

	PV solar heating with DMPPT450	Thermal Solar	Natural gas
Energy source	39 x 260V PV panels 0.8USD / Watt for panels + 0.3USD cables and connectors 1.1USD/Watt used for calculation	6x SunRain TZ-58 1800 30R Solar Hot Water Retrofit Kit - 2 Collector x 3 {see Link2 and Link3}	5000kWh/year * 25years (1m3 = 10kWh) 90% * (0.01052+0.00632) = 0.01684 / 0.9 = 0.0187 USD/kWh + 17.03/month (I used current price 2.77 USD/GJ (0.0187USD/kWh) price was 6.46 USD/GJ (0.0426USD/kWh) in 2008) {see Link1}
Total rated power [Watt]	10140	13200	Basic Monthly Charge (\$/month) Delivery Charge (\$/m3) Commodity Rate
Energy production in Canada Calgary or Regina [kWh / year]	14436	13002	17.03 0.0632 \$0.1052/m3 \$2.77/GJ
Collector total surface area [m^2]	63.96	31.44	
Cost total for energy source [USD]	11154	11516	7447
Heating device or furnace cost [USD]	445	0	2000
Heating device electricity usage pumps/fans cost [USD] (2kWh/day (6 month heating) for 25 years at 25cent/kWh)	0	2281	2281
Thermal mass storage for solar options min 150kWh [USD]	2400	2400	0
Heat exchanger	0	0	215
Heating radiator / in floor cable or pipe [USD]	460	625	625
Circulation pumps for in floor heating [USD]	0	360	360
Accessories fuse / pipe fittings ... [USD]	300	300	300
Solar cover for thermal solar collector 6x 292USD {see Link4}	0	1752	0
Total system cost [USD]	14759	19234	13228
Advantages:	The most cost effective heating solution in most cases Most reliable since there are no moving parts just electricity and wires In combination with offgrid electricity can save money by reducing the battery capacity Up to \$4000 savings over the life of the system because of reduced battery capacity needed Huge unused electrical energy available in summer months that can be used for something :) No need for an electrical connection can work completely independent. Will not need any maintenance over system life time Can most probably work for more than 25 years used in this example	Takes ~2x less area compared to PV solar panels	Requires the lowest initial investment if house already has a natural gas connection No need for thermal mass storage since gas is always available
Disadvantages:	PV panels take ~2x more area when compared with thermal solar Needs thermal mass for energy storage	More expensive Unreliable compared to PV solar Need to cover the unneeded panels in the warmer months Needs an electrical connection to work Needs thermal mass for energy storage Possibly need repair and maintenance cost	The most expensive if is a new house or old without natural line gas connection Price of natural gas can fluctuate over time Using the cost of natural gas from 2008 will make this much more expensive Less reliable than PV solar Needs an electrical connection to work Possibly need repair and maintenance cost

*System sized for my own small house 65sqm(~700sqft) that is in a cold but relatively sunny climate (Regina Saskatchewan Canada). Solar data for PV are from PVWatts online calculator and for thermal solar are based on last table on Link3 both are for Calgary that has identical temperature and solar radiation as Regina.

Link1: http://www.saskenergy.com/residential/resrates_curr.asp

Link2: <https://nlsolarheating.solarartubs.com/solar-hot-water-retrofit-kit-2-collector-p-246.html>

Link3: <http://www.solarartubs.com/solar-evacuated-tube.html>

Link4: <https://nlsolarheating.solarartubs.com/solar-cover-for-30-tube-vacuum-solar-collectors-p-13.html>