Collectors suitable for Industrial Applications

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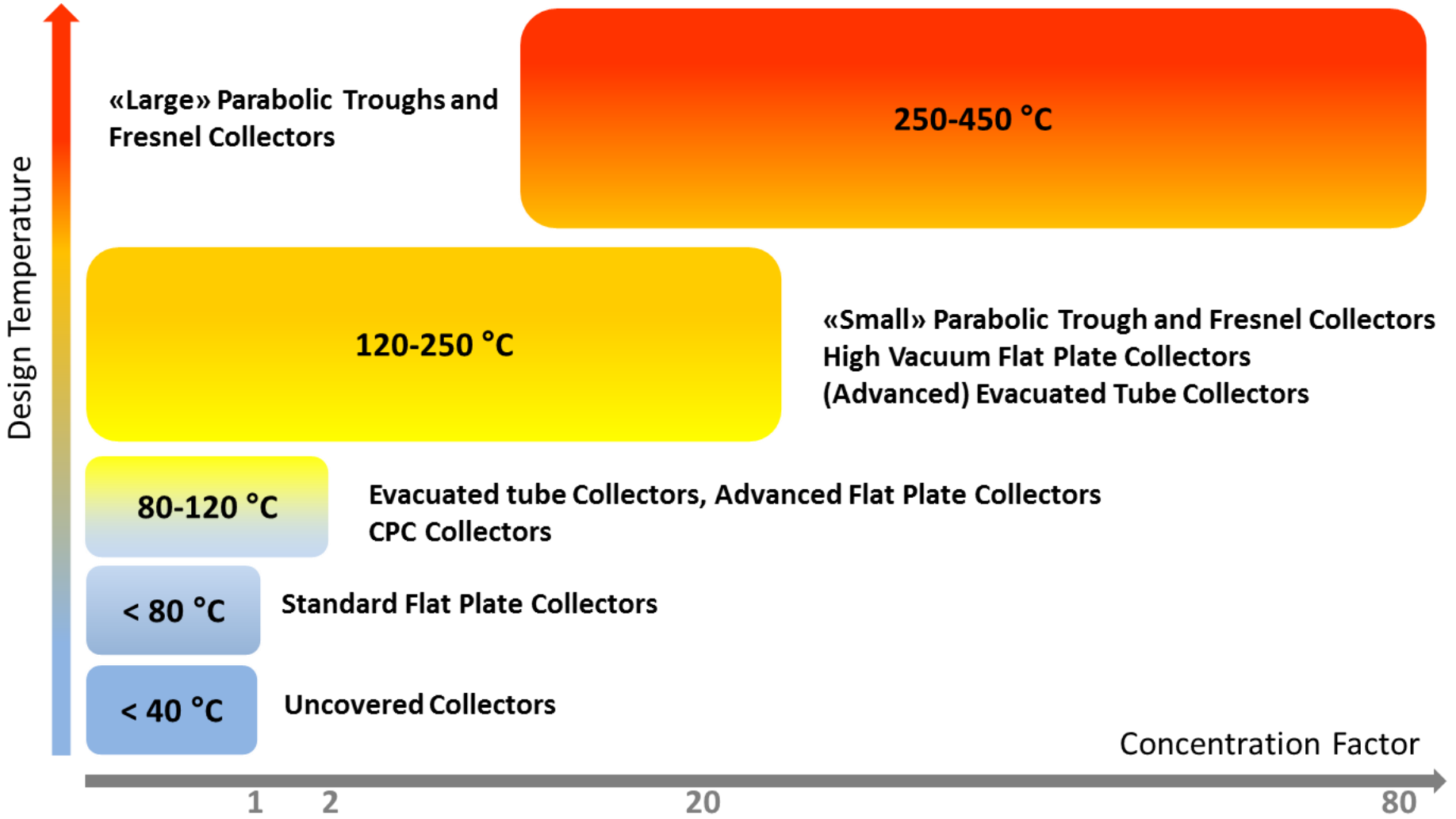
Collector Overview



Source: Elimar Frank - SPF

What is a «Process Heat Collector»?

All solar collectors that provide heat for an industrial process…

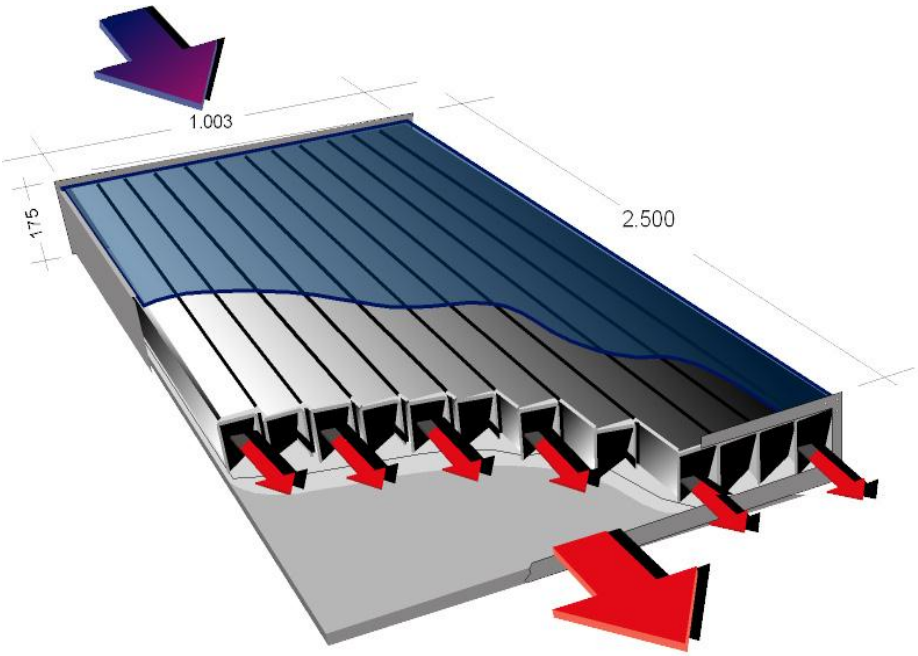
Nomenclature according to IEA SHC Task 49 / SolarPaces Annex IV:

below 100°C	100 °C .. 250 °C	above 250 °C
“low” temperature collector or application	“mid” temperature collector or application	“high” temperature collector or application

