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Solar Thermal Technical Note

Recommendation[1]: Converting Solar Thermal Collector Area into Installed Capacity (m^2 to kW$_{th}$)

Source: International Energy Agency, Solar Heating and Cooling Program Technical Note

1. Introduction

In the past, the installed base of solar thermal systems was measured in terms of collector area (square meters or square feet) rather than in terms of installed capacity to produce heat. As a consequence, solar thermal was not easily comparable with other (renewable) energy sources and thus was often left out of relevant statistics.

On 8th September 2004, representatives of the International Energy Agency's Solar Heating and Cooling Programme (IEA SHC) and several major solar thermal trade associations met in Gleisdorf, Austria (for a list of participating associations please see the end of this document). During this meeting, they discussed and agreed on an official recommendation for how to convert solar thermal collector area into installed capacity. Work is currently being done on defining also a suitable methodology to convert collector area into energy yield.

This recommendation was published jointly by IEA SHC and the involved associations who hope that this methodology will be used worldwide by all those who are concerned with solar thermal statistics.

2. The recommended conversion factor

For the purpose of solar thermal statistics, the installed capacity ([kW$_{th}$] – Kilowatt thermal) shall be calculated by multiplying the aperture area of the solar collector area [m^2] by the conversion factor 0.7 [kWth/m^2].

This factor shall be used uniformly for unglazed collectors, flat plate collectors and evacuated tubular collectors.

3. Explanatory Note

The following notes explain the origins of the conversion factor of 0.7 kWth/m^2.

3.1 Area

Three definitions of collector area exist:

> Absorber area = the area of absorber
> Aperture area = the area in which the solar radiation enters the collector
> Gross area = the area based on the outer dimensions of collector

All three areas are defined for glazed liquid heating collectors in the European standard EN12975-2 annex I. In EN12975-2 test reports all three areas are given. Efficiency coefficients in these reports are given based on both absorber area and aperture area. As there is a current trend towards using aperture area on

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[1] This document is based on a discussion paper by ESTIF technical consultant Jan Erik Nielsen.

certificates (e.g. DIN CERTCO Solar Keymark, SPF Factsheets) aperture area[2] shall be used.

This implies:

It is assumed that the existing statistics have counted aperture area.

Aperture area should be counted in future statistics.

Capacity conversion is done using the efficiency based on aperture area.

3.2 Collector Classification

Proposed collector classification:

Unglazed flat plate collectors: All unglazed collectors (selective and non-selective, tubes, tube/fin, all-wetted, …).

Glazed flat plate collectors: All glazed collectors of every type (single/double glazed, with/without convection suppression, selective and non-selective, tubes, tube/fin, all-wetted, air/gas…).

Evacuated tubular collectors: All types of evacuated tubular collectors (heat-pipe, direct, tube/fin, all-glass, …).

3.3 Typical collector efficiency

The capacity conversion is based on the following simplified typical collector efficiencies (based on aperture area):

Unglazed flat plate collectors[3] : $\eta_0 = 0{,}90$, $a_1 = 20{,}0$ W/(K*m²), $a_2 = 0{,}00$ W/(K²*m²)

Glazed flat plate collectors[4] : $\eta_0 = 0{,}78$, $a_1 = 3{,}2$ W/(K*m²), $a_2 = 0{,}015$ W/(K²*m²)

Evacuated tubular collectors[5] : $\eta_0 = 0{,}76$, $a_1 = 1{,}2$ W/(K*m²), $a_2 = 0{,}008$ W/(K²*m²)

3.4 Operation conditions

For the capacity conversion the following typical operation conditions are assumed6:

Unglazed flat plate collectors : G = 1000 W/m², Ta = 20 °C, Tm = 30 °C, u = 1,5 m/s

Glazed flat plate collectors : G = 1000 W/m², Ta = 20 °C, Tm = 50 °C

Evacuated tubular collectors : G = 1000 W/m², Ta = 20 °C, Tm = 50 °C

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[2] For unglazed collectors the three areas are the same

[3] Estimate

[4] Average of last 10 EN tested flat plate collectors in SPF Collector Catalogue 2004

[5] Average of last 10 EN tested ETC collectors in SPF Collector Catalogue 2004

[6] These operation conditions are given in the power tables in the "conformity report" in the EN12975-2

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3.5 "Installed" or "nominal" capacity : Capacity per m² of collector area

Definition 1:

"Nominal Capacity" of <u>unglazed</u> flat plate collectors is the instantaneous thermal output of the collector with the operation conditions:

G = 1000 W/m²

T_a = 20 °C

T_m = 30 °C

u = 1,5 m/s

Definition 2:

"Nominal Capacity" of <u>glazed</u> flat plate collectors and <u>evacuated tubular</u> collectors are the instantaneous thermal output of the collector with the operation conditions:

G = 1000 W/m²

T_a = 20 °C

T_m = 50 °C

Definition 3:

"Specific Nominal Capacity" of a collector is the nominal capacity of a collector divided by its aperture[7] area.

Using the assumption above, the factor for converting – for each collector type – square meters of collector area to specific nominal capacity:

Unglazed flat plate collectors: P/A = 0.7 kW$_{th}$/m²

Glazed flat plate collectors: P/A = 0.671 kW$_{th}$/m²

Evacuated tubular collectors: P/A = 0.717 kW$_{th}$/m²

Taking into consideration the uncertainty on each value it is reasonable to use only one value: 0.7 kW$_{th}$/m^2.

4. Participating organisations

The following organisations participated in the Gleisdorf meeting where the conversion factor of 0.7 kWth/m^2 was agreed upon:

Austria Solar – www.austriasolar.at
Bundesverband Solarindustrie, Germany (BSi) – www.bsi-solar.de
Canadian Solar Industries Association (CanSIA) – www.cansia.ca
European Solar Thermal Industry Federation (ESTIF) – www.estif.org
Holland Solar – www.hollandsolar.nl

Solar Heating and Cooling Programme of the International Energy Agency (IEA SHC) – www.iea-shc.org

Solar Energy Association of Sweden (SEAS) – www.solenergiforeningen.se
Solar Energy Industries Association, USA (SEIA) – www.seia.org

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[7] For unglazed collectors the aperture area equals the absorber area