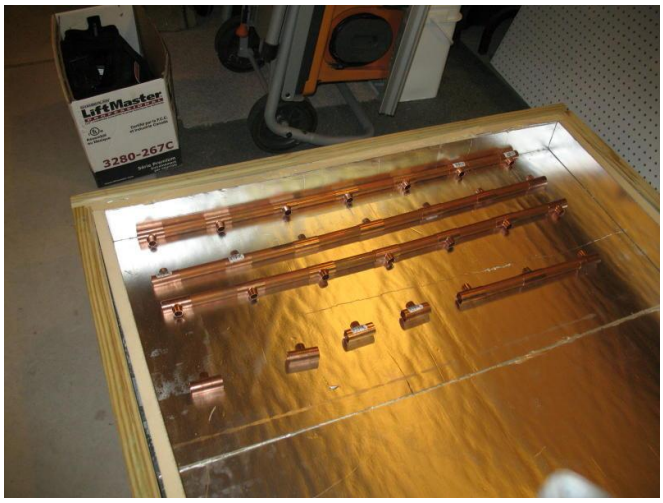
Corner Detail

You can see the grooves for the glazing below



Sawhorses are your friend

The manifolds being dry assembled.



Panels stored for the night

Yes I cleaned up every night after assembling. I built this garage when we built the house and both vehicles spend the night in it almost always! It is my workshop as well!

I created a jig to ensure each Horizontal riser ended up the same length. It is crude but it did work

So with one end in the bracket jig and the other end against the 1 x4 the edge gives me 109 inches

This ended up being shortened later by another 2 inches to ensure enough room on the end for the outlet to run down on the Right hand panel and room for the panel interconnection Tee's

For symmetry both Horizontal riser arrays where shortened. So my final length was 107 inches

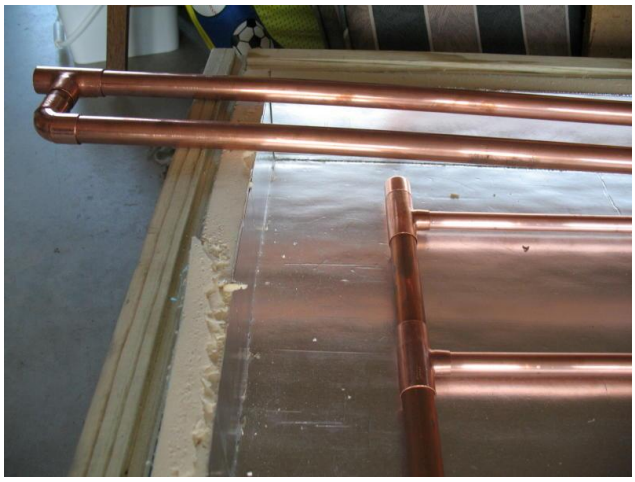
Your mileage may vary.

Dry fit of the array in the panel

Below is the detail of the interconnect T between the panels for the inlet. I subsequently decided that the Shark bite style T would work better for my build. It allowed for assembly test and pull apart for storage as I went along. Trying to solder the T connection in the panel once assembled was just going to be too risky for me as the absorbers would already be screwed down so no clearance from the insulation or wood frame at that point. It was a good decision. It made the final assembly very easy of the two panels.

The outlet T Detail Again I decided to change this one out to a shark bite style Tee

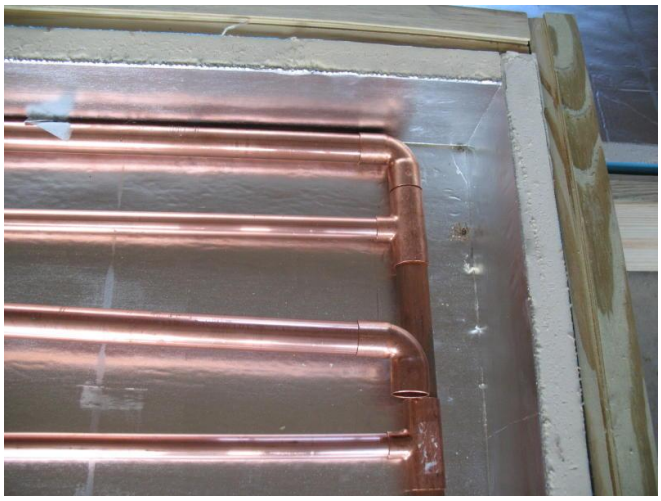
You can see the capped end of the vertical manifold in this picture as well.



