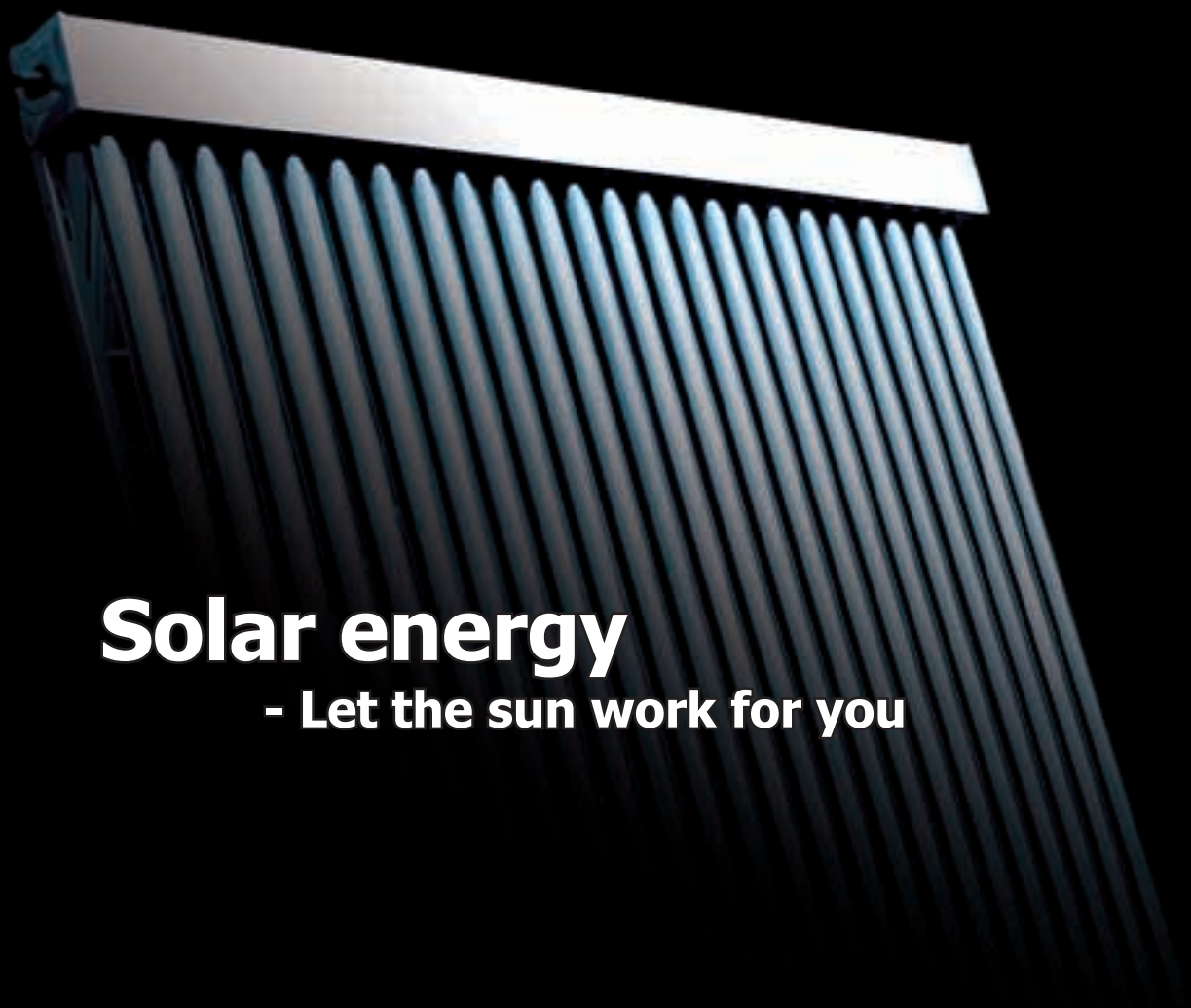
Intelli-heat



# Solar energy

## - Let the sun work for you

# The Sun
## - An immense source of energy

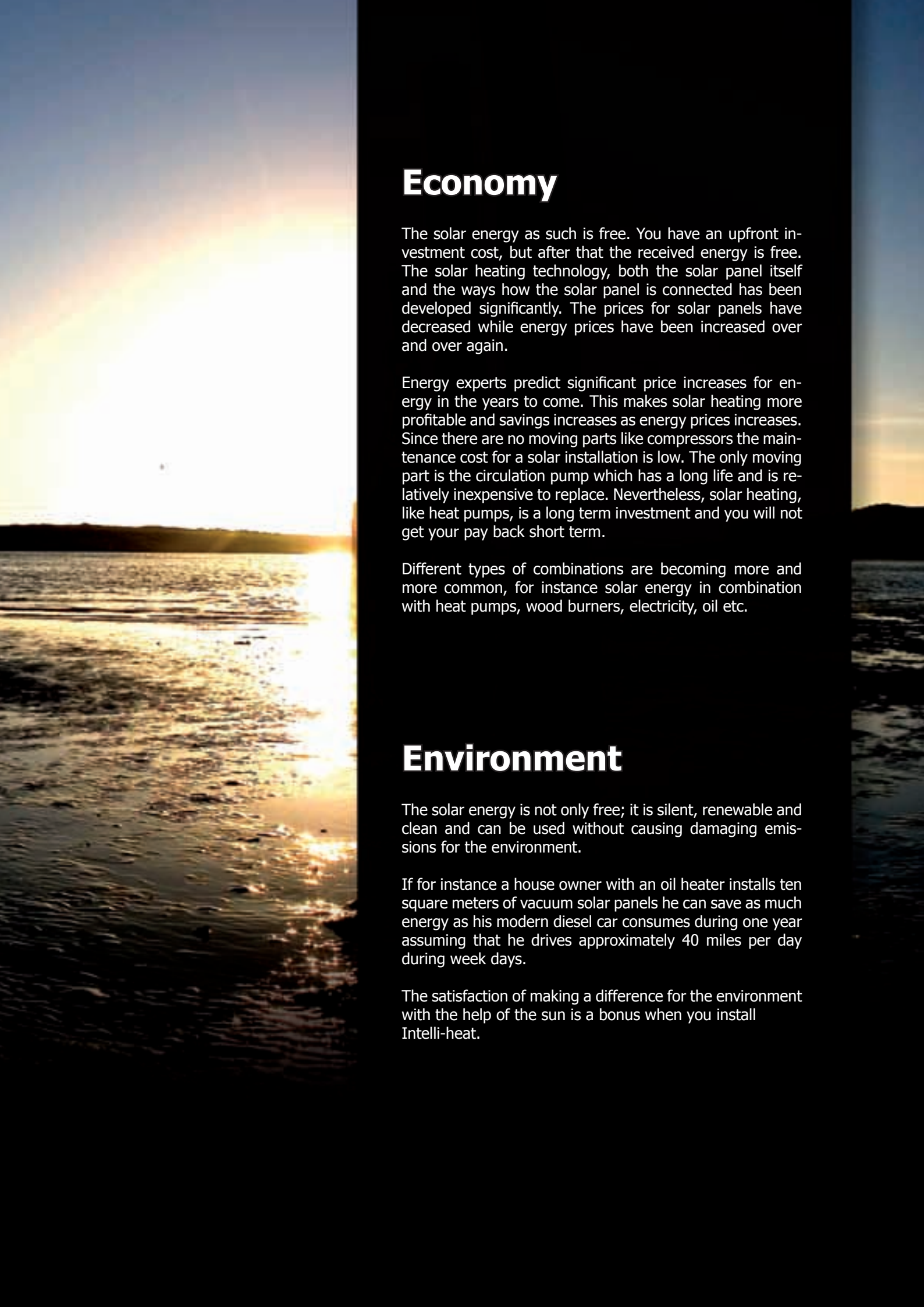
**One hour of sunshine against the surface of the earth equals the amount of energy that mankind consumes in one year.**

**An average sized roof of a domestic house receives roughly six times more energy than the household consumes.**

## Energy from the sun

The sunbeams transforms to heat and can either be used for hot tap water production, or in a combined system where both hot tap water and heating for the house is produced.

In addition to that, there are many different applications such as heating for swimming pools and for industrial processes. Even cooling can be achieved through evaporation techniques.



# Economy

The solar energy as such is free. You have an upfront investment cost, but after that the received energy is free. The solar heating technology, both the solar panel itself and the ways how the solar panel is connected has been developed significantly. The prices for solar panels have decreased while energy prices have been increased over and over again.

Energy experts predict significant price increases for energy in the years to come. This makes solar heating more profitable and savings increases as energy prices increases. Since there are no moving parts like compressors the maintenance cost for a solar installation is low. The only moving part is the circulation pump which has a long life and is relatively inexpensive to replace. Nevertheless, solar heating, like heat pumps, is a long term investment and you will not get your pay back short term.

Different types of combinations are becoming more and more common, for instance solar energy in combination with heat pumps, wood burners, electricity, oil etc.

# Environment

The solar energy is not only free; it is silent, renewable and clean and can be used without causing damaging emissions for the environment.

If for instance a house owner with an oil heater installs ten square meters of vacuum solar panels he can save as much energy as his modern diesel car consumes during one year assuming that he drives approximately 40 miles per day during week days.

The satisfaction of making a difference for the environment with the help of the sun is a bonus when you install Intelli-heat.

## The most common types of thermal solar power

1. The most uncomplicated type of solar panel is the swimming pool solar panel, often manufactured in black plastic or rubber. Without insulation or glass panel over the solar panel this gives a very limited thermal power but it can function relatively well for a pool given the low temperatures in the pool.

2. Another model is the flat model. It has typically got an insulated underside over which there is an absorbing surface covered by glass. This model is still very common and much more efficient than the swimming pool solar panel. Some of the very best flat solar panels can almost compare with the vacuum solar panel when it comes to the total energy produced per year in terms of kWh/m2. The flat model can produce more energy during the summer than the vacuum tube type but considerably less during cold half of the year.