Uncovered Plastic Absorbers

< 40 °C

Air collectors



Source: Grammer Solar, Germany

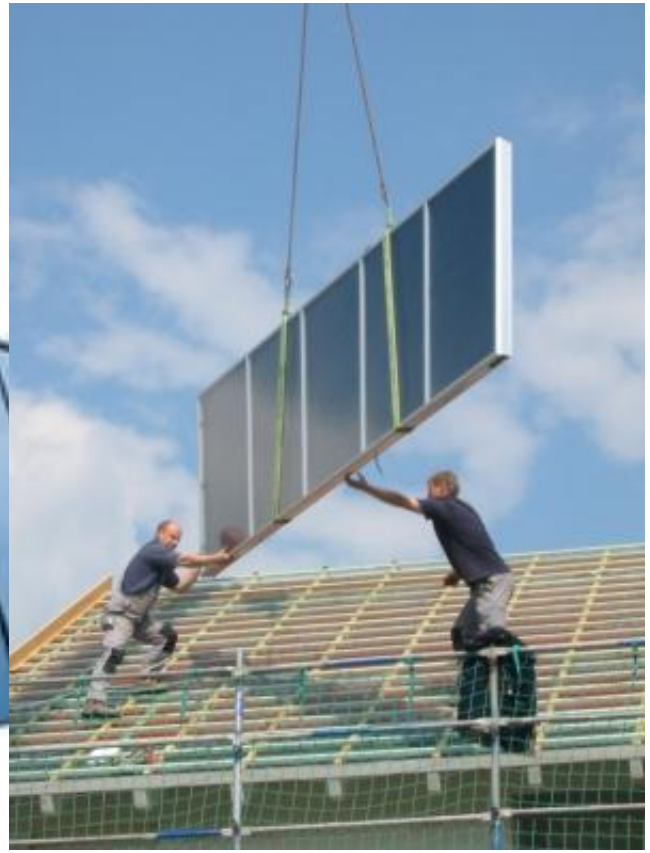
Kollektorfabrik, Germany

Air collectors

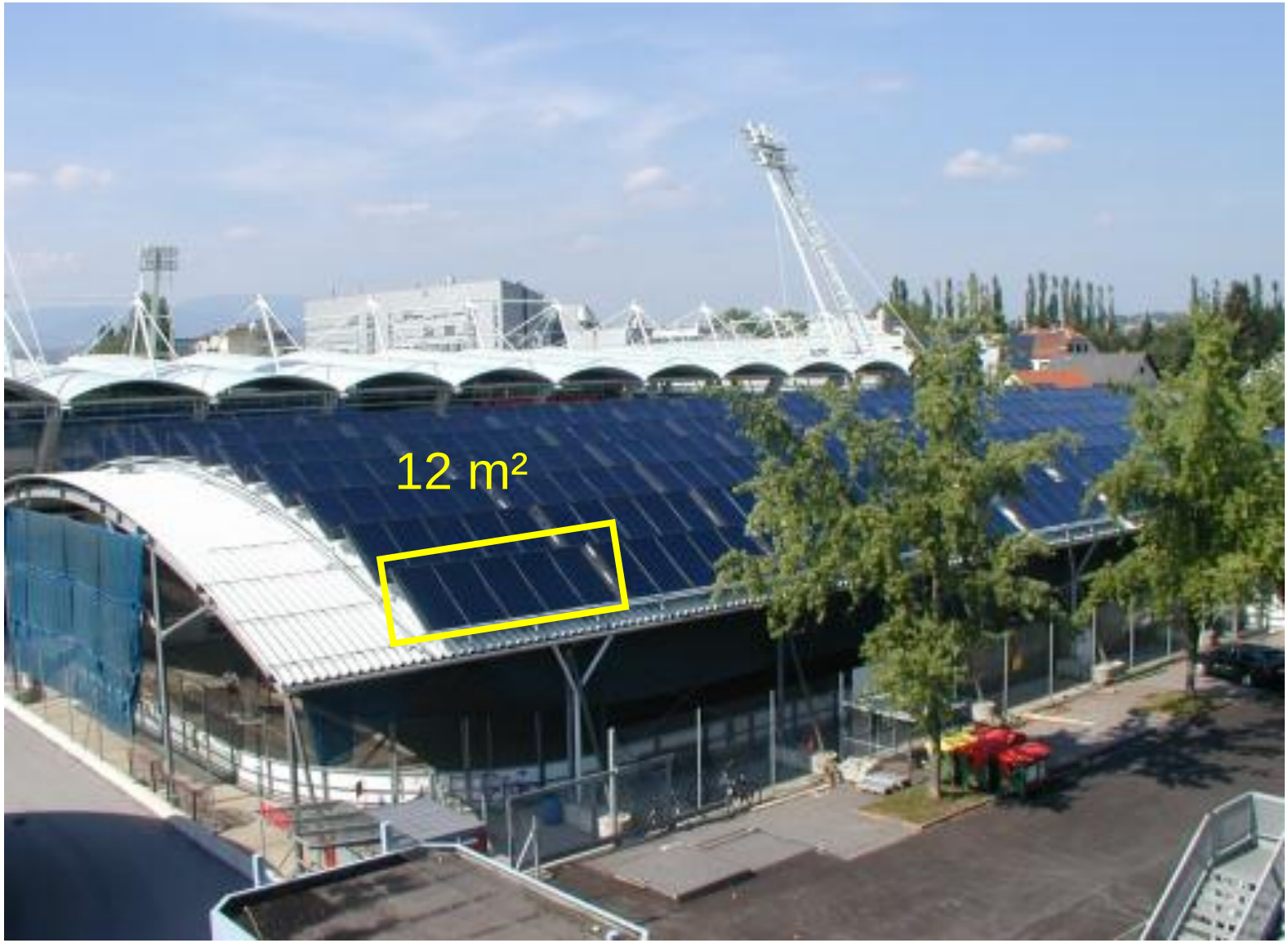
Source: SolaWall , Canada

Flat Plate Collectors

< 85 °C



Flat plate collectors



Biggest System Worldwide, Saudi Arabia

36.000 m² / 25 MW_{th}

Which collector can be used above 100 °C?

In principle all collectors with a *reasonable* collector output above 100 °C

***A reasonable* collector output above 100 °C is more than 300 W/m² collector (gross) area.**

For the following conditions:

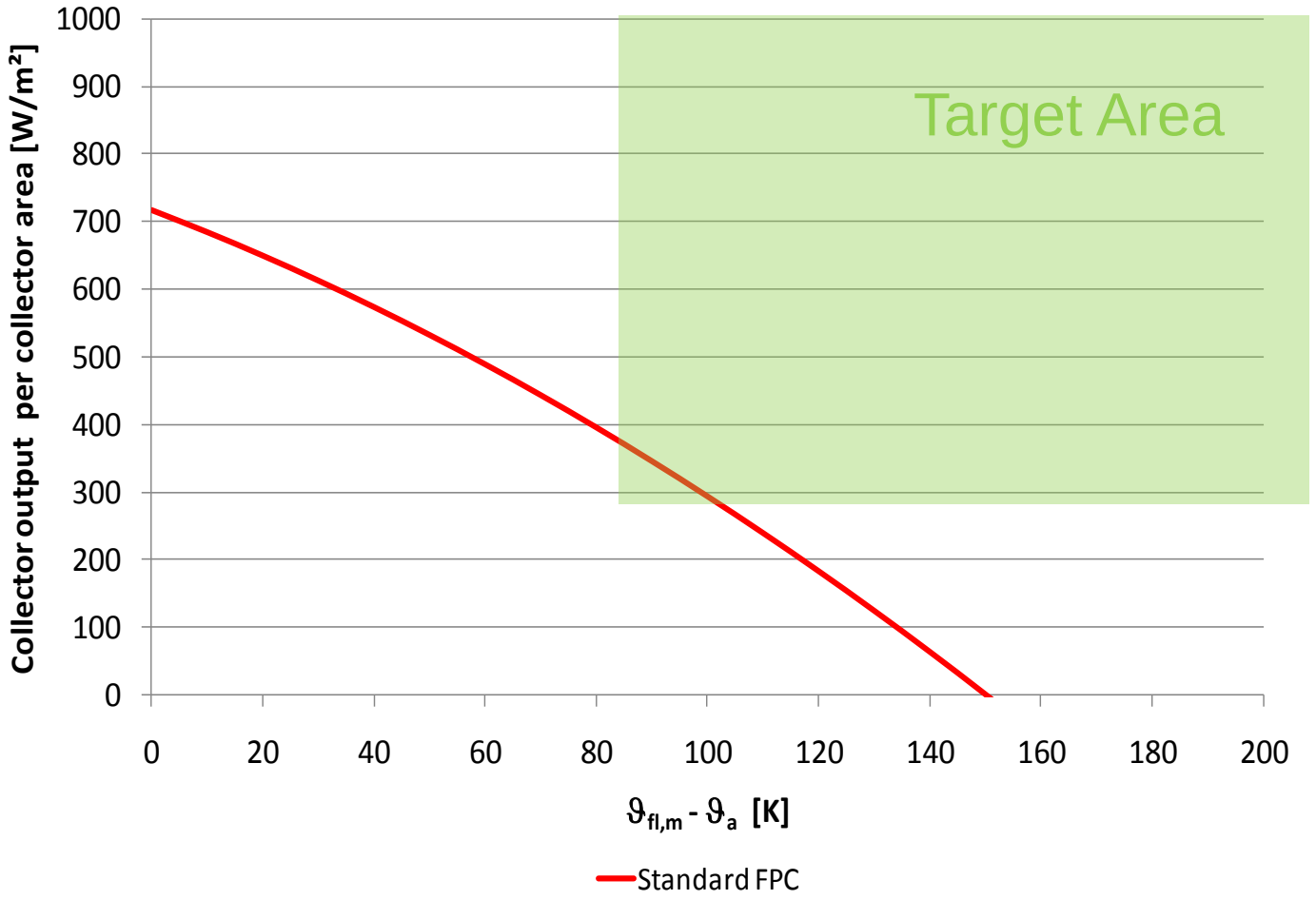
1000 W/m² hemispherical irradiance

10% diffuse fraction

20 °C ambient temperature

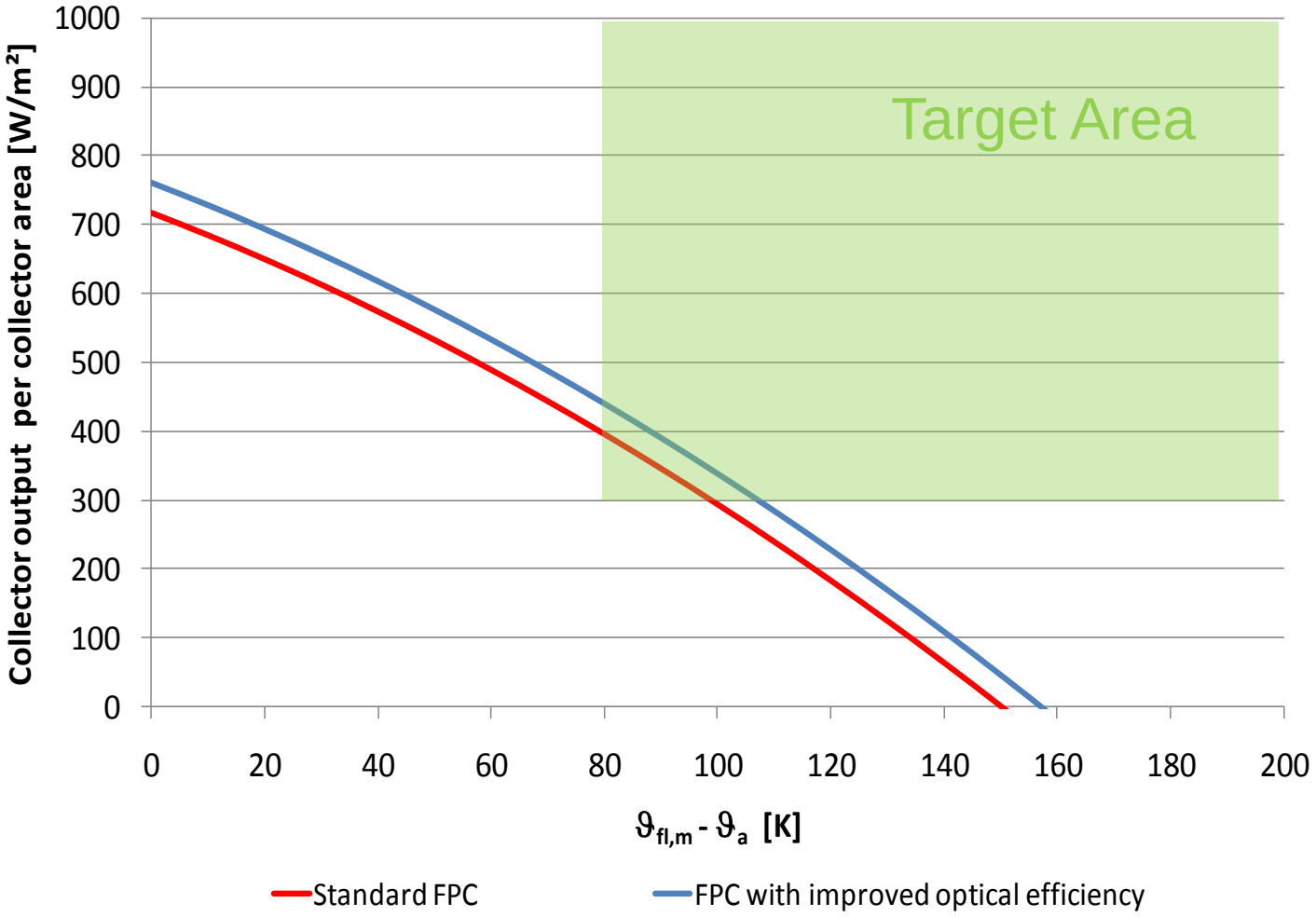
Source: Stephan Fischer, ITW

Flat Plate Collector



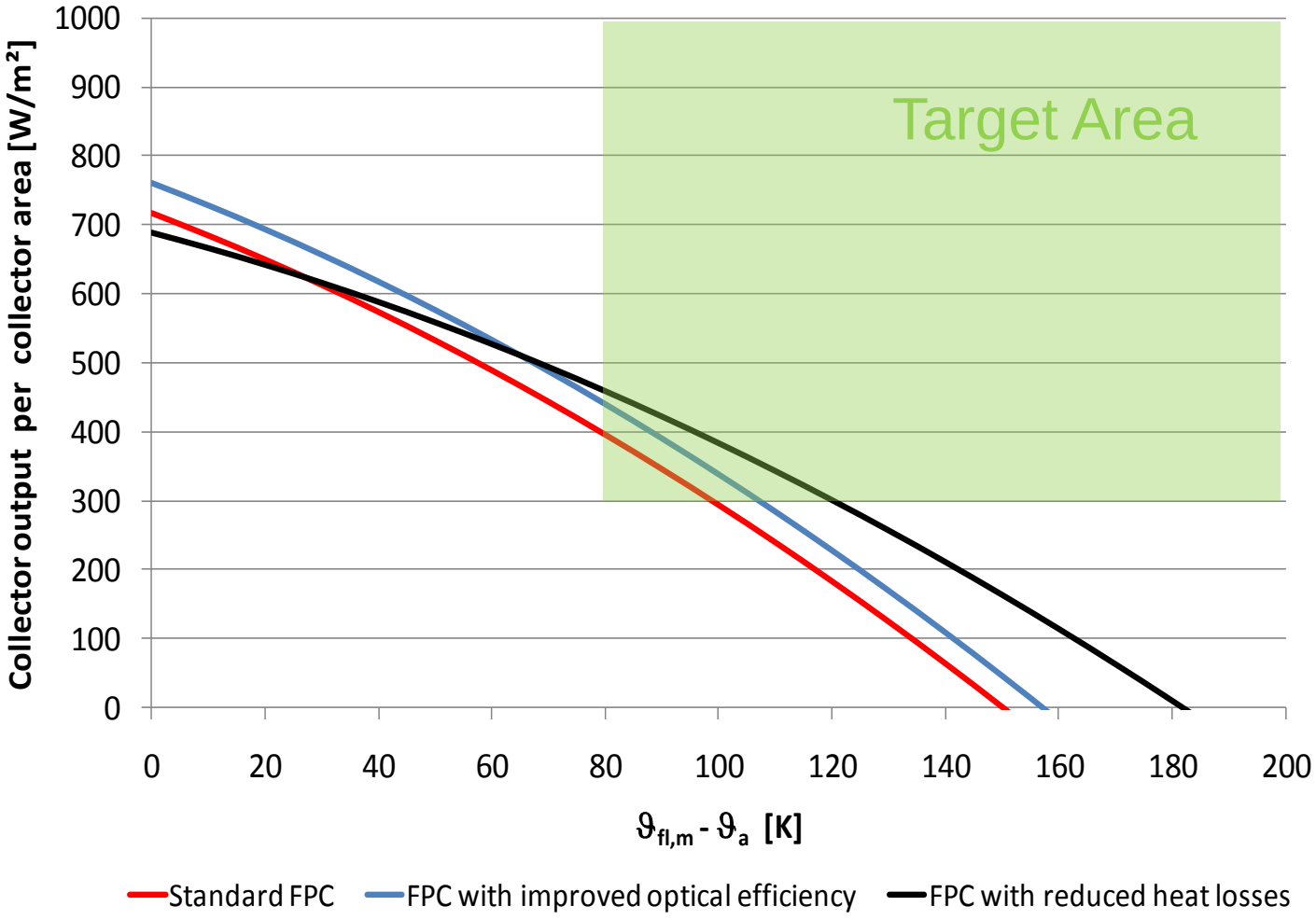
Source: Stephan Fischer, ITW

Flat Plate Collector



Source: Stephan Fischer, ITW

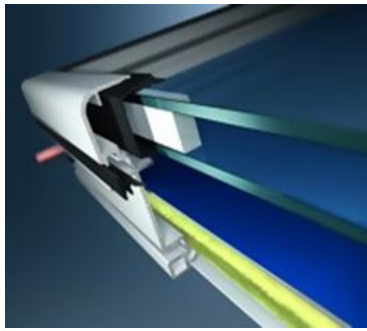
Flat Plate Collector



Source: Stephan Fischer, ITW