For my panels to work properly both had to have the same water resistant end to end

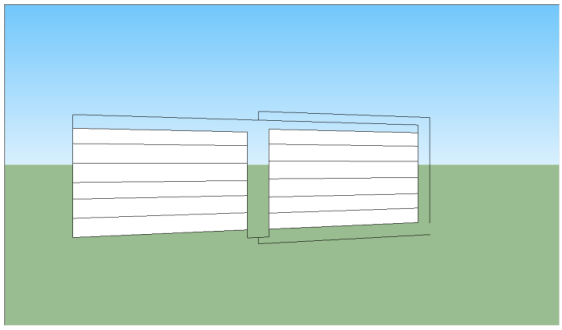
To accomplish this; the outlets where at opposite ends of the panels and both outlets feed back to the middle of the two panels.

They were then Tee connected to a single outlet line running to the end of the RH panel and down to the bottom directly above where the inlet entered the panel. Picture below shows the outlet of the RH



Panel elbowed back to the centre of the panel. The loose Copper elbow is the line to return back to this corner but would have the water from both panels in it.

Below is a concept drawing and is not to scale by any means. The area in White is the copper collector arrays. The lines outside the white are the interconnections All interconnections are ¾ inch copper. Inlet is at the bottom centre. Outlets are at the top outside ends and are run to the middle for the interconnection. Heat rises so outlet is at top. Outlet is brought around to the end for ease of installation but still ensuring the same water resistance for each panel. All the lines have fall to either the inlet or the outlet to ensure drain-back. The interconnect pipes from each end at the top actually fall back to the end headers. The very top outlet line falls to the RH corner.



Right Hand Panel Dry connected

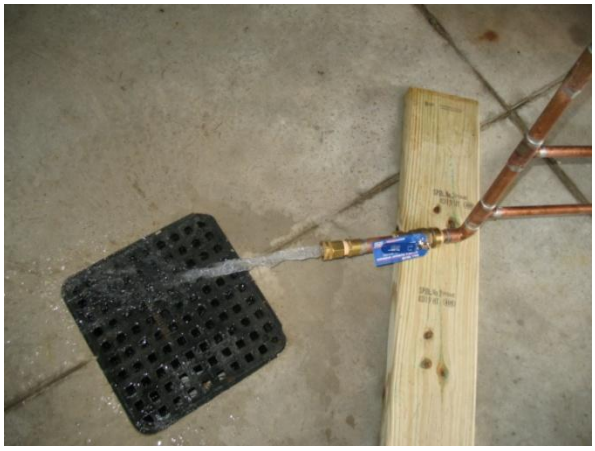
Left Hand Panel Dry Connected

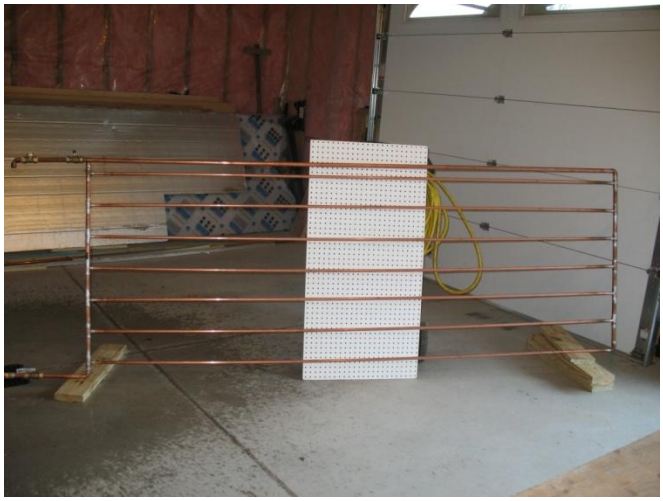
Water pressure Test on Arrays. The arrays are identical other than the interconnect pipes

No leaks! My pressure test was using city water pressure of about 60 psi. The arrays will not see that pressure in normal operation.

The drain back tests to ensure no water remained in the arrays

I had them mounted on 2x 4's to simulate the fall in the panel



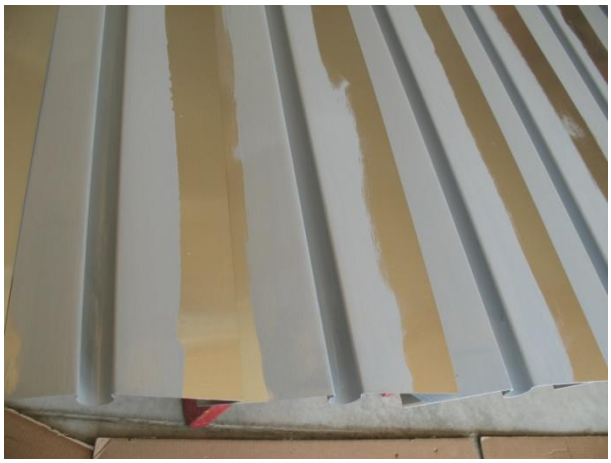


The white peg board was just to provide a flat surface against my air compressor.