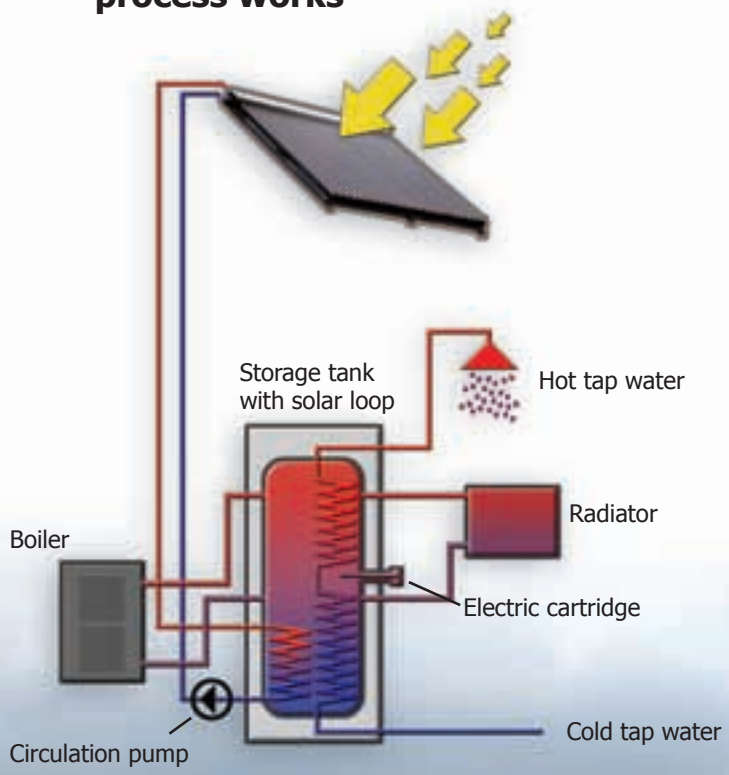
3. The vacuum tube solar panel is the most sophisticated type. It consists of vacuum tubes assembled to modules. Intelli-heat belongs to this type. The vacuum tube solar panel is characterised by its high power and small heat losses. The vacuum tube solar panel is sometimes referred to high-temperature solar panels. The vacuum layer creates a "thermos bottle". Just like a thermos bottle works well both of the beach and in the ski slope the thermal solar panel.

## The two main types of vacuum tubes are:

A) Full vacuum tube with a total vacuum inside a glass tube/vacuum tube with only one layer of glass. With this type of vacuum tube it is unavoidable that the glass tube needs to be sealed against the metal at the top of the tube in order to enclose the vacuum where the tube is passing from the inside of the vacuum tube to the collecting tube. This is a significant problem since the glass and the metal moves differently when heated causing loss of vacuum. Another disadvantage with this type is that the absorbing unit is usually flat making it less effective when the sun hits it from an angle.

B) The thermos type consists of one inner and one outer glass tube seals together in the bottom and at the top. This gives a seamless enclosure of the vacuum layer, in principal like a traditional thermos bottle. This construction makes it possible to keep the vacuum intact over time. This type has furthermore a round absorbing surface (360oC) making it very effective when the sun is coming from the side. Intelli-heat belongs to this type.

## This picture explains how the process works



## The two types of interior configuration in the vacuum tube are:

A) The U-tube type. A tube goes down and turns up in an absorbing sheet normally made of aluminium. With this model it is more difficult to change a faulty vacuum tube. Sometimes the glycol mix has to be emptied from the system. Another disadvantage is a significant pressure fall when the liquid shall pass through all narrow tubes. There is a risk that the circulation will not reach all tubes if an air pocket/bubble appears in one of the tubes in the module. More connection points in the collecting tube gives a higher risk for leakage.

