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Data For A Microsolar Hot Water System Installed In Or Near The New Plymouth Region

The information presented here is provided as a guide only and:

(a) Is specifically for a Microsolar system and while other systems may be similar their performance will not necessarily be identical.

(b) There are no guarantees expressed or implied that this or any system will meet the needs of a particular household and it is up to the individual to verify that the system that is on offer will meet the requirements of the individual's household.

(c) There are no guarantees expressed or implied that the system will meet the stated conditions in any month or year.

Summary:
The minimum temperature required by law that a hot water heater must reach to kill the Legionella Bacteria is 55 degrees C and the average New Zealander is said to use about 50 Litres of hot water per day. I have therefore used both of these parameters as set points and the following table is based on them.

- The analysis presented is for a family of 4 adults.
- The overall performance will be about 78% if applied to a family of 4 including two adults and two children or to three adults.
- A couple could expect an overall performance of 88% of the total energy required to be supplied by solar means.

Months	**Percentage of total energy supplied by solar heater**
System size	20 Tubes with 250 Litre Tank
All November through to the end of February	100%
March and October	86%
April and September	51%
May and August	43%
June and July	44%
Percentage of total energy supplied by solar heating annually	**70%**

Increases in size are only recommended where there is sufficient usage to keep the percentage of total energy supplied by solar heater to between 70 and 80 percent. Furthermore, no system will provide 100% of your hot water needs without creating large losses through overheating during the summer period.

Since there is only a 12% improvement to be expected from an increase in size from a 20-tube system to a 30-tube system, it makes little financial sense from several points of view:

- Increasing the size of an object by 50% increases the basic price, the installation costs and the complexity and cost of any modifications to the roof structure by a similar amount.
- The payback time is increased to a generally unacceptable time period, which limits any return on investment.
- In summertime the system may boil if there is insufficient water drawn off on a daily basis, resulting in increased water usage and larger water bills.

Since the solar insolation levels at Kaitaia and New Plymouth are identical the reason that the percentage of the total hot water energy supplied by solar is much less is that the incoming water is much colder that its northern counterpart. The best solution for this is not to expand the solar system but in using grey water heat recovery, which is much cheaper. If we raise the temperature of the incoming water by a degree or two when the shower is in use there will be a large gain in the overall performance and a faster payback time than a larger system.

Also, by selecting the smaller unit, as the children move away from home less water is required – consequently the percentage of hot water supplied by the solar water heater increases with an associated decrease in annual power consumption.

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Solar Resource and Heating Load Calculation Solar Hot Water Project

Site Latitude and Collector Orientation		Estimate	Notes/Range
Nearest location for weather data		New Plymouth	*NIWA Weather Database*
Latitude of project location	°S	42.0	0.0 to 90.0
Slope of solar collector	°	42.0	0.0 to 90.0
Azimuth of solar collector	°	0.00	0.0 to 180.0

Monthly Inputs

Month	Fraction of Month used (0 - 1)	Monthly average daily radiation on horizontal surface (kWh/m²/d)	Monthly average temperature (°C)	Monthly average daily radiation in plane of solar collector (kWh/m²/d)
January	1.00	6.44	21.8	9.81
February	1.00	5.81	22.3	8.78
March	1.00	4.53	21.1	5.51
April	1.00	3.01	18.7	2.92
May	1.00	2.12	16.0	2.98
June	1.00	1.69	14.0	3.03
July	1.00	1.86	13.3	2.99
August	1.00	2.69	13.9	2.87
September	1.00	3.60	15.0	3.88
October	1.00	4.65	16.3	6.81
November	1.00	5.82	18.1	9.13
December	1.00	6.26	19.9	9.71

Property	Units	Annual	Season of Use
Solar radiation (horizontal)	MWh/m²	1.47	1.47
Solar radiation (tilted surface)	MWh/m²	2.08	2.08
Average temperature	°C	17.5	17.5
Average wind speed	m/s	N/a	N/a

Water Heating Load Calculation		Estimate	Notes/Range
Application type	-	Service hot water	
System configuration	-	With storage	
Building or load type	-	House	
Number of units	Occupants	4	
Rate of occupancy	%	100%	50% to 100%
Hot water use	L/d	200	
Desired water temperature	°C	55	
Days per week system is used	Days	7	1 to 7
Cold water temperature Minimum	°C	16.1	4.0 o 20
Cold water temperature Maximum	°C	19.2	5.0 to 25
Months SWH system in use	Months	12	

System Requirements

Energy demand for months analysed	**MWh**	**3.19**
	GJ	**11.49**

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Energy Model - Solar Water Heating Project

Site Conditions		Estimate	Notes/Range
Nearest location for weather data		New Plymouth	NIWA Weather Database
Annual solar radiation (tilted surface)	MWh/m²	2.08	
Annual average temperature	°C	17.5	-20.0 to 30.0
Annual average wind speed	m/s	0.0	Not Applicable
Desired load temperature	°C	55	
Hot water use	L/d	200	
Number of months analysed	Months	12	
Energy demand for months analysed	MWh	3.19	
System Characteristics		**Estimate**	**Notes/Range**
Application type		Service hot water (with storage)	
Base Case Water Heating System			
Heating fuel type	-	**Electricity**	
Water heating system seasonal efficiency	%	100%	50% to 190%
Solar Collector			
Collector type	-	Evacuated	
Solar water heating collector manufacturer		Microsolar	
Solar water heating collector model		M60VT-HE 20	
Gross area of one collector	m²	3.34	1.00 to 5.00
Aperture area of one collector	m²	3.34	1.00 to 5.00
Fr (tau alpha) coefficient (Optical Losses)	-	0.57	0.40 to 0.80
Fr UL coefficient (Thermal Losses)	(W/m²)/°C	1.37	0.30 to 3.00
Temperature coefficient for Fr UL	(W/(m·°C)²)	0.00	0.000 to 0.010
Number of collectors		1	
Total gross collector area	m²	3.3	
Ratio of storage capacity to collector area	L/m²	83.0	37.5 to 100.0
Storage capacity	L	277	
Balance of System			
Heat exchanger/antifreeze protection	yes/no	No	
Pipe diameter	Mm	15	8 to 25 or PVC 35 to 50
Pumping power per collector area	W/m²	0	3 to 22, or 0
Piping and solar tank losses	%	1%	1% to 10%
Losses due to snow and/or dirt	%	3%	2% to 10%
Horizontal distance from machine room to collector	M	5	5 to 20
Number of floors from machine room to collector	-	1	0 to 20
Annual Energy Production (12 months analysed)		**Estimate**	**Notes/Range**
SWH system capacity	KW	2	
	MW	0.002	
Pumping energy (electricity)	MWh	**0.00**	
Specific yield	kWh/m²	671	
System efficiency	%	32%	
Solar fraction	%	70%	0 - 100%

Estimated Deliverables		
Renewable energy delivered over months analysed	**MWh**	**2.24**
	GJ	**8.07**

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