Array testing completed now onto the absorber cleaning and drying! Each piece was given a soapy wash and them left to dry before the aluminum primer paint was applied

Sawhorses are your friend when it comes to a project like this. That and scrap cardboard to keep the paint off of the floor.

To ensure we did not get any galvanic action between dissimilar metals we used Aluminum Primer paint and then a coat of left over interior house paint. It should be dry inside the panel so the interior paint should be fine.



The paint should cover the inside of the groove. This is the only physical connection between the copper and aluminum! So the brush marks on the flat surface is nothing to worry about.

Here is the original install on the outside of the house

I used standard strap hinges for the bottom connection of the panels to the base mount. If I ever need to adjust the angle it is pretty easy to change.

If you have never used Google Sketch-up take some time and get acquainted.

www.BuildItSolar.com

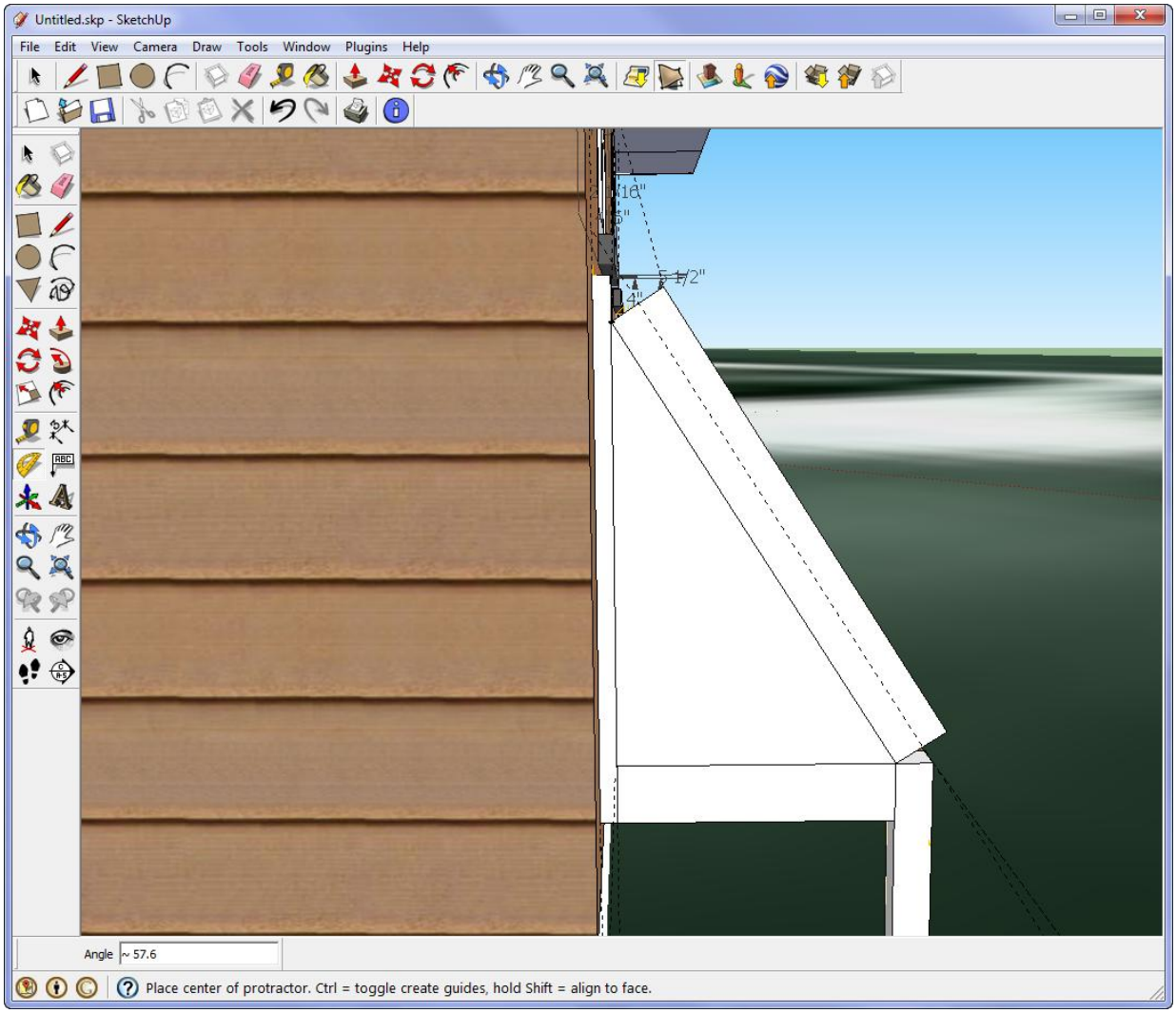
The angle I needed was 57*

My Latitude is 42* and you add 15* for best performance. Sketch up let me draw up the entire mounting with the panel so you can get your angle right the first time.