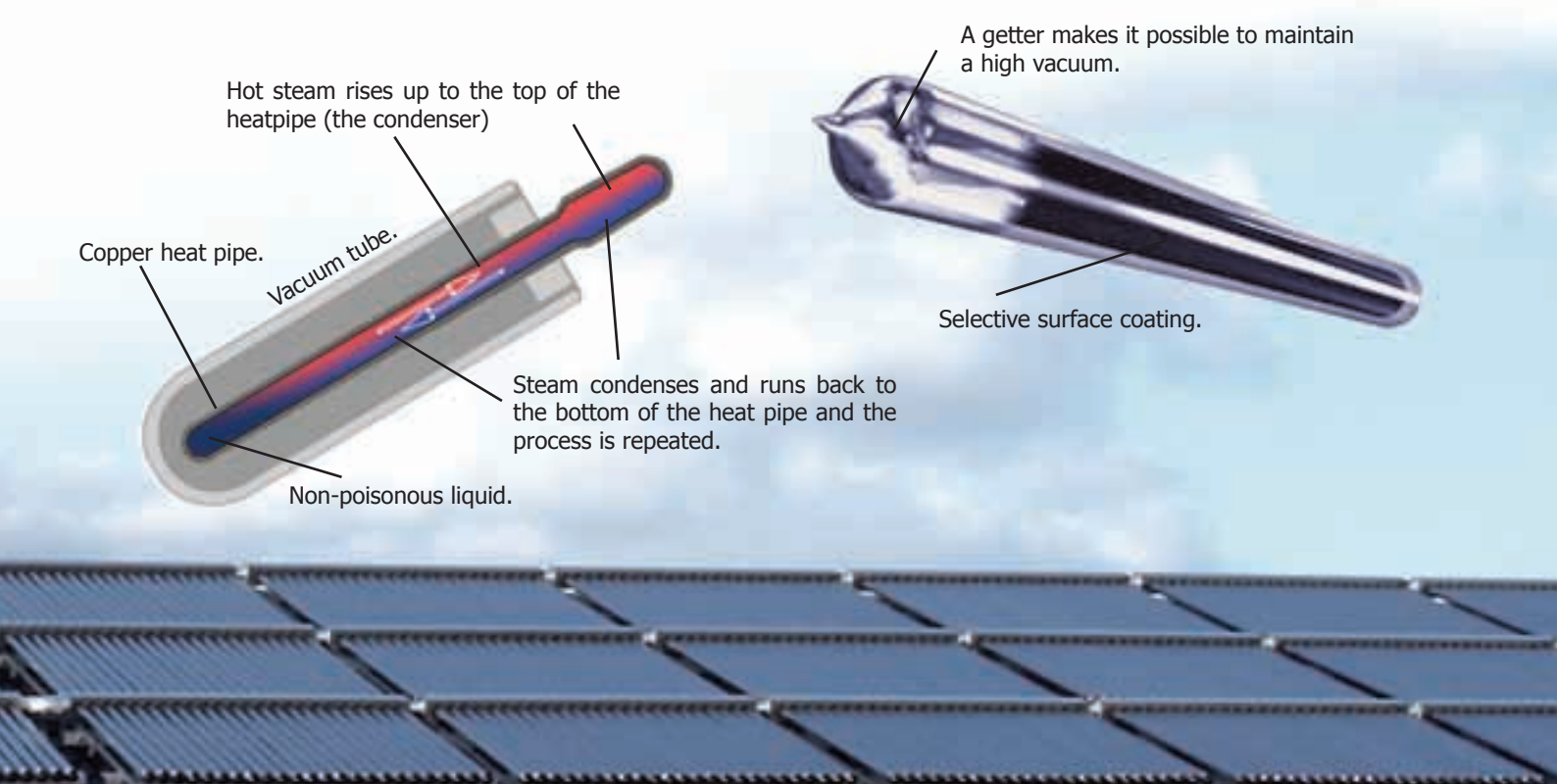
B) Heat Pipe, a copper tube surrounded by heat-conducting flanges usually made of aluminium. The heat pipe contains a small amount of liquid which is evaporated when heated. The gas rises up to the heat exchanging top of the heat pipe where it is heat exchanged to a glycol mix that is transported down to the heating storage, most of the time in the former buffer tank. When the heat exchange occurs in the collecting tube of the solar panel the gas is condensed to liquid form runs down and starts the same process all over again. This is the same principal function as a heat pump but in the heat pump this process is achieved through a compressor while it is achieved by the sun in the case of the vacuum tube. Even a day with overcast skies Intelli-heat can produce more or less heating depending on how thick the clouds are. The main part of the UV-radiation is blocked by the clouds but the bulk of the IR-radiation can pass and is received in the vacuum tube. The Heat Pipe has a so called "dry-connection" (heat transfer). This makes it very easy to replace faulty tube without turning off or emptying the solar panel. This is one of the advantages with this type. Intelli-heat vacuum tubes consist of the "thermos bottle" type and the interior configuration is of the heat pump type.

## Intelli-heat

We focus on some main factors: High efficiency (best in the market as mentioned by the official Swedish test institute), quality and reliable system solutions. We are actively working with product development and lead the development of system solutions for different combinations with thermal solar panels. Since we are buying big volumes of components and have good agreements with manufacturers and logistic partners we can offer competitive prices that our clients can benefit from. Our ambition is to make good technology available for everyone. Installation of solar energy in Europe hit a record level last year and is expected to increase

## Different System Solutions

We have many years of experience and abroad competence when it comes to heating and energy saving. We are therefore in a position to propose solutions for both smaller and more complex systems. We supply systems for domestic houses, camping sites, flats and industries. You can see many of our basic system solutions on our website.



# Technical specification intelli-heat

| **Vacuum tube / Module** | **24** | **18** |
|---|---|---|
| Width of the module: | 1975 mm | 1490 mm |
| Height of the module: | 1950 mm | 1950 mm |
| Thickness of the module: | 160 mm | 160 mm |
| Weight per solar panel: | 80 kg | 62 kg |
| Liquid volume per solar panel: | 1,5 litre | 1,1 litre |
| Gross area: | 3,71 m² | 2,78 m² |
| Aperture area/reference area*: | 2,28 m² | 1,71 m² |
| Absorbing area: | 1,95 m² | 1,46 m² |
| Pressure fall at 0.3 l/s and 20oC ± 2oC | 68 Pa | 55 Pa |

| | | | |
|---|---|---|---|
| Yield** kWh/ m2 per year at | 25 °C | 846 | 842 |
| | 50 °C | 718 | 711 |
| | 75 °C | 609 | 600 |

| | |
|---|---|
| Maximum instantaneous power: | 1,5 kW |
| Stagnation temperature***: | 212,4 °C |
| Maximum pressure: | 9 bar |
| Vaporisation temperature: | Approx: 40 °C |
| Hail resistance: | Approx: 25 mm |
| Wind resistance: | Approx: 30 m/s |
| Glass tube material: | High-grade Borosilicate glass |
| Outer tube diameter: | 58 mm |
| Inner tube diameter: | 47 mm |
| Outer glass thickness : | 1,8 mm |
| Inner glass thickness: | 1,6 mm |
| Vacuum tube length: | 1800 mm |
| Long-term vacuum protection: | Getter / Barium |
| Long-term high vacuum: | 5x10-3 Pa |
| Weight / Complete vacuum tube: | ca: 3 kg |
| Absorbing material: | Inner glass tube with surface coating (cylindrical) |

*Grant qualifying surface
**The yearly yield is calculated for a solar panel for a south facing solar panel at a 45oC angle. Weather data relates to Stockholm 1986. The year is calculated with a simulation program TRNSYS and is based on measurements carried out by SP (a Swedish government founded research institute). Please note (The main purpose of this data is to make it possible to compare to other systems. The real yield in a system will beside the available solar energy also depend on the design of the system, the orientation of the solar panel, habits of the user etc. Source: test report from SP.
***At 1000W / m2 and 30oC ambient temperature.

