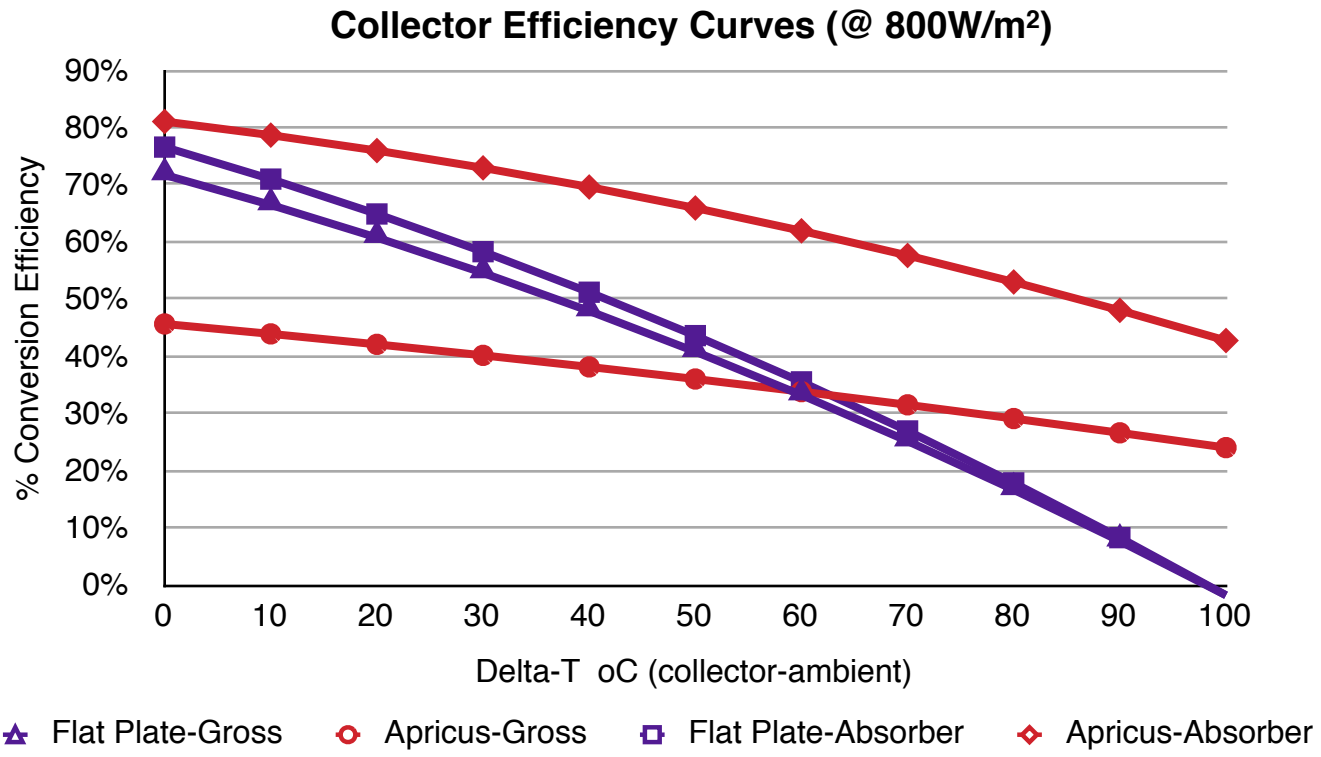
Flat Plate Comparison

Evacuated Tube vs. Flat Plate

Absorber vs. Aperture vs. Gross Area

Often graphs comparing flat plate collectors with evacuated tube collector are based on gross area, which shows the evacuated tube collector with a y-intercept of only 40-45%, and the flat plate around 75-80%. This can be very deceptive making it look like the flat plate is almost twice as efficient. This is of course not the case.

By using absorber area the graph can be radically changed to show evacuated tubes as much higher than flat plates. The graph below shows this clearly, with both gross and absorber efficiency lines for the Apricus evacuated solar collector and a leading flat plate. Aperture which is the exposed glass surface area is often a better or "fairer" surface area value to use, and is gradually becoming the standard for performance values.