Sketch up also lets you draw up your home pretty easily and has a shadow function.

Gary put me onto this program. The shadowing will let you see what the sun is going to hit for the entire year and at what time of day. You can add trees walls etc if you want to spend the time. Pretty cool!

As you can see I hit my target angle with a few spacers in the back wall with the panel mounted on the front edge of the support structure! I moved the bottom out to the front edge of the 4x4 mount so that the rain water will drip away from the frame work. Hence the need for the spacers!


Untitled.skp - SketchUp
File Edit View Camera Draw Tools Window Plugins Help
18"
5 1/2"
4"
Angle ~ 57.6
Place center of protractor. Ctrl = toggle create guides, hold Shift = align to face.

Here are the copper lines exiting the panel out the rear together. This allowed for an easy installation and feed through into the house. The valves where temporary to allow me to pressure test it once the panels where mounted and ensure a complete drain back was happening! I was lucky! I had 1 leak in the whole process. The shark bite Tee for the inlet wanted to be difficult when we put the panels together on the mount and wanted to drip. A little bit of adjusting on the absorbers and some extra mumbling and few words of encouragement and we had it fixed. No leaks on any of the other connections!

Here is my temperature sensor wire exiting the panel in the rear.

Here we go with the Tank build. All the lumber is precut for the ends and sides

The bottom framed out. I ran the long sides past the ends for strength rather than the corner angles Gary has used.

The insulation all cut ready for installation into the tank and the end pieces cut to size.

The long sides cut to fit. The notch in the top corner is to allow for the lap joint.

I assembled the entire tank in the garage and then pulled it back apart and reassembled in the basement. This meant fewer trips up and down the stairs and fewer marks or damage on the walls.

This picture shows the detail for the lap joint. Notice the long side plywood extends to the edge. This will interconnect to the sides with a 2x4 for strength

Here the south end plywood panel is going into place. It will butt up against the 2'x 4' at the bottom and against the 2' x 4' top lap joint at the top.

Two layers of insulation on the inside. These where trimmed down once the deck board was added

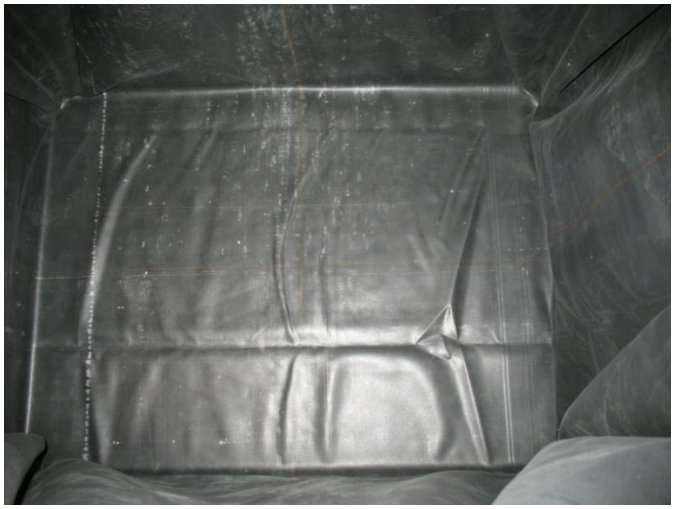
I have 1 layer of insulation on the outside. The combined R value is 6.5 x 3 plus the value of the ¾" plywood. Note the galvanized flat metal brackets. Yes it is over engineered but 300 gallons of hot water mixes with a finished basement would be a bad thing! I am NOT an engineer but rather a farmer's son. We over engineer everything!

Pond Liner going in! The pressure clamps just make it so much easier!

You can see my red centre line markings in the following picture

My corner folds completed

Detail bottom of the tank with folds Watch for bridging in the bottom.



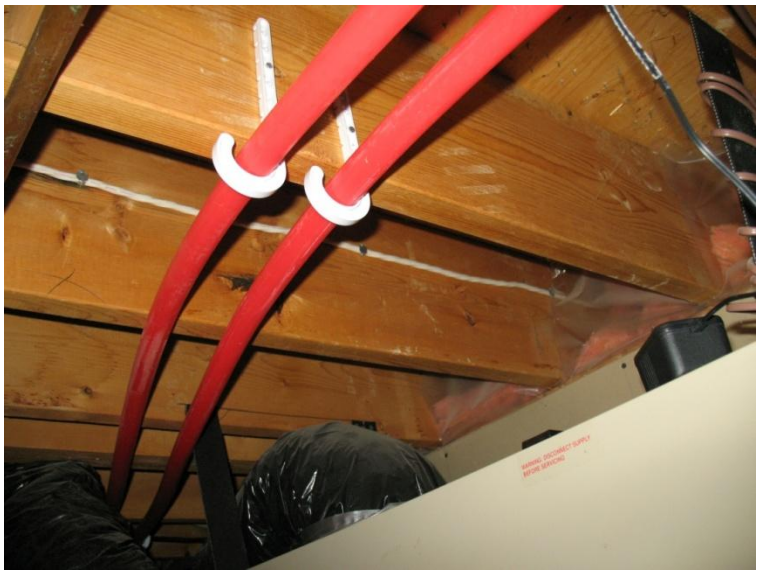
The 3 foot x 4 foot Lid section

The total lid but no wrap on the 2’ by 4’ section

300 feet of 1 inch Pex heat exchanger in the tank. You can see the tension strap across the middle of the tank. The deck board is in place and sealed to the pond liner.