# The Optimal Water Heater

**Optimal is a flexible solution for the future for different combinations. It makes it possible to connect in an optimal way from day one and also to make amendments. Optimal is developed to allow for optimal installations for thermal solar heating, heat pumps, wood burners, pellets as an electrical heater or as a combination of those systems.**

Maximum security concerning legionnaire's disease. The hot water is heated in double battery loops made of copper. The standing water volume is minimal (for normal water heaters it is common to have at least 120liter standing water). The water is quickly replaced as soon as it is flushed; there is a direct production of hot tap water.

Maximum flexibility. The tank has got many possibilities for connections. They are not connected at the top which gives a bigger flexibility and makes it possible to use different connection combinations. Different height of the connection can be chosen. It is for instance possible to retrofit a pool exchanger to the tank

The loops are kept apart and vertical for optimal heat exchange. We are using 22mm loops to achieve a lower pressure fall and larger heat exchange surface. Our pre-heating loop starts far down in the tank. This gives the lower bottom better layering and allows the solar panel to produce more energy per year.

The tanks are produced in three sizes: 300L, 500L, 750L. 300 and 500 litre are delivered in white or galvanised steel sheet. 750 litre is polyurethane insulated. This insulation is possible to remove.

Optimal 750 Litres

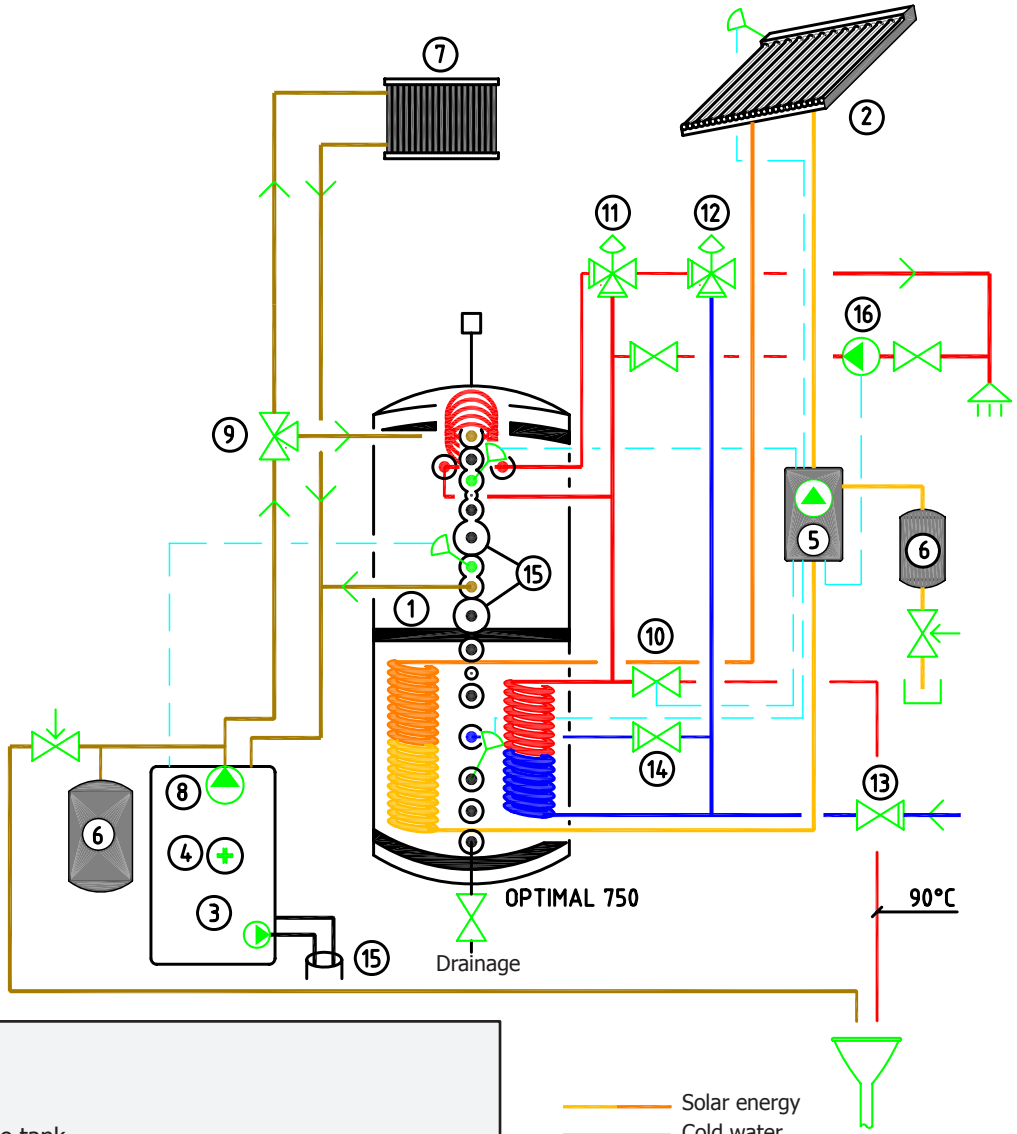
Optimal 300 and 500 Litres

## Technical Specification

| Dimensions | 300 litre | 500 litre | 750 litre |
|---|---|---|---|
| Dimensions: | 600x600x1740 mm | 740x740x1750 mm | 750x1900 mm |
| Insulation: | Mineral wool 70 mm | Mineral wool 70 mm | Polyurethane 40 mm (alt 90 mm) |
| Total height: | 1800 mm | 1860 mm | 1945 mm |
| Hot tap water loop: | Extruded coppercoils 22 mm x 15 m | Extruded coppercoils 22 mm x 15 m | Extruded coppercoils 22 mm x 15 m |
| Pre-heating loop: | Extruded coppercoils 22 mm x 9,5 m | Extruded coppercoils 22 mm x 9,5 m | Extruded coppercoils 22 mm x 9,5 m |
| Solar heating loop: | Extruded coppercoils 22 mm x 15 m (9,5 m) | Extruded coppercoils 22 mm x 15 m (9,5 m) | Extruded coppercoils 22 mm x 15 m (9,5 m) |

# Principles for solar heating

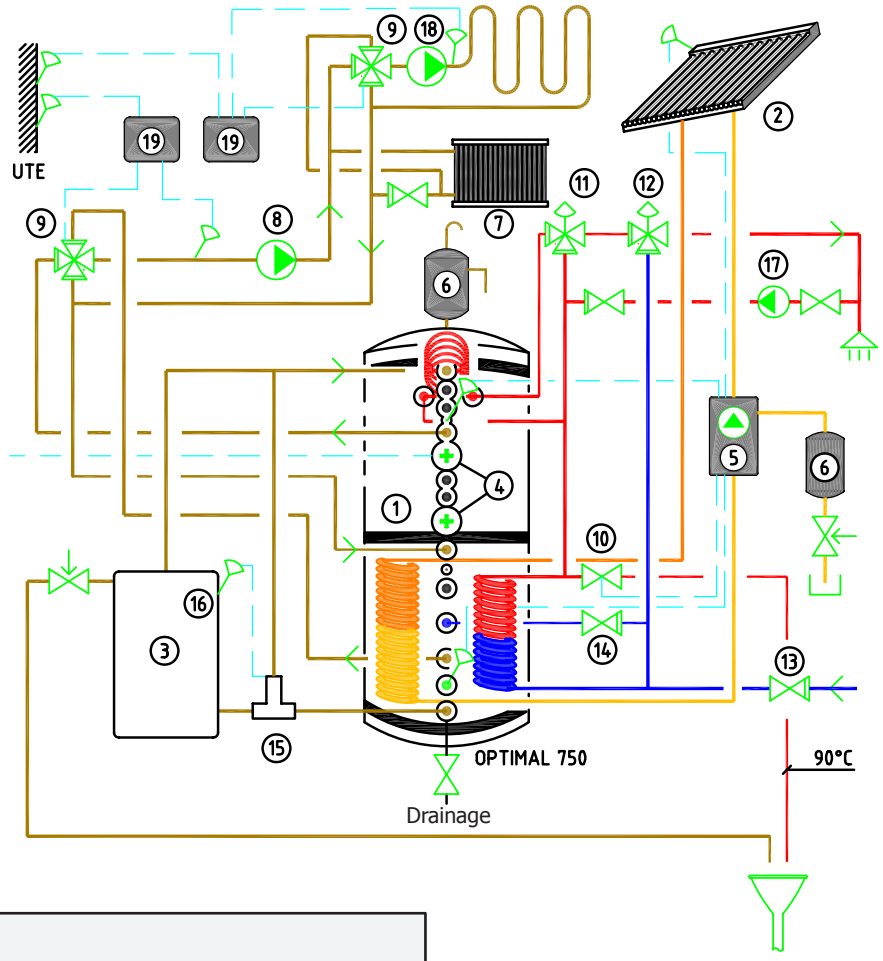
| | |
|---|---|
| Heat sources: | **Solar, heat pump (with floating temperature), electrical** |
| Hot tap water production: | **1. Solar 2. Heat Pump** |
| Heating: | **1. Heat Pump** |




## Legend

| | |
|---|---|
| 1 | Storage tank |
| 2 | Solar panel |
| 3 | Heat pump |
| 4 | Electrical immersion heater |
| 5 | Solar charging package |
| 6 | Expansion vessel |
| 7 | Radiator |
| 8 | Radiator pump |
| 9 | Mixing valve |
| 10 | Magnet valve, controlled by lower tank sensor |
| 11 | Mixing valve 30-60, recommended for 55°C installations |
| 12 | Mixing valve 35-60, recommended for 60°C installations |
| 13 | Venting pipe with security valve |
| 14 | Top up vent |
| 15 | Borehole/ground loop |
| 16 | Hot water pump |

