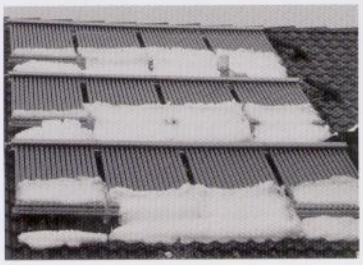
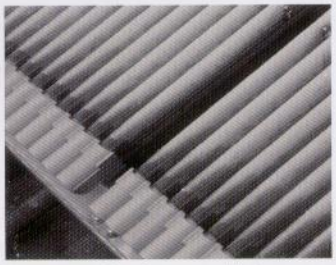
# SOLAR FLAT PLATE VS. EVACUATED TUBE COLLECTORS

## PERFORMANCE IN COLD CLIMATES

The main advantage for evacuated tubes is its low heat loss at high temperatures relative to ambient temperature. However in actual cold, snowy conditions, this poses a problem.

Where ambient temperature is very low, snow and frost play a important role in collector performance. Snow melts and can slide easily down the smooth, warm surface of the glass on a flat plate collector but gets stuck in the gaps between the cold tubes of an evacuated tube collector. The German Centre of Excellence for Solar Engineering at Ingolstadt University of Applied Sciences performed an independent study of a typical European home with both evacuated tube and flat plate collectors mounted on the roof. The following pictures taken of the home in January show dramatic photos of how snow and frost can collect on evacuated tube yet slides off and settles at the bottom of flat plate collectors.





*pictured above: evacuated tube collectors with snow and frost accumulated*
*photos courtesy of Center of Excellence For Solar Engineering at Ingolstadt University*

*pictured above: snow that has slid down the surface of a solar flat plate collector*
*photos courtesy of Center of Excellence For Solar Engineering at Ingolstadt University*

## INSTALLATION

The argument over which type of collector is easier to install is subjective. Both collectors have their advantages and drawbacks in terms of installation.

Proponents of evacuated tube argue that because they come unassembled, one person can easily carry the evacuated tube components onto the roof without needing any special equipment. Proponents of flat plate argue that because they are fully assembled, once hoisted onto the roof, no assembly is required thus greatly reducing installation time. Which type of collector is easier to install is therefore based on the installer's personal preference.

## DURABILITY & LONGEVITY

Nearly all evacuated tube and flat plate collectors sold in the U.S. carry a 10 year limited warranty. Generally speaking both types of collectors are designed to last 20 years or more. However, evacuated tubes are prone to more maintenance and repair for 2 reasons:

1. A quality flat plate collector will use thick (usually 4 millimeters), tempered glass which can take quite a beating under harsh weather conditions such as hail storms. Evacuated tubes use thinner glass (usually 1.6 millimeters) which is more susceptible to breaking and needing to be replaced.

2. Evacuated tubes rely on a vacuum seal to prevent heat loss. Over time this seal can be lost, again requiring the tube to be replaced.

Flat plate collectors very rarely need repairs done to them. A common misconception is that because fluid travels through it, the tubing in a flat plate collector will corrode or leak over time. As long as proper installation and the appropriate fluid is used, this will not happen. The main drawback of flat plate is that if something does break (such as the glass), the installer will usually need to replace the entire collector. Though evacuated tube collectors are more prone to breaking, the tubes can be replaced individually without having to replace the entire collector.

## SUMMARY

- **Performance:** Flat plate gives better year round performance
- **Efficiency:** Flat plate is best at delivering temperatures needed for the most common hot water applications
- **Cost & Value:** Flat plate is generally less expensive and gives more energy per dollar spent than vacuum tube
- **Cold Weather Performance:** Vacuum tube does not carry an advantage over flat plate because snow build up hampers its performance
- **Installation:** Vacuum tube collectors take more time to assemble while flat plate collectors take more effort to hoist onto the roof
- **Durability:** Vacuum tube collectors are fragile and prone to more maintenance