My SHEM controller mounted and connected

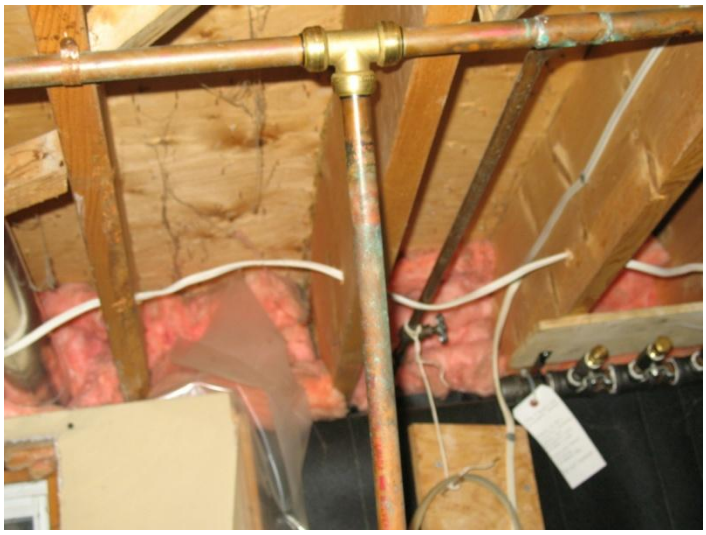
Here is a view of the lines from the collector to the tank. I used the j hooks to allow for fall when crossing the floor joists. The hooks are actually for 1 ¼" pipe but give you some room to make rolling corners.



The connection into the cold inlet to my electric hot water tank

Note the Ball valve so I can isolate the heat exchanger

Below is the cold inlet connection into the heat exchanger. Cold line actually ran directly over the tank! Bonus!



Below is the turn from south to east under the house. The lines ran south to north inside the joist cavity. West to East they are running under the joists on the J hook hangers which allow me to continue the fall.

Pump installed and plumbed up. Left is the inlet from tank. Right is the line going out to the collector. I will be insulating these lines up some more. I ran out of pipe insulation before this picture was taken.

This picture shows the connections into the tank. The line running up is from the collector panel back into the tank.

Here are the interconnections from the heat exchanger leaving the tank. The un-insulated line is the cold water coming into the exchanger. From the cold line above.

The tank with the lid in place

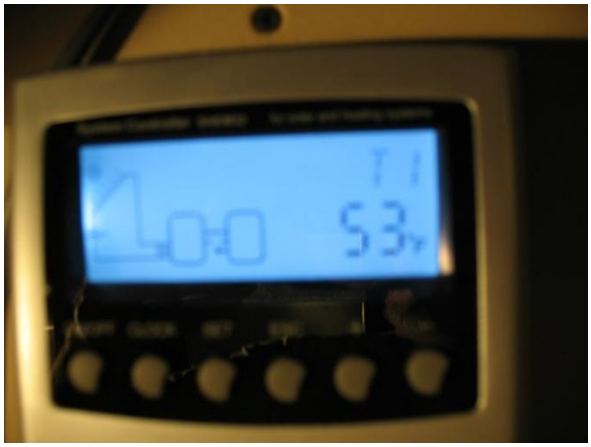
You can see my old deep well pump and lines in the background

Lines to the collector going thru the ducting for my air to air exchanger

The ball valve at the ceiling (Blue handles) Right hand is for exchanger isolation. The left hand is for the tank fill line.

