How to compare flat plates to Apricus collectors?

1. ABSORBER vs APERTURE vs GROSS?

Firstly you need to understand that a flat plate is basically all absorber, so the gross area and absorber area are pretty much the same size. For an evacuated tube collector however, the difference is huge. For Apricus solar collector the absorber is only about 59% of the gross area (depending on the method used for calculating gross area).

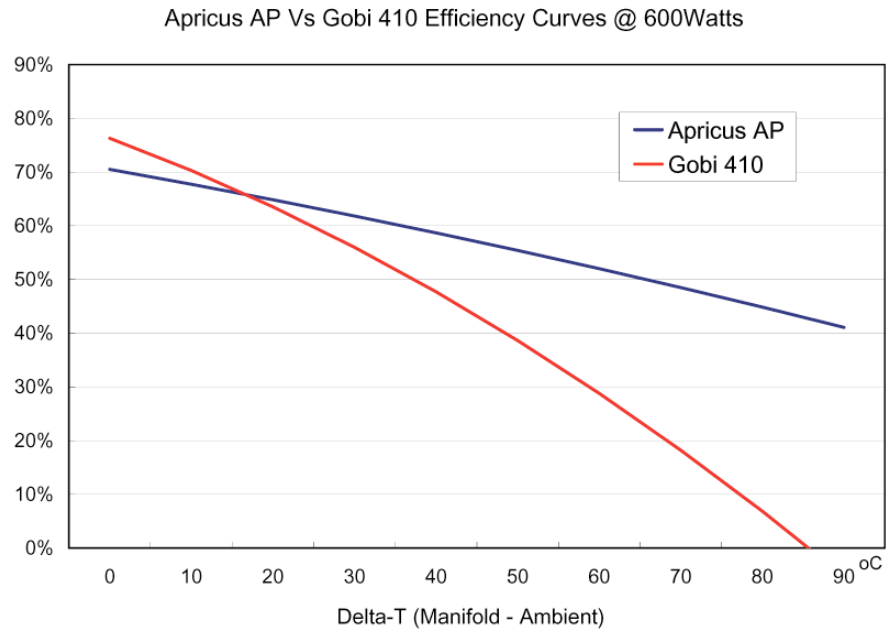
For flat plate collectors the aperture and absorber are almost the same area – different again for evacuated tubes.

2. COMPARING APPLES TO APPLES

When comparing two collectors you MUST compare absorber to absorber to fully understand the difference.
Eg.
Heliodyne Gobi 410 flat plate collector (a top of the range flat plate):
Gross Area = 3.744m^2
Absorber Area = 3.558m^2
Absorber/Gross = 0.95
Gross Area: η = 0.725 a1 = 3.2 a2 = 0.022
Adjusted for Absorber Area: η = 0.763 a1 = 3.37 a2 = 0.023

Apricus AP-30 Solar Collector (based on old SRCC data - soon to be updated)
Gross Area = 4.05m2
Absorber Area = 2.4m2
Absorber/Gross = 0.59
Gross Area: η = 0.416 a1 = 0.96 a2 = 0.0023
Adjusted for Absorber Area: η = 0.705 a1 = 1.62 a2 = 0.0038

These values produce the following curves:



As can be seen there is a significant difference between the two collectors, with the flat plate dropping off greatly as soon as higher delta-t values are reached, hence poor performance in cold weather, or when trying to achieve high output temps. It should be noted that y-intercept alone is NOT a good indication of a collectors performance. The fact that the flat plate is higher than Apricus is not that important. A black rubbish bin full of water may provide an excellent y-intercept value, but have zero efficiency by a delta-t of 30°C due to heat loss. It is therefore important to look at the curve in the temperature range the collector is likely to be operating, which in Toronto (for example) is 30-60oC delta-t during much of the year.

3. DATA COMPARISON

When comparing the heat output of the two collectors the adjustment for absorber area must be made, as the heat output ratings by SRCC are based on total collector area, therefore cannot be used to effectively compare the performance of two different models.

The table below shows data from SRCC reports adjusted into MJ/m^2 absorber area.

	Category	CLEAR	MILDLY CLOUDY	CLOUDY
Apricus	C (20°C)	15.4	11.25	7.08
	D (50°C)	13.3	9.16	5
Gobi 410	C (20°C)	13.5	9.27	5.3
	D (50°C)	8.4	4.77	1.4
% difference	C (20°C)	14%	20%	33%
	D (50°C)	58%	92%	257%

It can be seen that there is a significant difference in heat output/m^2 absorber area particularly at the high temps (Category D).

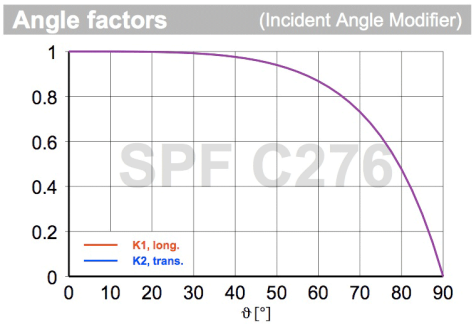
When averaged over a 12 month period, the AP collector could be expected to provide:
Sunny, warm region: ~30+% greater heat output than the Gobi 410 per m2 absorber
Moderate, cooler region: ~50+% greater heat output than the Gobi 410 per m2 absorber

4. 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 difference angle, with directly overhead and perpendicular to the panel used as the baseline.