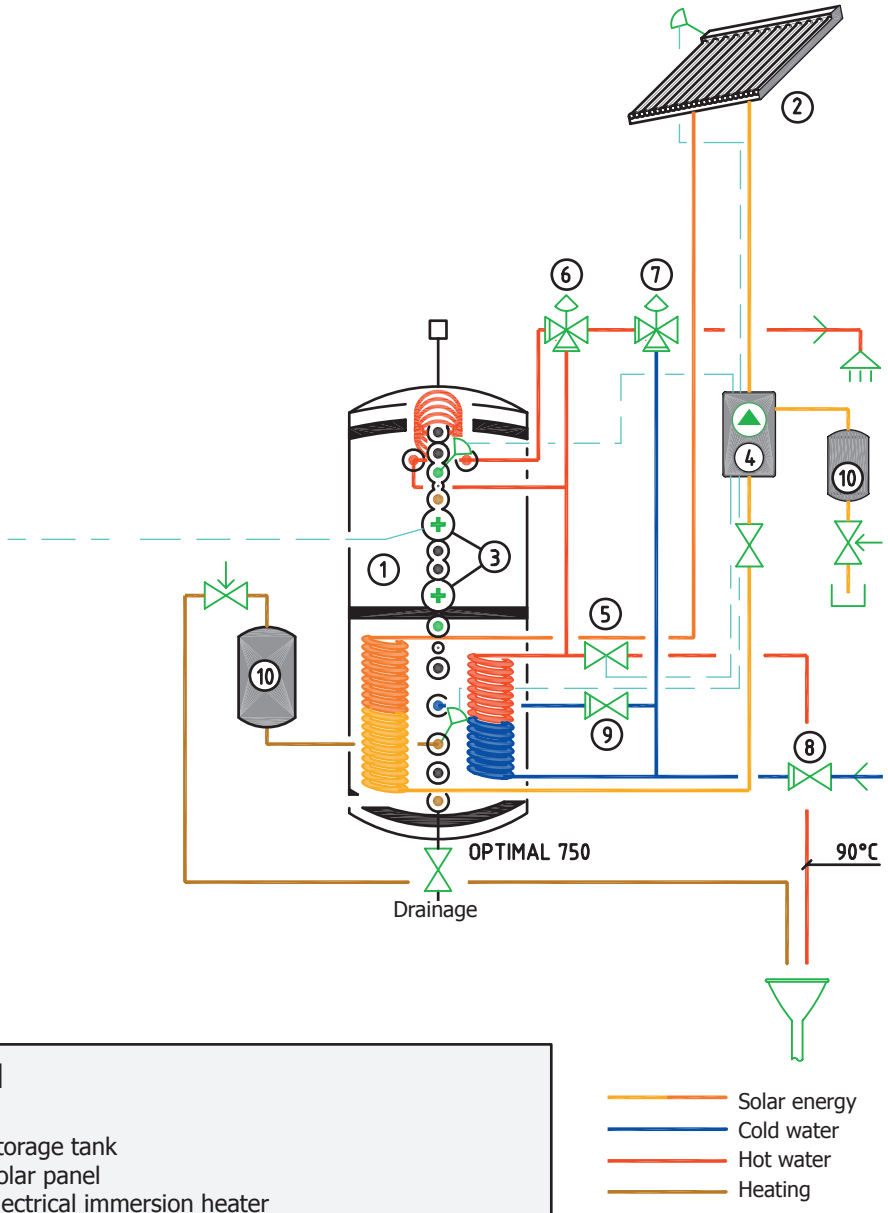
| | |
|---|---|
| Heat sources: | **Solar, Biomass boiler, Electrical** |
| Hot tap water production: | **1. Solar 2. Biomass boiler, Electrical** |
| Heating : | **1. Solar 2. Biomass boiler, Electrical** |




## Legend

| | |
|---|---|
| 1 | Storage tank |
| 2 | Solar panel |
| 3 | Biomass boiler |
| 4 | Electrical immersion heater |
| 5 | Solar charging package |
| 6 | Expansion vessel |
| 7 | Radiator |
| 8 | Radiator pump |
| 9 | Two position shunt |
| 10 | Magnet valve, controlled by lower tank sensor |
| 11 | Mixing valve 30-60, recommended for 55°C installations |
| 12 | Mixing valve 35-60, recommended for 60°C installations |
| 13 | Venting pipe with security valve |
| 14 | Top up vent |
| 15 | Wood charging device |
| 16 | Hot gas thermostat controlling the wood charging device |
| 17 | Hot water pump |
| 18 | Underfloor heating pump |
| 19 | Control unit |

| | |
|---|---|
| Heat sources: | **Solar, Electrical.** |
| Hot tap water production: | **1 Solar 2. Electrical** |




## Legend

| | |
|---|---|
| 1 | Storage tank |
| 2 | Solar panel |
| 3 | Electrical immersion heater |
| 4 | Solar charging package |
| 5 | Magnet valve, controlled by lower tank sensor |
| 6 | Mixing valve 30-60, recommended for 55°C installations |
| 7 | Mixing valve 35-60, recommended for 60°C installations |
| 8 | Venting pipe with security valve |
| 9 | Top up vent |
| 10 | Expansion vessel |

2007-05-24

## Annual Energy Output

The solar collector Intelliheat 58/24*1800 and 58/18*1800 accomplish with the requirements of SP´s "initial testing of solar collectors". The purpose of the Annual Energy Output is to give end users a possibility to compare different kinds of solar collectors. The comparison can be based on the annual energy output from the collector below. With knowledge of cost of the collector and the energy output it is possible to calculate the price per annual output. The mean temperature in the collector is important in a comparison of thermal solar collectors.