So by manipulating which surface area is used, it is possible to show a flat plate being almost twice as efficient as evacuated tube, or considerably lower. It is therefore important that the whole picture is understood so a realistic comparison can be made.

Looking at either the gross or absorber area graph it can be seen there is a significant difference in the shape of the lines. Due to the higher heat loss of the flat plate the curve drops off as the temperature differential increases. At temperatures of around 100°C the efficiency of a flat plate is virtually zero while an Apricus evacuated tube collector can still be converting 40+% of available sunlight into heat energy (based on absorber area). For this reason evacuated tube collectors are required for any applications requiring higher temperatures.

The superior insulation properties of the evacuated tubes are also the reason that the performance in cold regions is far better.

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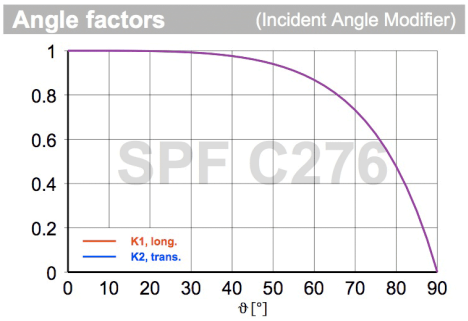
Passive Tracking (IAM)

Another key difference between flat plates and evacuated tubes is the passive tracking.

This is called IAM which stands for Incidence Angle Modifier, so basically how the heat output changes at different angles, with the sun directly overhead and perpendicular to the panel used as the baseline.

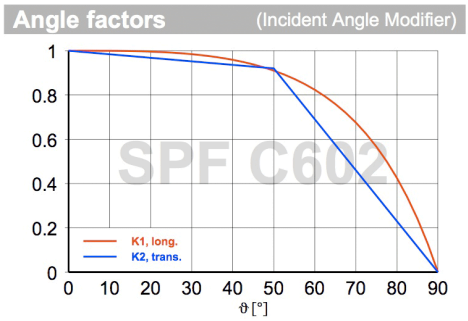
There are two forms of IAM, transversal and longitudinal. Transversal is what we are really interested in and looks at how the collector behaves throughout the day as the sun passes across the sky. Longitudinal looks at the sun's path through the sky throughout they year. All collectors have a similar curve for this aspect, unless of course the install angle is adjusted to track the seasonal sun position. The following graphs show a flat plate collector and the Apricus collector.

Flat Plate



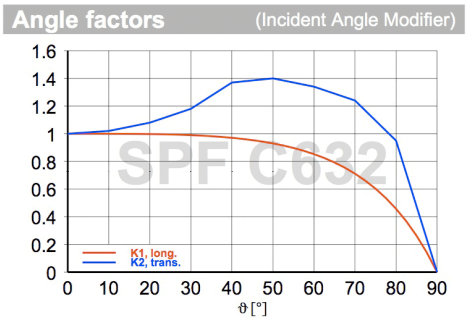
K1, longitudinal (50°)	0.94
K2, transversal (50°)	0.94

Thermomax



K1, longitudinal (50°)	0.91
K2, transversal (50°)	0.92

Apricus



K1, longitudinal (50°)	0.93
K2, transversal (50°)	1.40

Notice the massive difference in the transversal curves (BLUE). For flat plates both transversal and longitudinal are the same, which is pretty close to a cosine curve. Please note that NOT ALL evacuated tubes have this positive IAM curve. Evacuated tubes that have a flat absorber have similar tracking curves (IAM) to flat plates. This is displayed in the middle graph, the Thermomax transversal curve is the same as the flat plate, but is shows as straight lines because they have only taken one value at 50deg.

Apricus collectors have a round absorber which passively tracks the sun and thus provides more stable heat output from mid morning to mid afternoon. Software based output modeling comparing the Apricus collector with a "flat plate" IAM curve and the real passive tracking IAM curve an average daily output difference of 25% was obtained. This highlights the importance of passive tracking, and also explains that while some collectors may have better efficiency curves than the Apricus AP-30, once IAM output is considered the Apricus AP-30 output is greater.