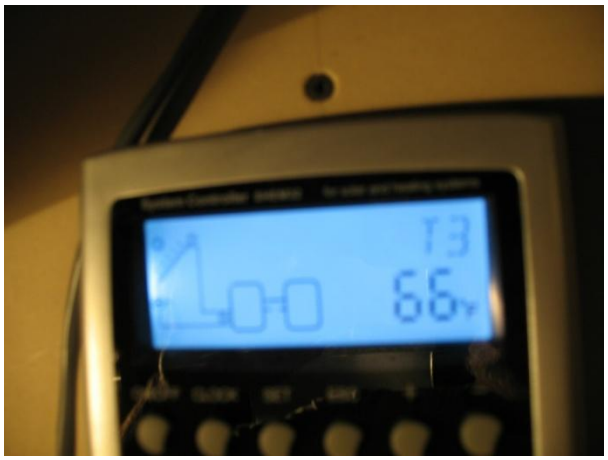
My controller mounted on the wall and all setup. I ended up tweaking the pump shutdown temp from a 4 * delta to a 2*. I found on the somewhat overcast days the pump would cycle on and fill the panel lines and then cycle off right away. The 2* delta seemed to solve that issue. Update: I found that the 2* delta was causing a different issue. The pump was staying on after sunset and pumping hot water into the panel. I have reverted back to the 4* Delta for now. Thinking I may have to move the tank sensor closer to the top of the tank to hit the delta temp more often.

T1 is the collector temperature



T2 is the Tank Temperature after Day 1 of solar gain Initial tank temperature was 66*F

T3 is the temperature of my cold water coming into the house



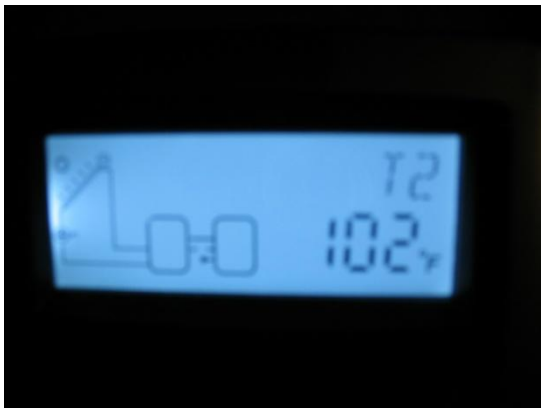
Here are some additional pictures of the collectors after fixing an oversight on my part. I missed tying down the centre portions of the polycarbonate. They ballooned out and broke the silicone calking seal I had on the ends and allowed moisture inside the twin wall. Fortunately it did not leak water into the actual collectors. After cleaning it up; blowing out the moisture inside the twin wall spaces with my air compressor and resealing the ends. I then added additional vinyl pieces and screwed through them, the polycarbonate and into the EMT pipe supports. I also added strips of pond liner behind the vinyl to provide a positive seal at the ends of the panel and where the screws went through to the EMT pipe.

This is now holding the panels in place quite nicely.

We will be filling in under the panels to keep the critters, bees, hornets and bats from making a home behind the panel but that will be a next spring project. I will likely finish it with a tan siding. For now the rock border will have to do across the bottom.

The propane tank is used by our new range and a small space heater in the basement TV room.

October 24th temperature reading as of 8:00pm T1 is the panel temperature, T2 is the tank Temperature and T3 is my cold water line. We have had the furnace /Heat Pump running over the weekend and the piping has warmed up about 2*F



Cost of System

My total investment before taxes, fuel to pick up the goods and the $5.00 a box fee for my delivery mailbox drop in Port Huron came to just over $2700.00 Canadian with an average of par on the US to Canadian Dollar.

Yes it did cost more than Gary's system but here are the major differences:

My collectors are larger and fully framed.

My tank is about twice the capacity at 300+ gallons to Gary's original tank. The tank dimensions forced me to use more sheets of plywood and longer lengths of 2" x4" lumber. They also increased the number of sheets of Polyiso I needed.

The cost of everything has gone up since Gary did his build.

An example of why I purchased in the USA

I bought the ¾" x ¾" x ½" copper Tee's online at Pex Supply for a box of 25 for 1.65 each Plus shipping.

At the big box store in Sarnia the same fittings (both made in Canada by the same company) $4.56 each

I was quoted on the Grundfos pump by a local Plumbing Supplies Company $220.00. Same pump model from Pex Universe online was $82.00 with free delivery

Oh and on the Canadian quoted price you have to add 13% HST. You just cannot escape this tax!

If I order online, ship from New York State (Either Pex Supply or Pex Universe) to Michigan it is state tax exempt apparently.