Advanced flat-plate collectors

< 80 -120 °C



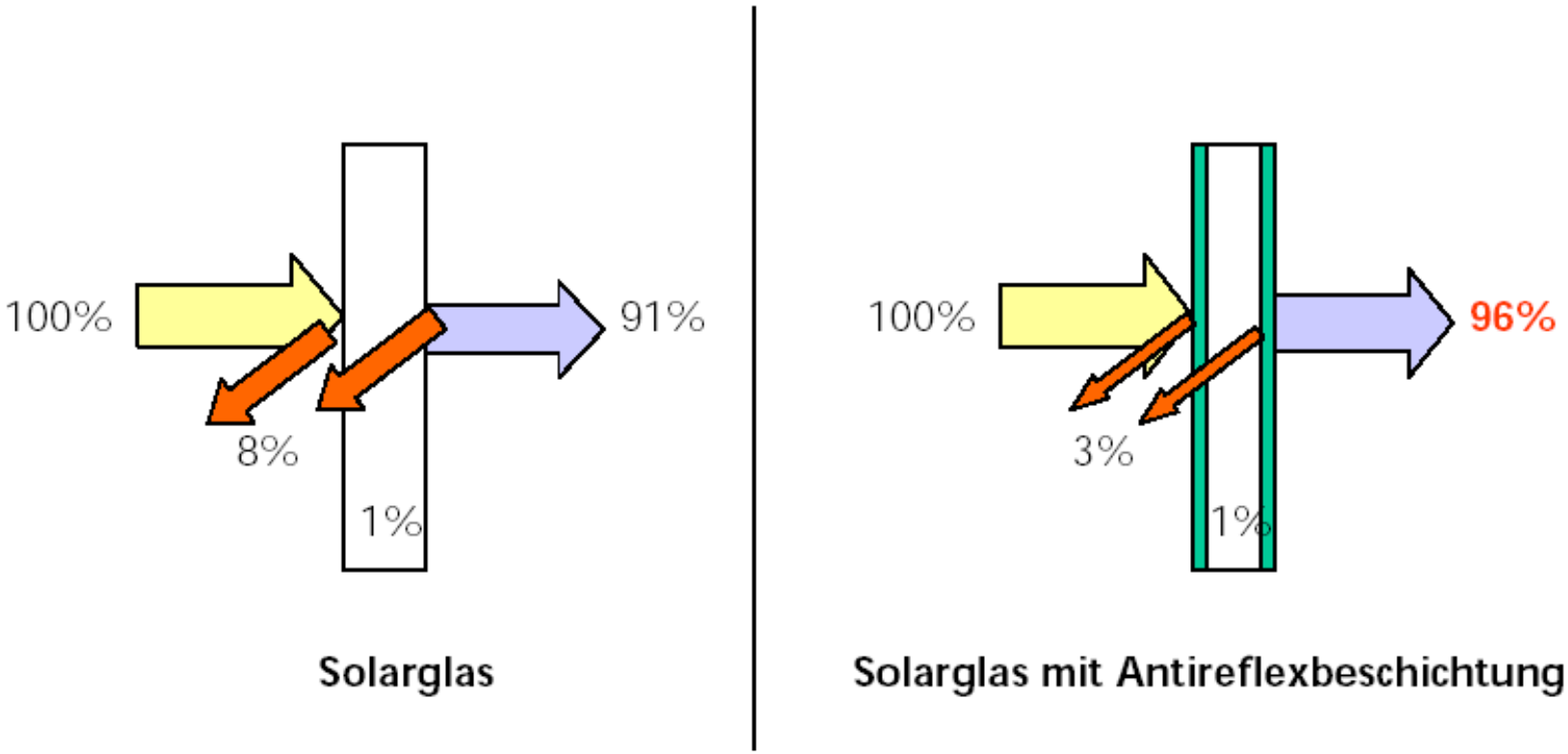
Double-glazed,

flat-plate collector with

anti-reflective glass and inert gas filling

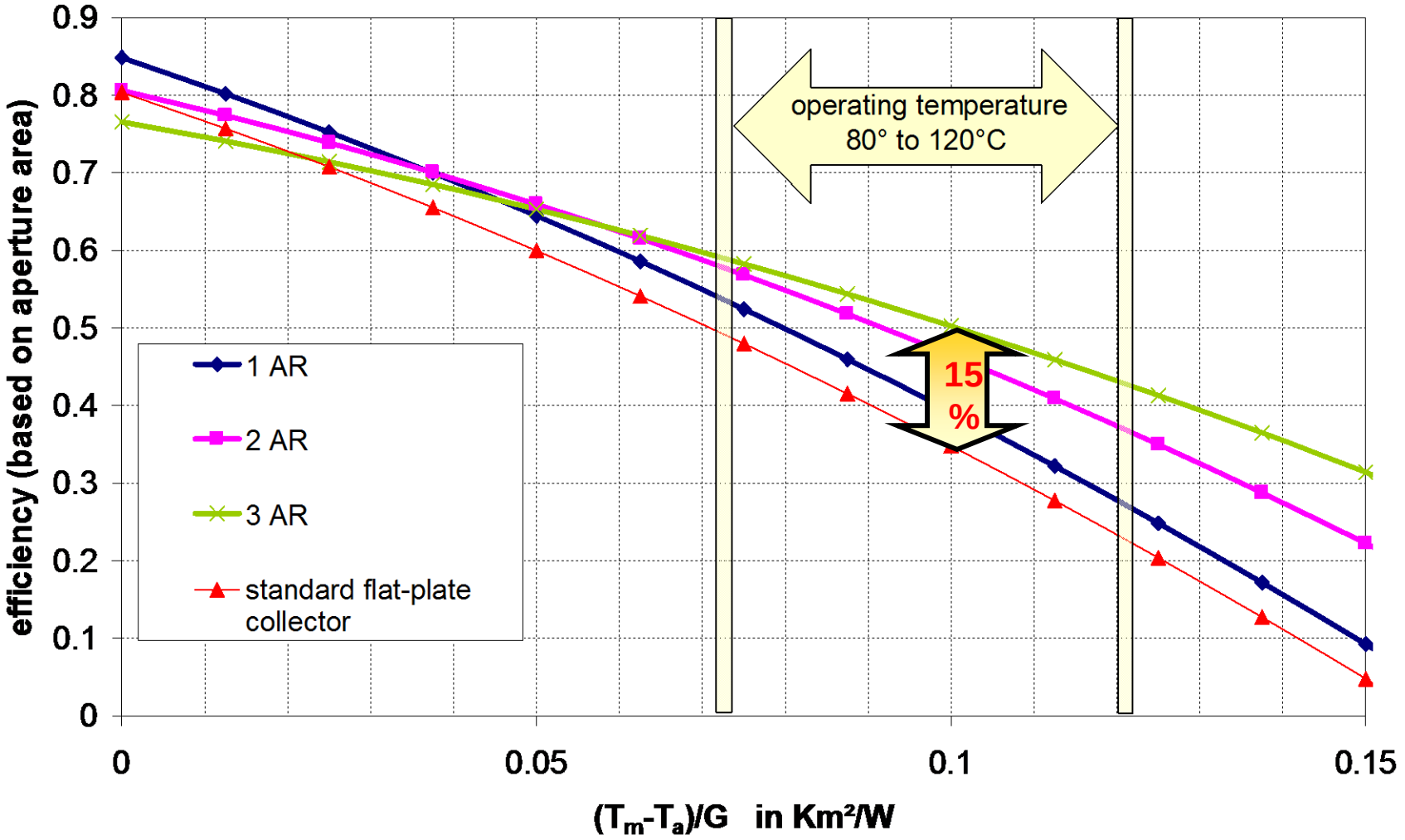
Source: Fraunhofer ISE, Schüco

ADVANCED FLAT-PLATE COLLECTORS



Source: Fraunhofer ISE

ADVANCED FLAT-PLATE COLLECTORS



Source: Fraunhofer ISE

Flat plate collector with external reflector (RefleC)