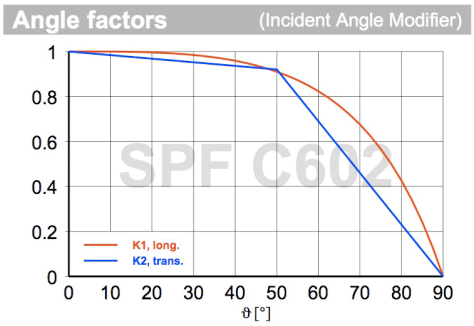
There are two forms of IAM, transversal and longitudinal. Transversal is what we are really interested in and looks at how the collector behaves throughout the day as the sun passes across the sky. Longitudinal looks at the sun's path through the sky throughout they year. All collectors have a similar 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



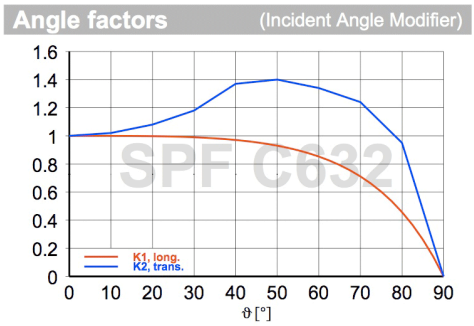
K1, longitudinal (50°)	0.94
K2, transversal (50°)	0.94

Thermomax



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

Apricus



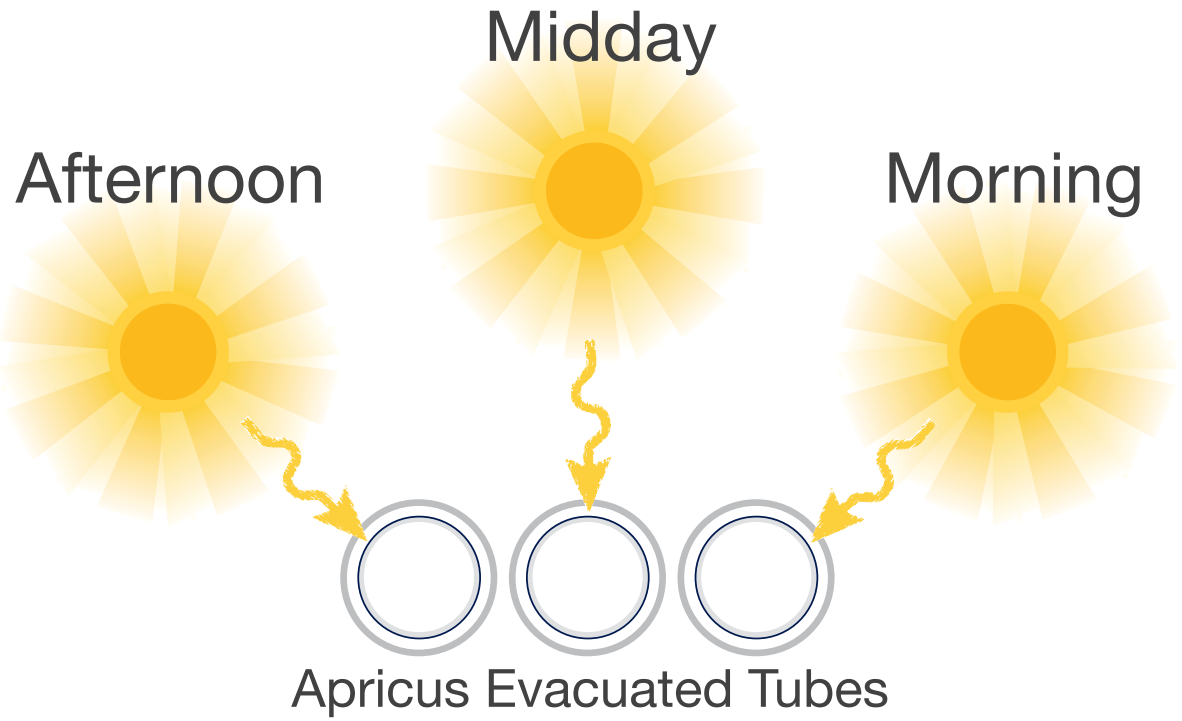
K1, longitudinal (50°)	0.93
K2, transversal (50°)	1.40

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. Thermomax and Sunda 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. Complete modelling using Fchart 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 Thermomax collector have better efficiency curves, field experience is that an AP-30 puts out the same amount of energy as a 30 tube Mazdon - due to the difference in passive tracking!

The following diagram can help to show the passive tracking principle.



5. SUMMARY - KEY POINTS

- Evacuated tubes work in all seasons and are more efficient in extreme temperatures.
- An Apricus collector is not solely dependent on direct sunlight. Also works in all weather conditions where there is direct or diffuse sunlight.
- Apricus systems are designed for ease of installation and assembly. No need for a crane 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.
- As hot water temperature demand increases ET outperforms flat plate (FP).
- ET perform better at achieving higher temperatures due to lower heat losses.
- ET can be positioned more favorably towards the sun than FP collectors and have a greater range of installation flexibility (wall, flat roof, pitched roof, pole mount).
- Apricus collectors passively track the sun (IAM – Transversal Incidence Angle Modifier) allows direct solar exposure from early morning to late afternoon.
- Apricus collector have a much more favorable performance curve. The y-intercept is not a key indicator of actual performance.

Flat plate collectors have their place in the market, and it is likely that Apricus will offer a flat plate collector at some point in the future, as for certain regions and applications flat plates work really well. But when you want higher temperatures or performance in cooler weather, evacuated tubes have a huge advantage over flat plate collectors.

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