On High Mountains

By Robert Kyriakides, Genersys plc

The highest mountain in Germany is called the Zugspitze and in the late 1990s a hotel called the Schneefernerhaus closed down and its premises were adapted to use as an environmental research station. Its main task is to measure accurately and carefully changes in atmospheric pollution. There are many places doing this work throughout the world and the sum of their research adds greatly to our knowledge about global warming and climate change.

If you went skiing on the Zugspitze, around noon you would see on the south side high on the wall of the environmental research station, a large mass of dark black wall. A few hours later, this wall will appear to be silver. However, you would not be looking at a wall in the conventional sense, but a wall of vacuum thermal solar panels some 100 square meters in area, designed and installed by ThermoSolar, Genersys' associated company based in Bavaria. These panels provide around 30% of the spacing heating for the environmental research centre all year round.

I should explain some deviations from the normal means of installing thermal solar systems that make the Zugspitze both dramatic to view and interesting to consider.

At these latitudes, we normally recommend mounting the panels at an angle of between 40 and 45 degrees. The Zugspitze's panels are mounted vertically, and thus do not receive the maximum amount of solar radiation. The reason for this is snow. In normal conditions, snow will melt from a well - designed solar thermal panel first - usually before it melts from evacuated tubes - but these are not normal conditions.
The panels are mounted on a mountain side some 2,650 metres above sea level. In these conditions snow is usually present ten out of twelve months each year, and so mounting the panels as a vertical wall prevents the snow collecting on them and enables the panels to collect light bouncing off the surrounding snow fields. The low winter sun makes the vertical angel more efficient in winter, because the sun's rays strike at a better angle.

On good days, the panels achieve the solar constant which is 1.4kWm2; the yearly energy gain is 1950kWh/m2. For eight months of the year the panels provide a solar fraction of 100% and only in deep winter does the heat provided by the panels prove insufficient. I have to admit that there some advantages in mounting panels on a building 2,600 meters above sea level. There are very good light levels so high; clouds and fogs often shroud the base of the mountains but leave the peak in bright light.

ThermoSolar's 100 square meters of panels are evacuated to around 3mbars of pressure. This is about 3% of atmospheric pressure at sea level. Although it is not a perfect vacuum (does such a vacuum exist?) it is reinforced with krypton gas, just like installations we have completed in Kent and London. For my technically minded readers I am told that filling the panels with 30mbar krypton increases the insulation tremendously. The heat transition coefficient is 2.6W/m2K, which keeps heat losses to a minimum even in a place where temperature drops to -40degrees c.
The heat that the panels create from light is stored in a 100 m3 insulated fire tank. Because of the tremendous heat potential, ThermoSolar had to design safeguards top ensure that the water stored would never be hotter than 60 degrees Celsius, otherwise fire fighters would be endangered in the event of fighting a fire. Computer simulations indicated that water temperatures would not exceed 45 degrees and would often be far lower.

The design team used an electrical heat pump to raise water temperature to that needed for space heating. Electricity was chosen as a supplemental heating system rather than gas or oil because the station's scientific measurements in atmospheric pollution would be affected by emissions. The station also specified the vacuum panels that we called the Genersys 1450 because they do not contain insulation, which can also affect the minute readings that are taken.
All in all, the figures work out like this; the overall energy demand is 270MWh a year. The thermal solar panels produce 80 MWh, the heat pump 44MWh and the electrical boiler around 145MWh. ThermoSolar tell me that the solar thermal contribution could have been higher by installing more panels but there were budgetary constraints in that the system was designed commercially and not as an exercise in creative engineering research.

As a result the important work of measuring atmospheric pollution is still being carried on in conditions unpolluted by the energy requirements that are needed to keep the researchers warm, using not only the fossil fuel industry but also sustainables working in partnership for a cleaner future.

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