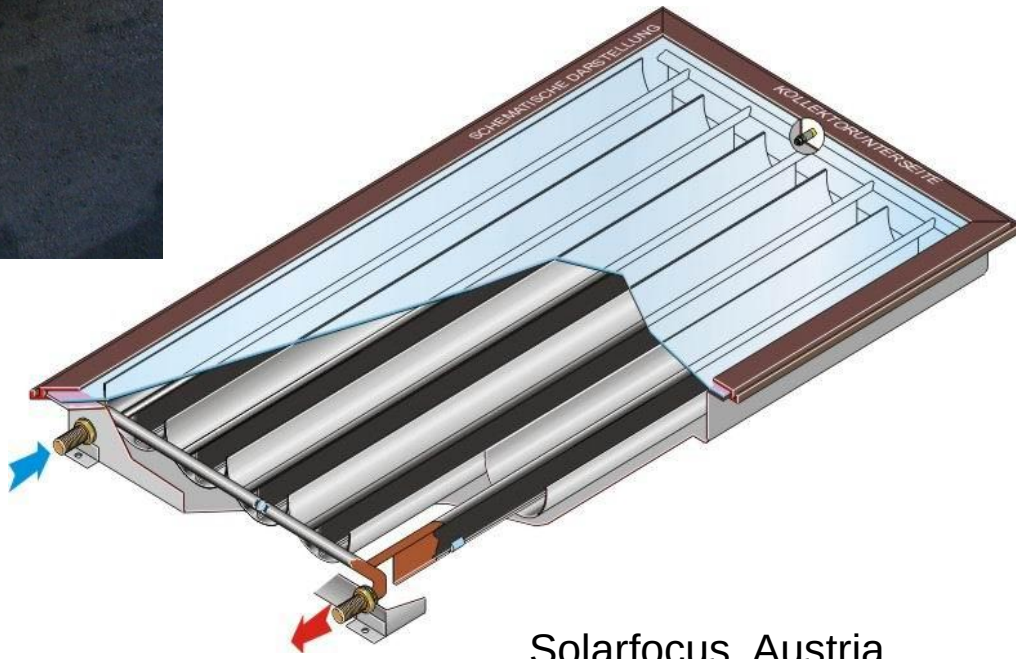
Source: Wagner & Co Solartechnik

CPC Collectors

AoSol, Portugal

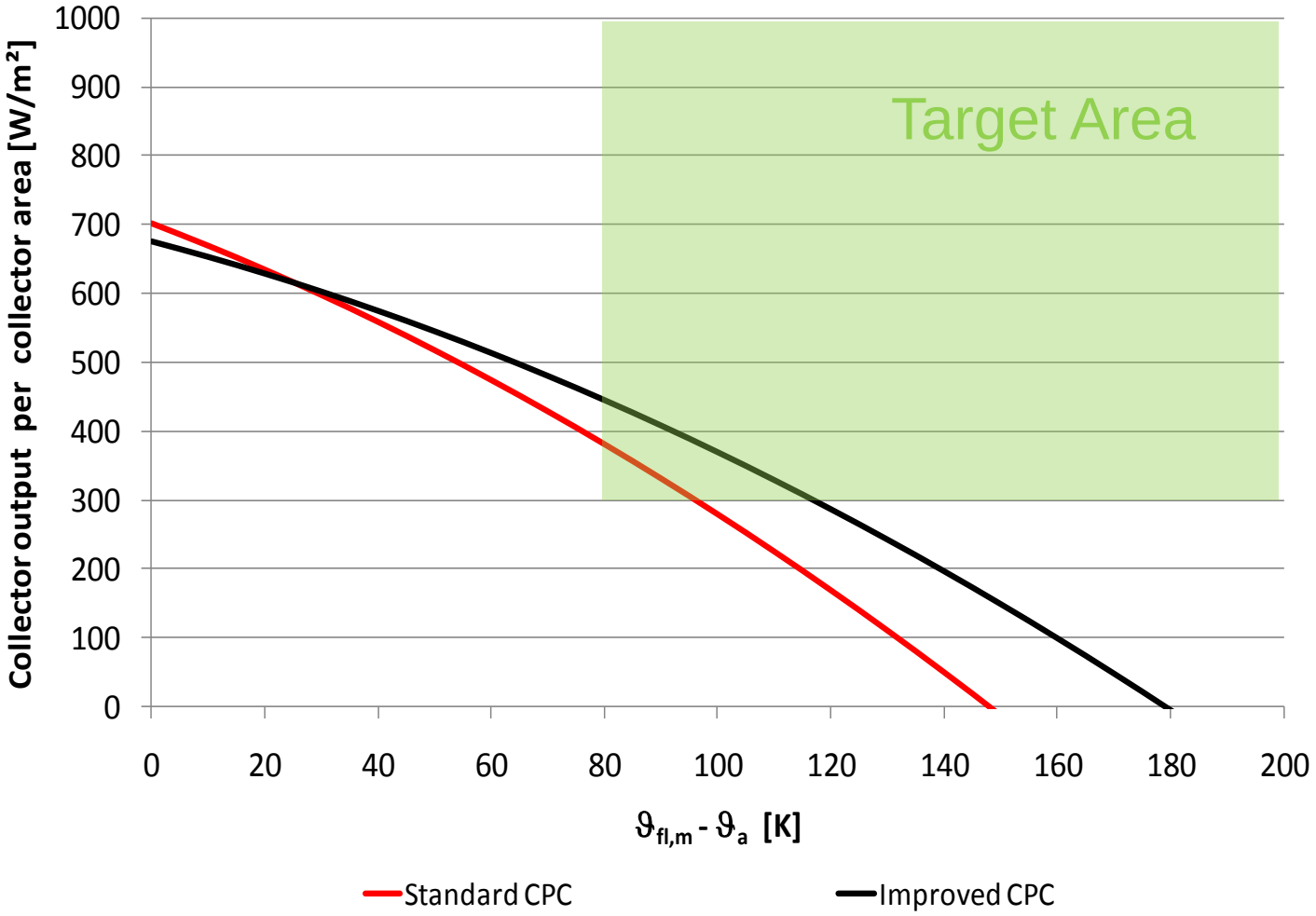
1,12 – 1,7 x

Acceptance angle: 37 – 56°



Solarfocus, Austria