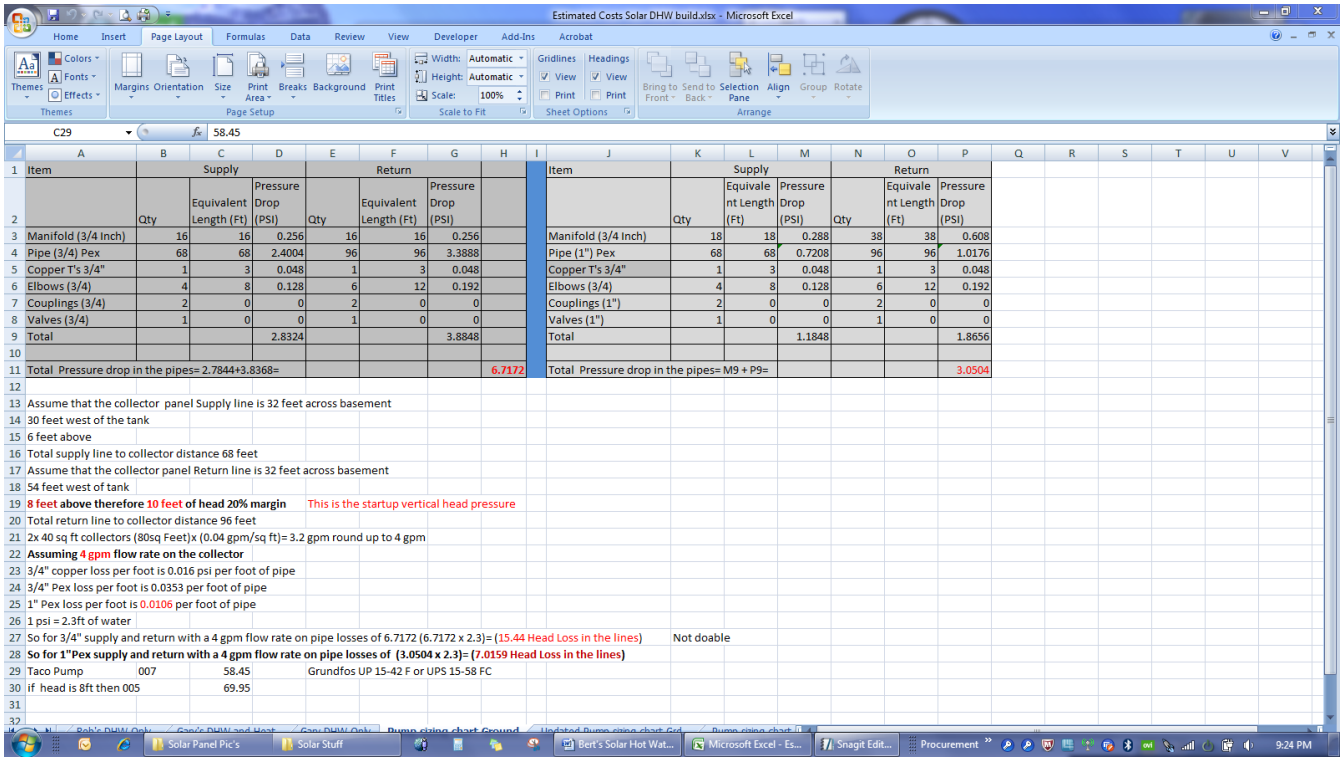
If the customs folks decide to let me go without a trip to secondary to pay the HST, I ended up landing a number of items tax free! Bonus!!!!!

Sorry for the rant but we Canadian's are just paying way too much!

I am a proud Canadian but something is just wrong given the Free Trade Agreement and our par Dollar.

Here is my pump sizing chart for reference only

You would need to plug your values in.



Here is my costing sheet which does not include taxes, shipping, or mailbox fee. I have included the cost of my new Pex tools in the total and my forecasted cost to connect into my heating system.

Item	Description	Unit Cost	Qty	Item Cost	Total cost
Collector					
Frame lumber	2X6 x10 PT	$5.97	2	$11.94	
Frame lumber	2x6 x12 PT	$6.97	4	$27.88	
Backing board	3/4 inch CDX plywood 4x 8	$30.97	3	$92.91	
Copper	1/2" Riser 10 foot lengths	$12.40	14	$173.60	
Copper	3/4" Manifold x 10 foot lengths	$20.44	6	$122.64	
Copper	3/4 x 3/4 x 1/2 T get at Pex supply @ 1.65 each	$1.65	28	$46.20	
Copper	3/4 x 3/4 Elbows	$0.89	10	$8.90	
Copper	3/4 x 3/4 x 3/4 T	$1.72	2	$3.44	
Copper	3/4 x 1/2 Elbow	$5.15	2	$10.30	
Glazing	8mm twin wall sheets	1.60/ sf	80 sf	$128.00	
Steel Glazing support	1/2 EMT 10 foot	$2.18	2	$4.36	
Absorber	premade for 1/2 "	0.72	103	$74.16	
Absorber	premade for 3/4"	0.75	10	$7.50	