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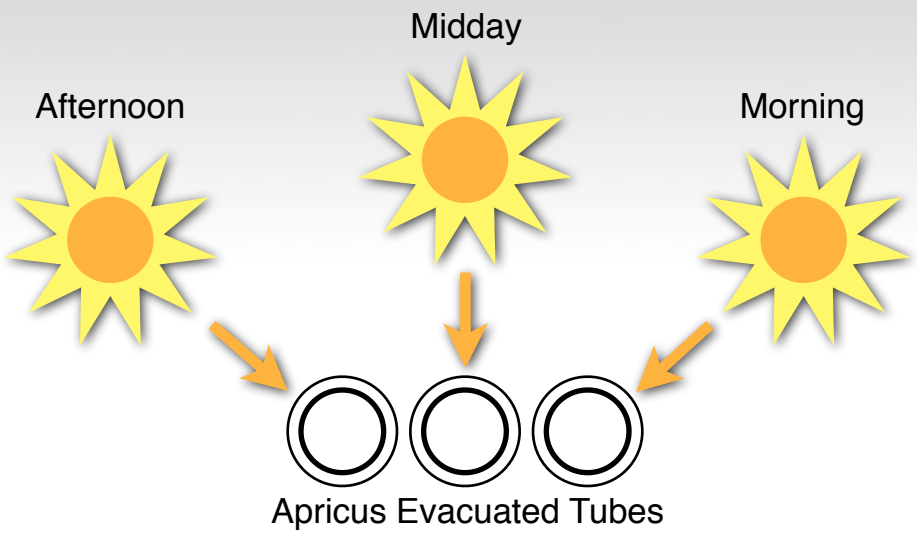

Third Party Data Comparison

When comparing the heat output of the two collectors an adjustment should be made to ensure the difference is actual panel size is considered. The total panel values should be divided by the aperture to give an energy per m^2 value. Most test reports now provide performance variables based on aperture as standard.

The table below shows data from SRCC reports adjusted into Btu/m^2 of aperture area.

		CLEAR	MILDLY CLOUDY	CLOUDY
Apricus*	**C (20°C)**	14,367 Btu	10,349 Btu	6,363 Btu
	D (50°C)	12,057 Btu	8,105 Btu	4,153 Btu
Flat Plate*	**C (20°C)**	11,373 Btu	7,746 Btu	4,216 Btu
	D (50°C)	6,863 Btu	3,628 Btu	784 Btu
% difference	**C (20°C)**	26%	34%	51%
	D (50°C)	76%	123%	429%

*Based on Apricus and Leading Flat plate SRCC test data.

Domestic hot water production will result in the collector operating in both the C and D categories, so it may be valid to take an average of the two categories to get more realistic comparison.

Clear = 51%

Mildly Cloudy = 79%

Cloudy = 240%

So can be seen that there is a significant difference in heat output/m2 aperture area particularly at the high temps (Category D).

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Summary - Key Points

- Evacuated tubes work in all seasons and are more efficient at higher temperature differentials, such as during colder weather or when trying to achieve high target temperatures.
- Apricus systems are designed for ease of installation and assembly. No need for a crane or cherry-picker as may be required for flat plates.
- Higher variability of applications (Spas/hot-tubs, Heating support, Solar cooling).
- Better overall contribution in Fall/Autumn, Winter & Spring.
- Easy to maintain – In the event of a damaged tube(s) simply remove and replace.
- ET can be positioned more favorably towards the sun than flat plate. Can be up to 30^{o} either side of equator pointing and still achieve good solar collection.
- Apricus collectors passively track the sun (IAM – Transversal Incidence Angle Modifier) allowing direct solar exposure from early morning to late afternoon.
- Apricus collector have a much more favorable performance curve. The y-intercept alone is not a key indicator of actual performance. The shape of the curve and IAM must also be considered.
- Flat plate collectors have their place in the market, but when you want higher temperatures or performance in cooler weather, evacuated tubes have a huge advantage over flat plate collectors.