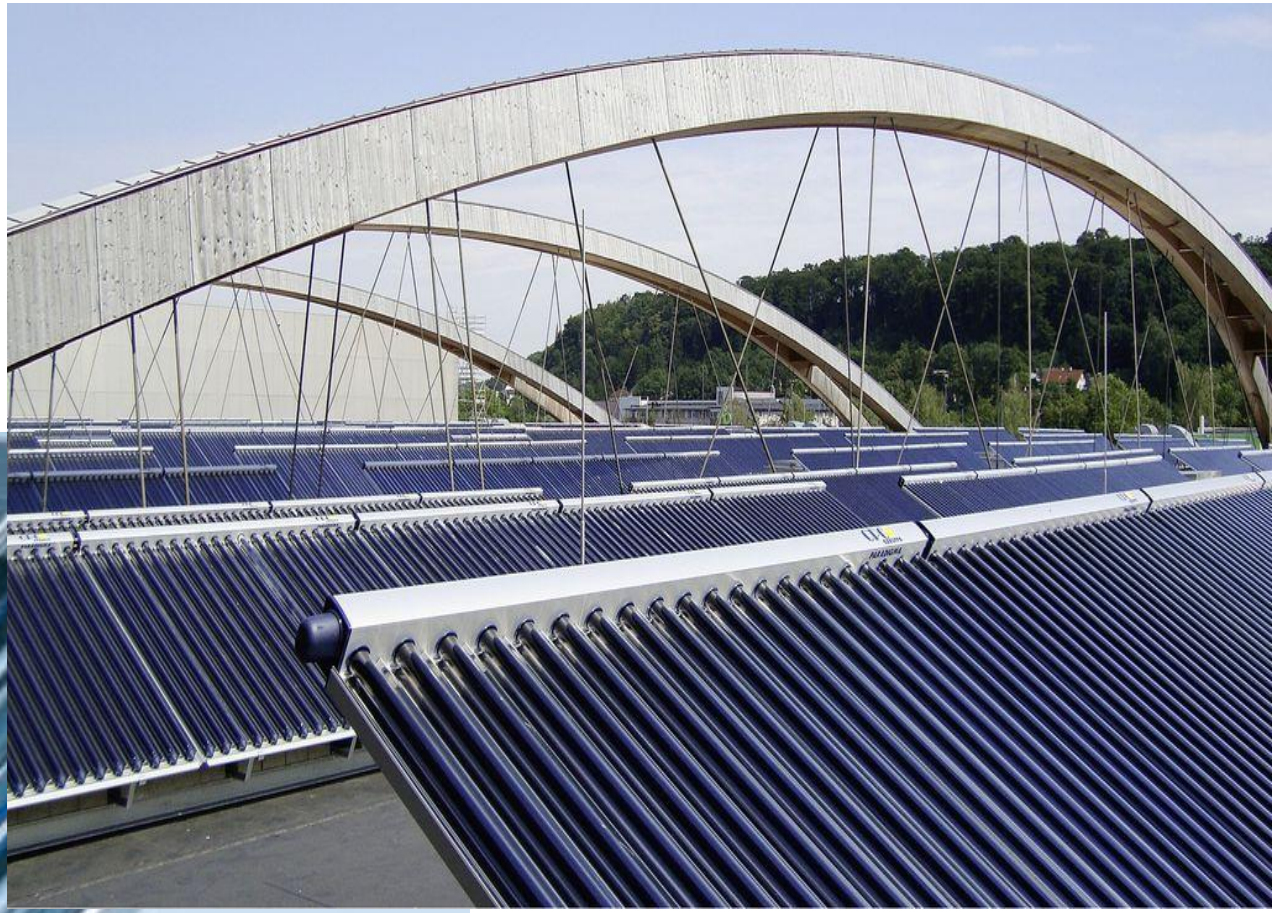
CPC Collectors

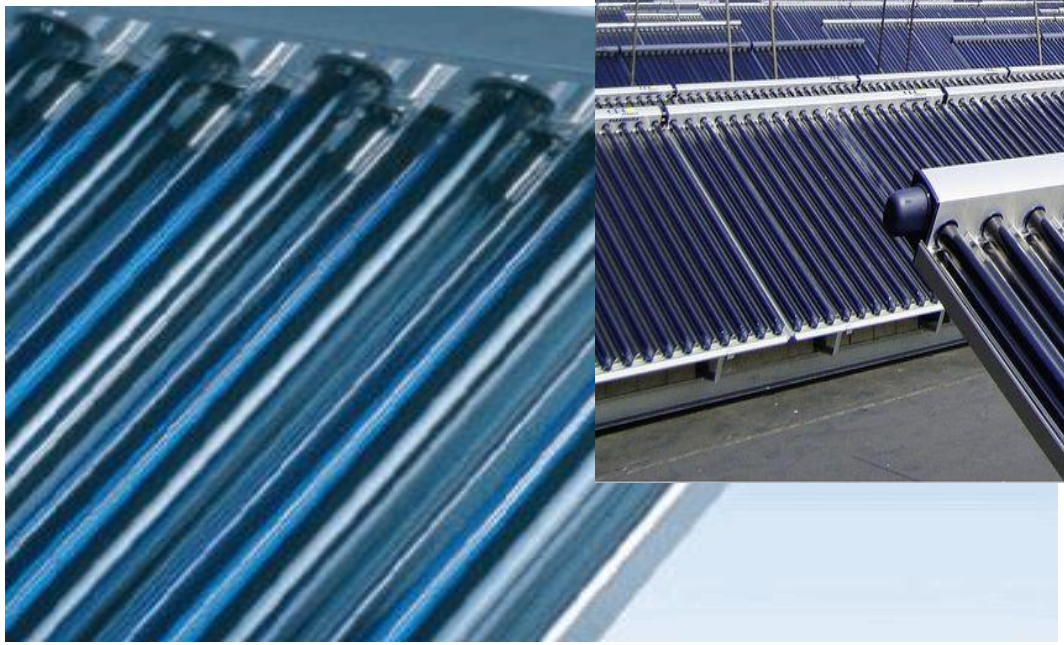


Source: Stephan Fischer, ITW

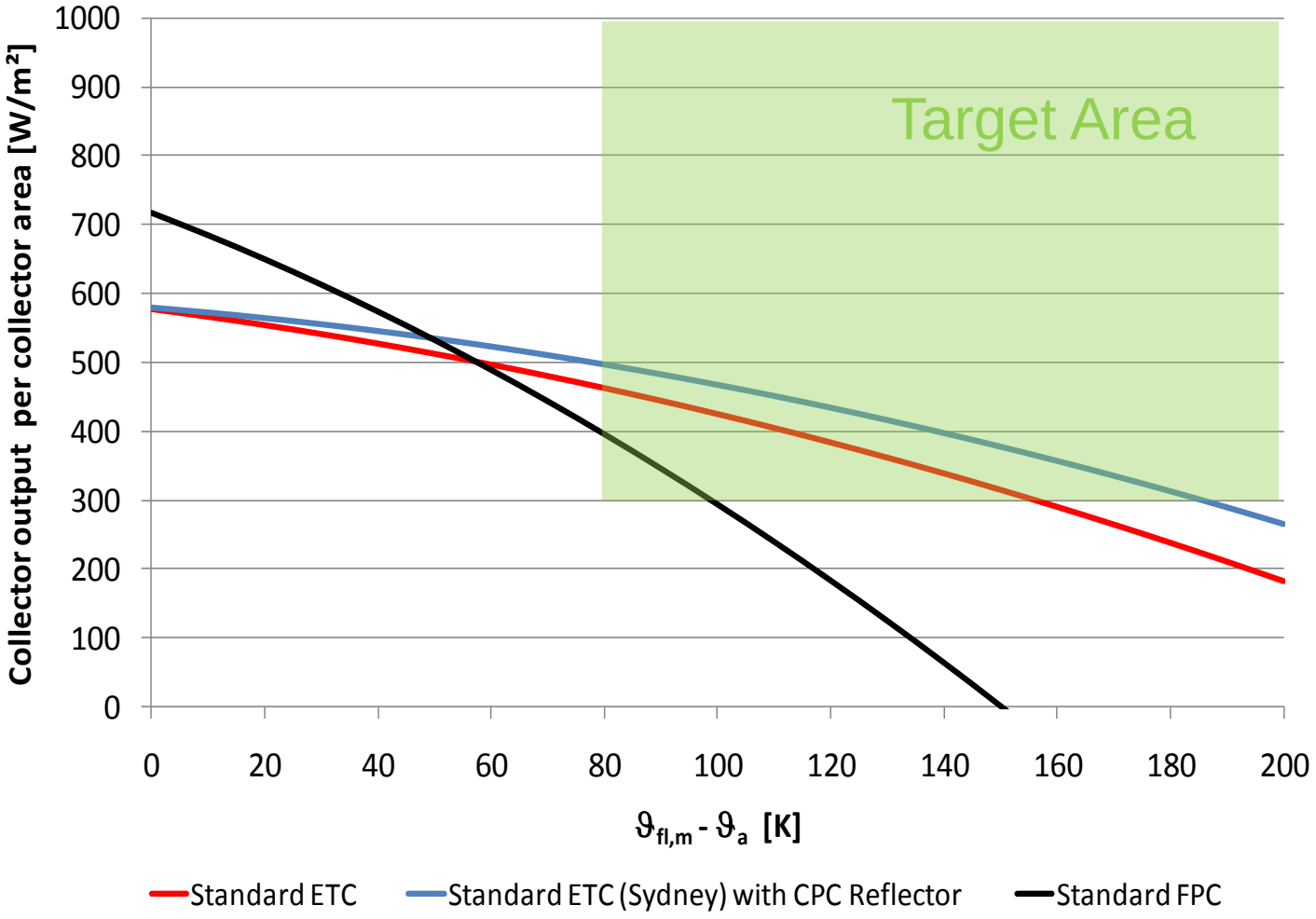
Advanced Evacuated Tube Collectors

< 80 -180 °C





