Comparison of Thermal Performance of Different Solar Collector Technologies for Solar District Heating Systems Based on Solar Keymark Certificates and SCEnOCalc

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Introduction The freeware tool SCEnOCalc (Solar Collector Energy Output Calculator) which has been developed within the European project QAiST (Quality Assurance in Solar Thermal Heating and Cooling Technology) is a reliable and easy to use tool to assess and to compare the thermal performance of solar collectors. Using SCEnOCalc together with the results published in Solar Keymark certificates the method has three major advantages compared to other calculation methods:

1. High transparency due to the fact that the collector performance test results as well as the validated software tool are publically available (www.estif.org/solarkeymarknew/)
2. Only reliable thermal performance test results which were determined by accredited test laboratories are listed in the Solar Keymark Certificates
3. The quality of the produced collectors is controlled by periodically conducted factory inspections of the production sites and physical inspections of the certified solar collector

SCEnOCalc is used in this contribution to compare 8 different collector technologies based on the yearly collector gain per m² of gross collector area.

Collector technologies

The thermal performance of the following collector technologies have been evaluated.
Collector data sheets are available under www.estif.org/solarkeymarknew/

No.	Collector technology	Solar Keymark register no.
#1	Evacuated flat plate collector	011-7S1890 F
#2	High end evacuated tubular collector with CPC reflector	011-7S2031 R
#3	Standard evacuated tubular collector with CPC reflector	011-7S768 R
#4	Standard evacuated tubular collector with heat pipe	011-7S2122 R
#5	Standard evacuated tubular collector with direct flow	011-7S060 R
#6	Large scale flat plate collector with double glazing	011-7S1520 F
#7	Standard flat plate collector with high selective coating	011-7S052 F
#8	Standard flat plate collector with selective coating	011-7S1145

The Solar Keymark
CEN Keymark Scheme

During the performance test under the Solar Keymark Scheme usually water is used as heat transfer fluid. By use of antifreeze the yearly collector gain may be smaller than the collector gain predicted for water.

Results for different mean fluid temperatures and locations

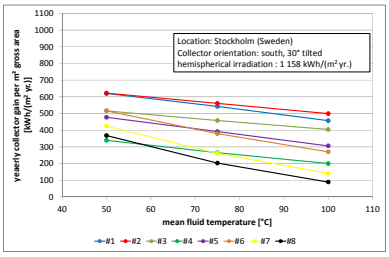

Figure 1: Collector gains for Stockholm

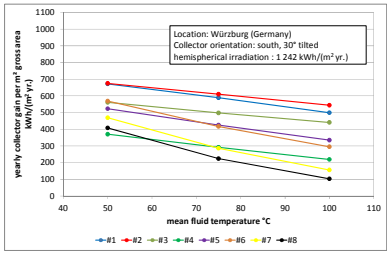

Figure 2: Collector gains for Würzburg

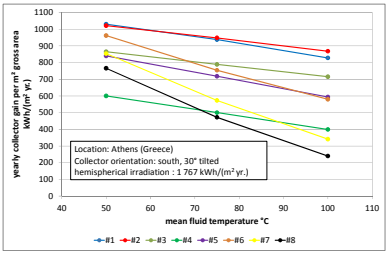

Figure 3: Collector gains for Athens

Results for different tilt and azimuth angles

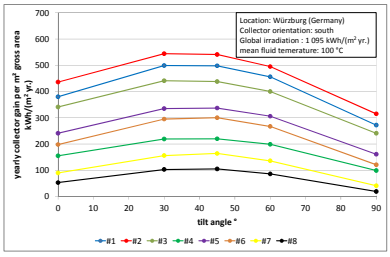

Figure 4: Collector gains for different tilt angles

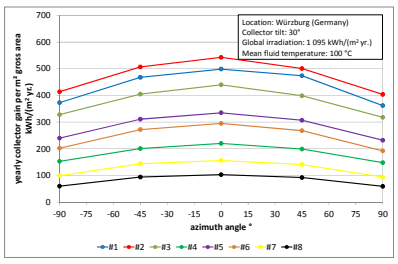

Figure 5: Collector gains for different azimuth angles

Conclusions

- Using certified collector performance data and the software tool SCEnOCalc gives at present the best available guarantee for a reliable assessment and comparison of the thermal performance for solar thermal collectors.
- Performance figures based on *collector gross area* are the most appropriate way to compare the performance of solar thermal collectors.
- Evacuated tubular collectors with CPC reflectors and evacuated flat plate collectors can deliver up to 25 to 80 % (depending on the location, see Figure 1 to 3) higher collector gains per m² gross area than high end flat plate collectors at mean fluid temperatures of 100 °C.
- Evacuated tubular collectors without reflector do not have higher collector gains than flat plate collectors due to a small ratio of aperture to gross area.
- The higher the yearly energy gain of a collector the lower is the decrease (in %) of the yearly energy gain in case it is not oriented south with the optimum tilt angle, e.g. facing east or west or at high tilt angles.