## REFERENCES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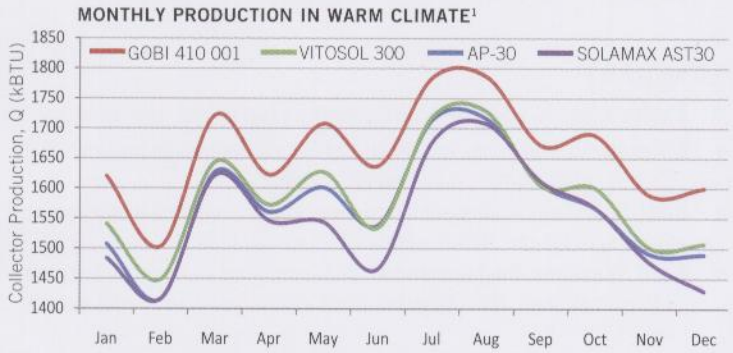
# SOLAR FLAT PLATE VS. EVACUATED TUBE COLLECTORS

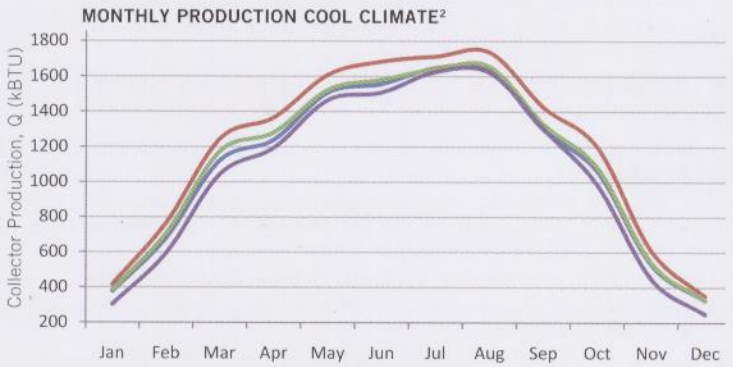
This document has been created to objectively highlight differences and performance characteristics between flat plate and evacuated tube collectors. It addresses concerns and corrects fallacies and assumptions regarding the two collector types. Information was gathered from various independent third parties which have been noted when applicable.

## YEAR ROUND PERFORMANCE

The graphs below show calculated year round energy output for 1 flat plate collector (the Heliodyne GOBI 410 001) and 3 vacuum tube collectors (the Apricus AP-30, Thermomax Solamax AST30 and Viessman Vitosol 300). All 4 collectors are of comparable size. Graph 1 demonstrates collector performance in a warm region. Graph 2 shows performance in a cool, cloudy region. Graph test data was obtained by the Solar Ratings & Certification Corporation (SRCC), the industry's governing independent testing authority. Detailed results and numbers can be found at www.solar-rating.org.

As one can clearly see, energy production (measured in thousands of BTUs) is greater with the flat plate collector compared with 3 competing brands of evacuated tube collectors of comparable size.




1. Collectors adjusted to total aperture area of 80Ft², tilted to 35°, due South with 80.3 gallons per day and 125°F set temperature.
2. Same parameters as (1) above but with 45° tilt.

## EFFICIENCY

The efficiency curves of the GOBI flat plate and 3 vacuum tube brands are shown in the graph below as a function of the system operating temperature. Plotting the operating temperature ranges of the most common solar system applications shows flat plate collectors as a better option. It's only at system operation temperatures above 210°F that some vacuum tubes become a viable alternative.


*At ambient temperature = 74°F; Insolation = 317 Btu/hr·Ft² (1,000 W/m²)

## COST & VALUE

The manufacturing process, mechanical complexity and material selection of evacuated tube collectors make them more expensive than flat plate collectors. This plays an important role when determining the cost efficiency of the collector. The table below shows how much average daily energy (measured in BTUs) per dollar spent on the collector is produced. To calculate this, we simply divided energy output (data provided by SRCC) of the 4 collectors by their list prices*. Comparison of the collectors shows the GOBI as the best value.

**BTU Per Dollar Comparison For Climate Categories A-D****

| Climate Category | Gobi 410 001 MSRP $1,359 | Solamax AST30 MSRP $3,925 | Vitosol 300 MSRP $3,833 | AP-30 MSRP $1,781 |
|---|---|---|---|---|
| A (Warm climate pool) | 30.90 | 8.72 | 8.60 | 16.11 |
| B (Cool climate pool) | 27.22 | 7.69 | 8.08 | 15.55 |
| C (Warm climate DHW) | 22.07 | 5.89 | 7.56 | 13.88 |
| D (Cool climate DHW) | 11.77 | 3.33 | 6.26 | 11.66 |

*List prices obtained direct from manufacturers or dealers (See reference list). Prices cannot be guaranteed 100% accurate and are subject to change.

**SRCC "mild cloudy day" energy collector test output used for categories A-D.

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