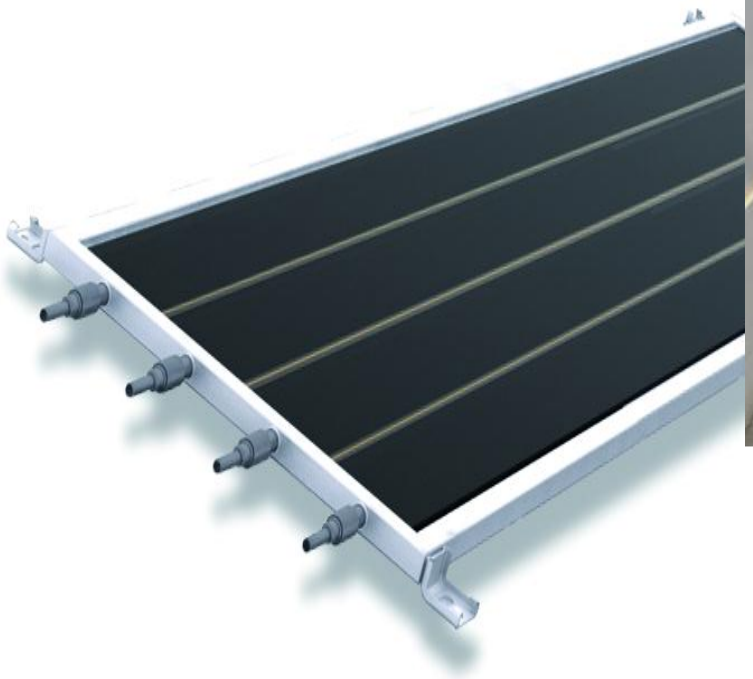
Evacuated Tubular Collector



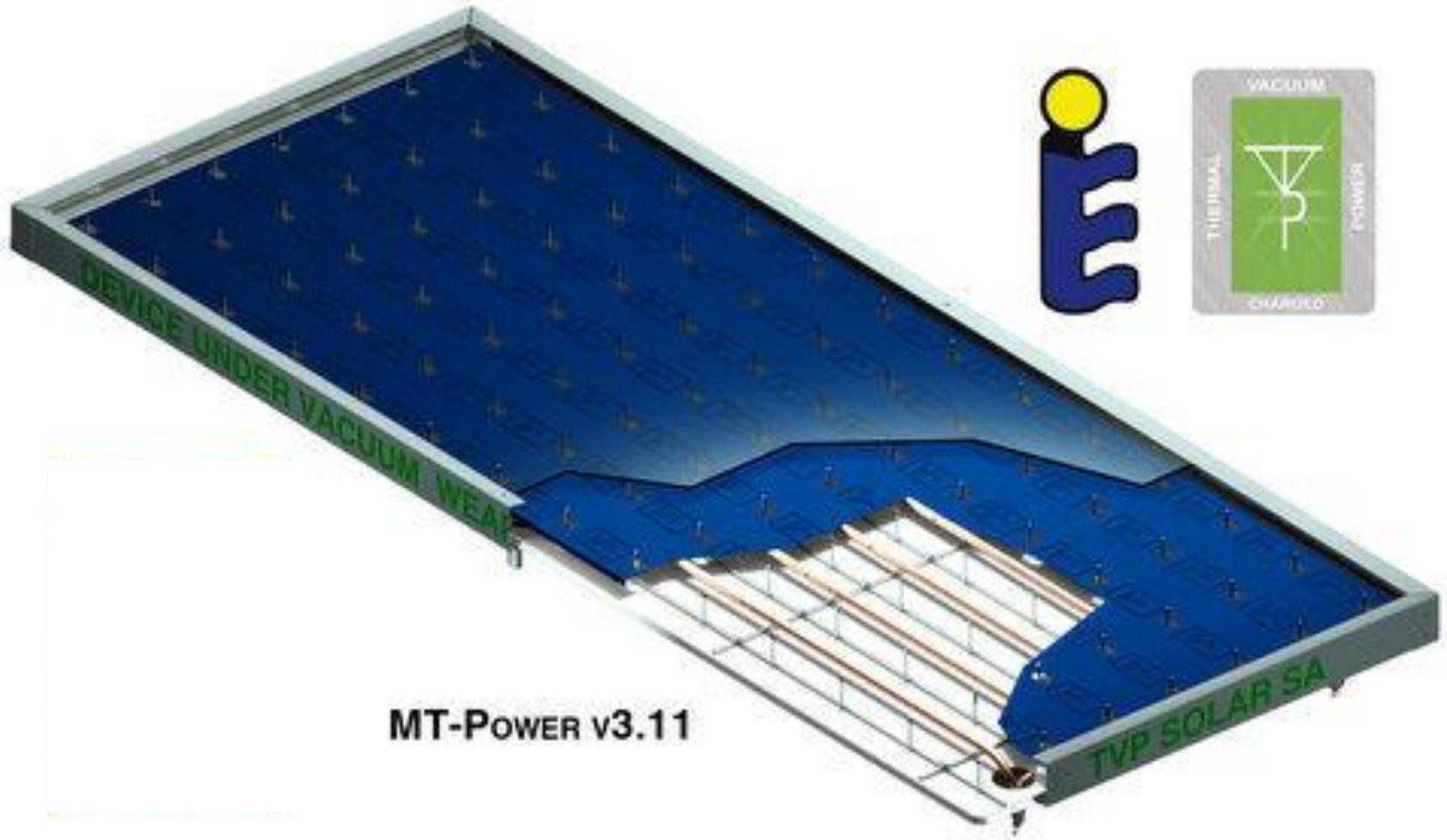
Source: Stephan Fischer, ITW

High Vacuum Flat Plate Collectors

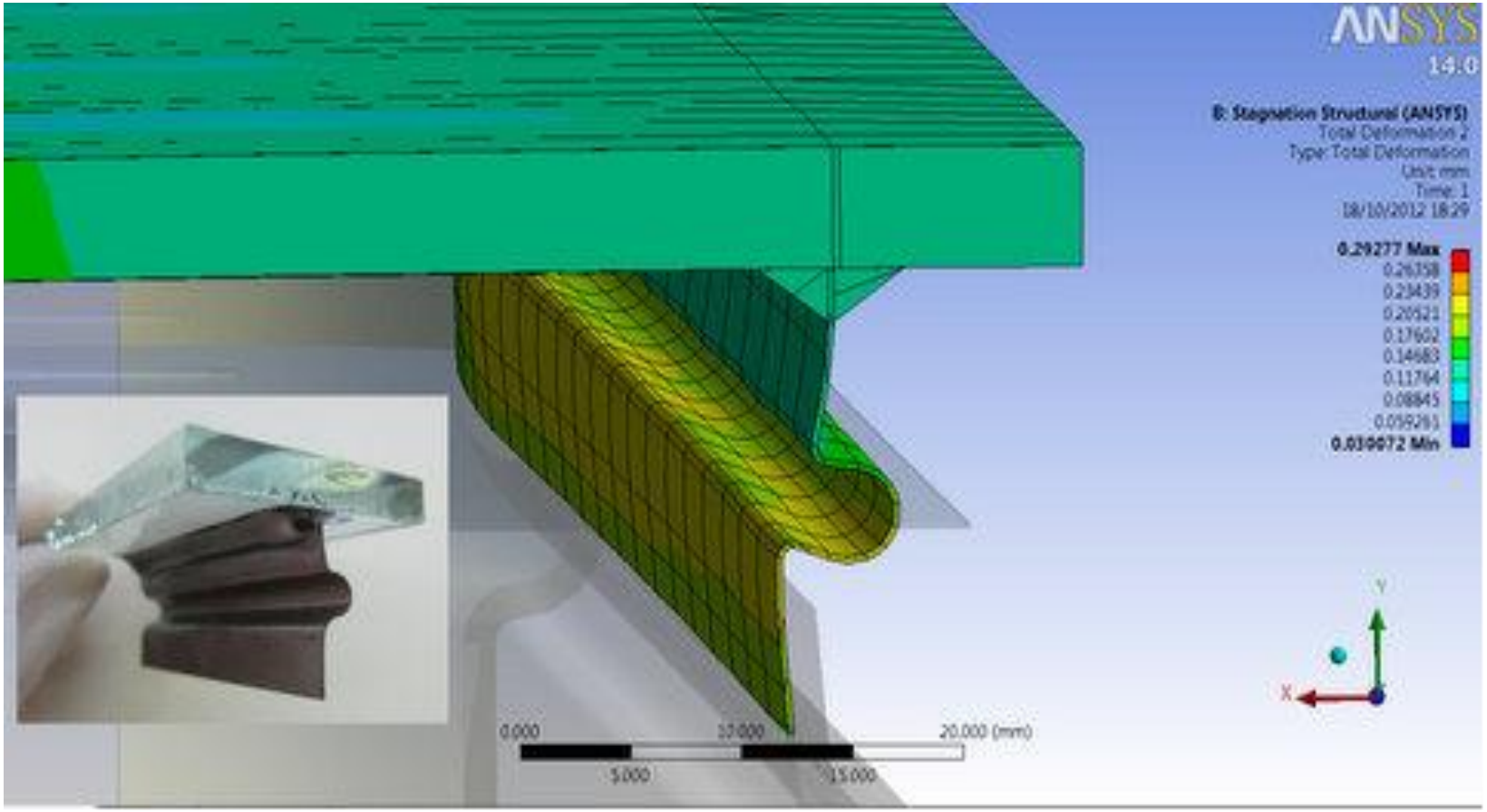