The presented figures are associated to gross energy output at the connections of the solar collector. The output is given for three different temperatures and applications:

25°C Swimming pools
50°C Domestic hot water, Space heating
75°C Space heating, District heating, Process heating

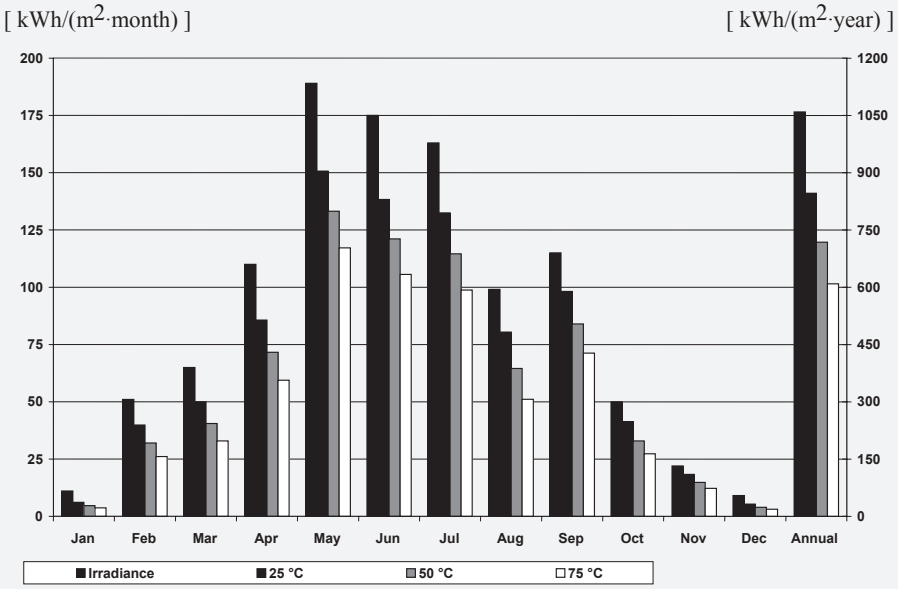


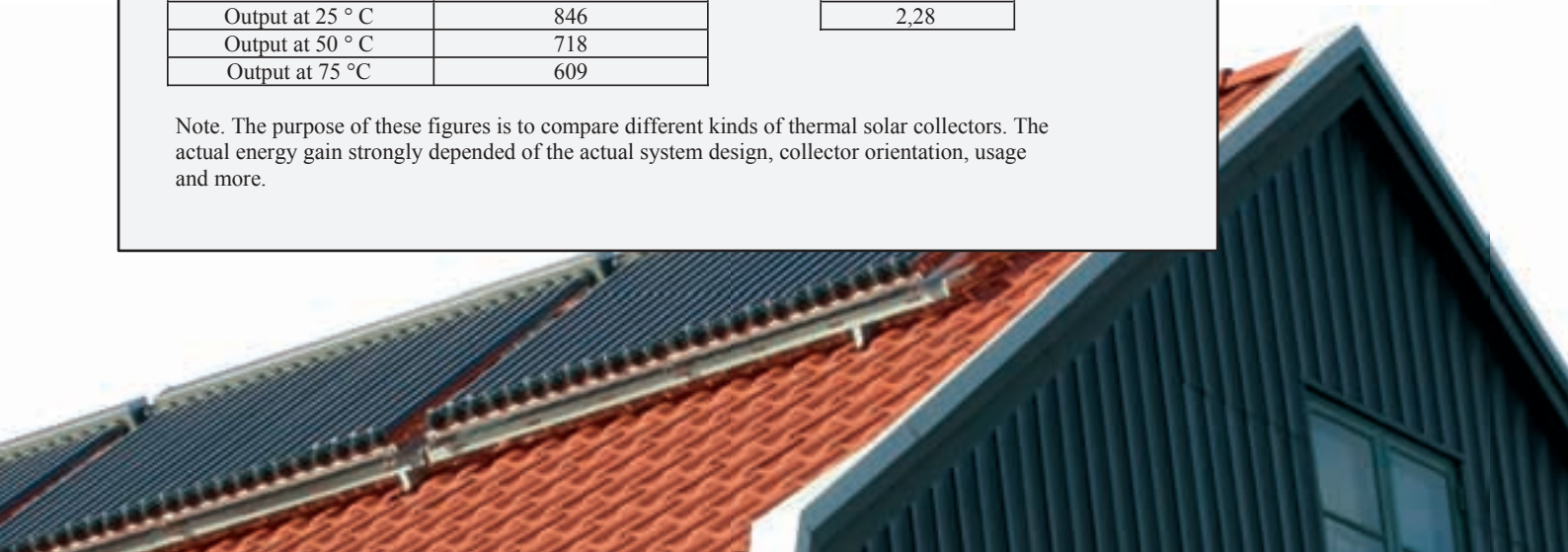

Diagram 1. Calculated Annual Energy Output at mean temperature 25, 50 and 75°C, together with total global solar radiation.

The energy output is calculated on a collector facing south and a tilt angle of 45°. Weather data is Stockholm 1986. The energy output is calculated with TRNSYS och based on thermal performance testing at SP National Research Institute of Sweden.

| Total Global Irradiance 1056 kWh | Annual Energy Output [ kWh / m2 ] |
|---|---|
| Output at 25 ° C | 846 |
| Output at 50 ° C | 718 |
| Output at 75 °C | 609 |

| Reference area of testing [m2] |
|---|
| 2,28 |

Note. The purpose of these figures is to compare different kinds of thermal solar collectors. The actual energy gain strongly depended of the actual system design, collector orientation, usage and more.



# Intelli-heat

## Solar heating systems

**Retailer / Installer:**

**Manufacturer:**

Sol & Energiteknik SE AB


Tel: **+46(36) 513 45**
Fax: **+46(36) 513 44**
E-mail: **contact@solenergiteknik.com**
Web: **www.solenergiteknik.com**
**www.solenergiteknik.se**

Esbjörnarp 10
SE-561 92 Huskvarna
Sweden