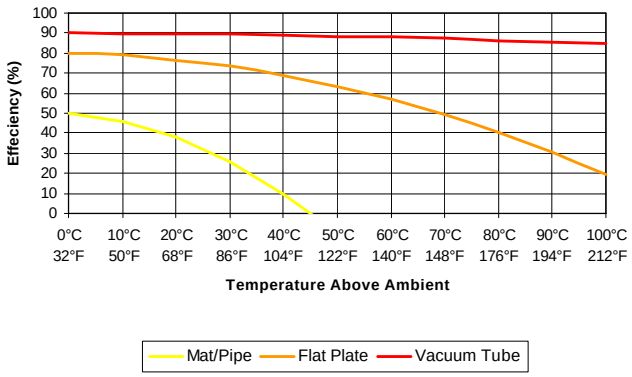
Vacuum Tube Vs Flat Plate Collectors

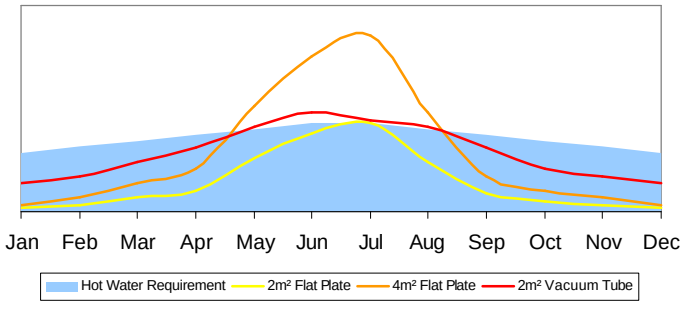
Solar thermal collectors can potentially gain energy through radiation, conduction and convection. The first law of thermodynamics states that heat energy moves from hot to cold, so when looking specifically at energy transfer in solar collectors, conduction and convection will almost always mean energy is being moved from the hotter collector to the colder ambient air. This is because domestic water needs to be heated to c.60°C (swimming pool water <30°C), but the air temperature in the UK rarely exceeds 22°C. So for a solar thermal collector to be effective it must minimise conduction (by using good insulation) and convection (by using a sealing barrier). A solar thermal collector therefore can only gain energy through radiation, hence the development of selective coatings that absorb radiation but limit the amount re-radiated.

	Radiation	Conduction	Convection
Vacuum Tube	Gain	None	None
Flat Plate	Gain	Loss	None

The table on the left indicates the ways in which energy is transmitted in typical modern Vacuum Tube and Flat Plate systems, when the collectors are hotter than the surrounding air. As you can see, both types of collector will be gaining energy through radiation. However, a Flat Plate collector will lose energy through conduction, therefore reducing the amount of energy that can be transferred to your hot water cylinder, pool etc. There is virtually no loss of energy from the Vacuum Tube collector as conduction cannot take place across the near perfect vacuum. Because more of the collected energy is trapped, more energy can be transferred into your domestic hot water system or pool. A vacuum is the only effective way to stop energy being conducted out of the system. Conduction will still take place across double-glazed and gas-filled Flat Plate collectors. Insufficient insulation means a Flat Plate collector is influenced by the surrounding air temperature, wind chill and evaporation of moisture from its surface. A Vacuum Tube collector works virtually independently of these influences as the vacuum acts as an impassable barrier that stops the energy collected from escaping. A Vacuum Tube collector will produce almost as much energy on a sunny winter's day when it is -2°C outside, as it will on a sunny summer's day when it is 22°C outside.



The amount of energy a collector can gain through radiation decreases, as its temperature increases above the ambient air temperature. The graph on the left indicates the efficiency of typical modern Vacuum Tube and Flat Plate collectors at gaining energy at different temperatures above ambient. The performance of a typical rubber Solar Mat/Pipe pool heating system has been added for reference. It is easy to see that the efficiency of all collectors falls as the temperature above ambient increases, but it is important to compare the efficiencies at the particular water temperature trying to be achieved. If we assume that we are trying to heat domestic water to 50°C above the ambient temperature then the Vacuum Tube system is 88% efficient, where as the efficiency of the Flat Plate system has fallen to just 63%. The Solar Mat cannot even heat water to 60°C! At 15°C above ambient (the temperature required for swimming pools) the Vacuum Tube system is 89% efficient, the Flat Plate system a respectable 77% efficient and the Solar Mat a disappointing 41% efficient. These figures relate to how efficiently collectors gain energy at different temperatures above ambient air temperature. They don't take into account the efficiency of the collector at trapping energy (discussed above), the efficiency of the energy transfer from the collecting surface to the heat transfer medium, or the efficiency of the overall system at transferring energy from the heat transfer medium to your hot water cylinder, pool etc.



UK tests have shown that throughout the year, and per m² of collector, a high quality Vacuum Tube system will produce about twice the energy a Flat Plate system will. Even though over the year a 4m² Flat Plate system will produce about the same amount of energy as a 2m² Vacuum Tube system, the vast majority of the energy will be produced during the summer months. The blue shaded area in the graph on the right indicates the amount of hot water required throughout the year. The coloured lines indicate the contribution various systems could make to this requirement. Any energy produced in excess of the hot water requirement is wasted, so as you can see, there is limited benefit of installing an oversized Flat Plate System.

The LaZer2 collectors and associated control systems have all been designed and developed after taking the above factors (plus many more) into consideration. That is why we are confident that a LaZer2 system will out perform any other system currently available. And because we know some people are concerned about the durability of Vacuum Tube collectors, all LaZer2 collectors are covered by a 25-year warranty against loss of vacuum.