Tom's Locking pliers	For over crimp of absorbers	20	2	$40.00	
Back insulation	1.0 inch polyiso (R7)	16.48	3	$49.44	
deckmate screws	1 5/8 " 500 count box	$15.47	2	$30.94	
deckmate screws	1 5/8" 200 count box	$6.93	2	$13.86	
Silicone caulking by the tube	Ge 9.8 oz	$4.47	5	$22.35	
Silicone caulking by the tube	3 pack	$11.27	3	$33.81	
Wood Screws	The Hillman Group 50-Pack 8 x 2 in Flat Head Wood Screws	$6.58	1	$6.58	
Rustoleum Black BBQ Paint	BBQ Paint 12 oz can	$3.97	7	$27.79	
Aluminum primer paint	1 quart	$8.98	1	$8.98	
glue	TiteBond 16 oz	$5.48	2	$10.96	
Vinyl facing strips	12 foot length	$5.96	8	$47.68	
Weather strip seal	EDPM Rubber seal 60 feet	$5.07	4	$20.28	
Total Collector					**$1,025**
Collector Mounting structure					
4x4 x12	4x4 x12	$12.97	1	$12.97	
4x4 x10	4x4 x10	$10.97	1	$10.97	
2x6x 12	2x6x 12	$6.97	4	$27.88	
2x6 x10	2x6 x10	$5.97	5	$29.85	
Bolts	Bolts 5/16 x 51/2 or 6	$20.00	1	$20.00	
Hinges for interconnection	4" square Hinge	$2.81	4	$11.24	
Lag Screws	6" x 5/16" Lag Screws	$2.84	1	$2.84	
QuickCrete	60 lb bag	$2.64	3	$7.92	
Finishing of mounting	TBD				
Screws or Nails	TBD				
Top Cap	TBD				
Total Structure					**$101.67**
Storage Tank and Heat Exchanger					
Plywood	4ft x 8ft x 3/4in Fir CDX Plywood	$30.97	5	$154.85	
Tank frame lumber	2X4 x12'	$4.57	8	$36.56	

EPDM lining	EPDM rubber pond liner 15ft x 20 ft	.69 sqf	300	$207.00	
Insulation	1 inch polyiso (4' x 8')	17.95	10	$179.50	
Heat Exchanger	300 ft 1 inch Pex B Non Barrier	$165.95	1	$165.95	
Deck Board	ChoiceDek 12' Gray Composite Decking	$21.97	2	$43.94	
Metal reenforcement Strips	Simpson Strong-Tie Wood to Wood Tie Plate	$1.68	16	$26.88	
Lid hold downs	Lag Screws x16				
Total Storage					**$815**
Pump and Controls					
Pump cost allowance	UPS15-58FC 3-Speed Circulator Pump @ 82.00	$82.00	1	$82.00	
Pump Flanges	1" sweat Isolator Flange Valves (pair)	$35.95	1	$35.95	
1" copper sweat to 1" pex	1" copper sweat to 1" pex	$1.85	2	$3.70	
Differential Controller & sensors	SHEM32	$90.00	1	$90.00	
18 Awg shielded wire	18 Awg shielded wire minimum 75 ft				
Wiring, tubing, fittings				$20.00	
Total Pump/Controls					**$232**
Connection to House Plumbing					
Pex to connect to house plumbing	1" - (300 ft. coil)	$165.95	1	$165.95	
Pex Hangers	1" pex Tube Talons hangers 50 cnt	$10.95	2	$21.90	
1 ¼"Tubing Hangers	10 per package	$7.95	2	$15.90	
3/4 x 3/4 x3/4 T	Sharkbite	$12.32	2	$24.64	
Pex to 3/4" copper fitting HW tank	1" Pex to 3/4" copper Sweat	$2.30	4	$9.20	

Pex 1" x 1" elbow	Pex 1" x 1" elbow	$2.35	10	$23.50	
Pex Rings	1" pex copper crimp rings 25 per bag	$5.95	2	$11.90	
	1" copper Elbow	$4.86	3	$14.58	
					$287.57
Pex Tools					
Pex Tool set	EverHot PEX Crimp Tool Kit for sizes 3/8", 1/2", 5/8", 3/4" &1"	$112.95	1	$112.95	
Pex Pipe Cutter	Ratchet PEX Pipe Cutter Tool	$14.95	1	$14.95	
PEX De-crimping Tool	PEX De-crimping Tool	$28.75	1	$28.75	
					$157
Heating interconnection					
Small circulation Pump	UPS15-58FC 3-Speed Circulator Pump		1	$82.00	
Water to Air Heat Exchanger	Possibly free AC A Frame		1	$0.00	
Relay			1	$10.00	
Misc wire and tubing				$20.00	
					$112
Total system					$2,729

So if we take 80% of the tank average KWh usage from the beginning of this project. This is an estimate of what the solar system can reduce the electrical usage by.

3500 x 80% X blended rate of 12 cents per kilowatt hour we have a cost per year of $336.00 for hot water

If I am successful and get some saving on my home heating as well, then the payback period is shortened from 8 years to something quite a bit less. We also need to consider that the cost of electricity is not going to go down in my lifetime unless there is a significant discovery in how to produce it in a very cheap manner.

I will know better once I have a heating season completed on what the payback time line will look like.

Would I do this again? In a heartbeat!

Rob M

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