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Flat Plate and Evacuated Tube Collectors Explained
What You Need To Know
The "Flat"-Out Truth

Myth:
Evacuated tube collectors are more efficient than flat plate collectors.
Fact:
Evacuated tube collectors can outperform flat plate collectors and flat plate collectors can outperform evacuated tube collectors, but neither one can be considered "more efficient" than the other. The outcome is dependent on the environmental conditions. Collector efficiency varies with respect to the differential between the collector inlet temperature and the outside ambient temperature (see graph on pg. 2). At higher differentials, evacuated tubes prove more efficient, whereas at lower differentials the flat plate collector is superior.

Myth:
Evacuated tube collectors are better suited for domestic water heating.
Fact:
There are three main categories for solar water heating: Seasonal Pool Heating, Domestic Water Heating and High-End Process Heat. The key difference between these applications is the temperature differential at which they operate. Seasonal pool heating only requires the water to be heated to just above, or the same as, the ambient temperature. In this case there is no need for insulation and an unglazed collector is ideal. Solar domestic water heating operates in the range of 20 to 70°C (36 to 125° F) above the ambient temperature, depending on location and season. Within this temperature range, the flat plates tend to prove more efficient than the evacuated tube collectors. At temperature ranges above 70°C as in high-end process heat applications, the evacuated tube collectors will prove most efficient.

Collector Economics
Getting the Best Bang for Your Buck!
To accurately compare solar thermal collectors, one must not only look at the performance of the collectors, but also the cost. The simplest way to do this is to divide the energy output of the collector by the cost, resulting in a Btu/$ or MJ/$ value for each collector. When comparing collectors in this manner, it becomes quite clear that Flat Plate Collectors are far more economical than evacuated tubes.

Cloudy Days
Parting the Clouds
To add another piece to the puzzle, the collector efficiency also varies with respect to the amount of available radiation. On overcast days the evacuated tube collector will perform better than a flat plate collector. Of course, if there's not much sun to begin with, doubling your efficiency is not a big advantage. The question is do you want a collector that will perform better when there is plenty of sun to be captured, or one that will perform better when there is not much sun to start with.

Collector Efficiency

A "Shining" Performance

Collector performance is defined by an efficiency curve. The curve describes how the collector efficiency varies over a range of temperature differentials (Inlet Temperature - Ambient Temperature). The range of temperature differential for domestic water heating varies between 25 and 70°C. The graph below shows the difference between the Flat Plate Collector and the Solar Evacuated Tube Collector.

The blue shaded area on the graph represents the temperature differentials where the Flat Plate collector is more efficient than the evacuated tube collector and the red area is where the evacuated tube collector is more efficient. The graphs are shown at an irradiance level of 1000 W/m2 which is equivalent to full sun.

SRCC Efficiency Curve Comparison