< 80 -180 °C



TVP High Vacuum Flat-plate Collector with Solar KEYMARK certified up to 200°C



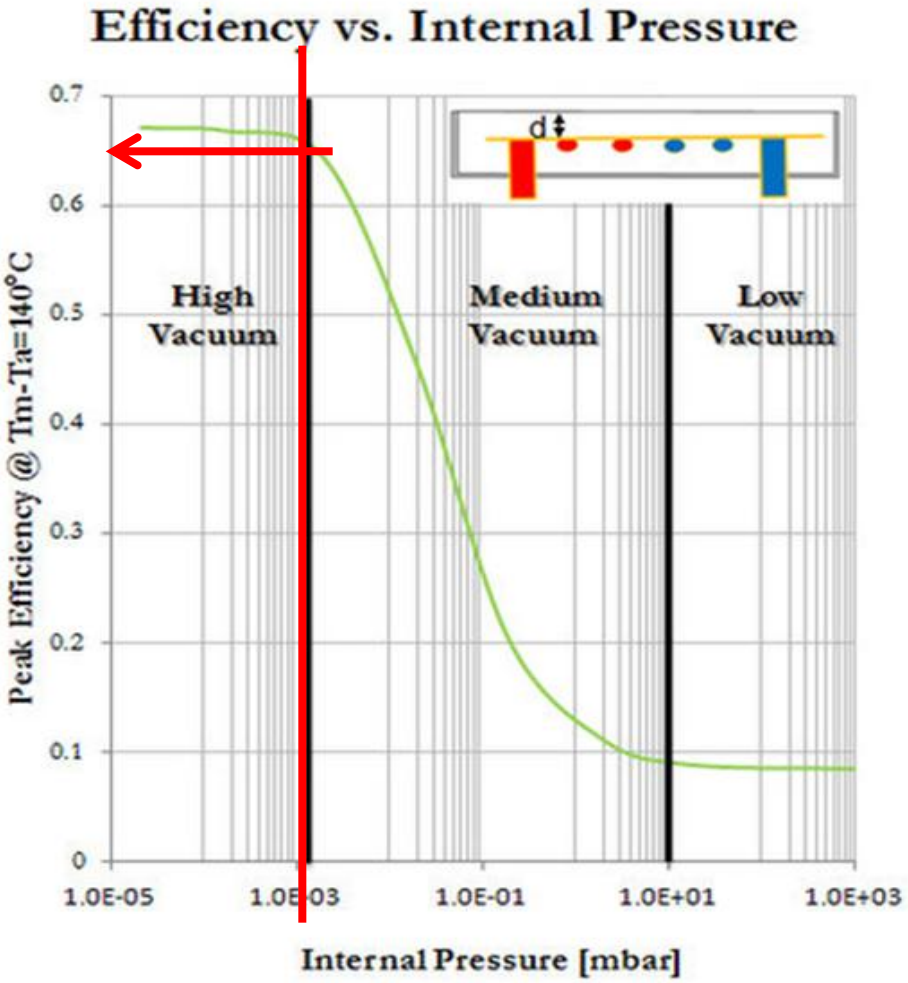
Glass-metal seal



Evacuated at almost 300°C during the manufacturing process

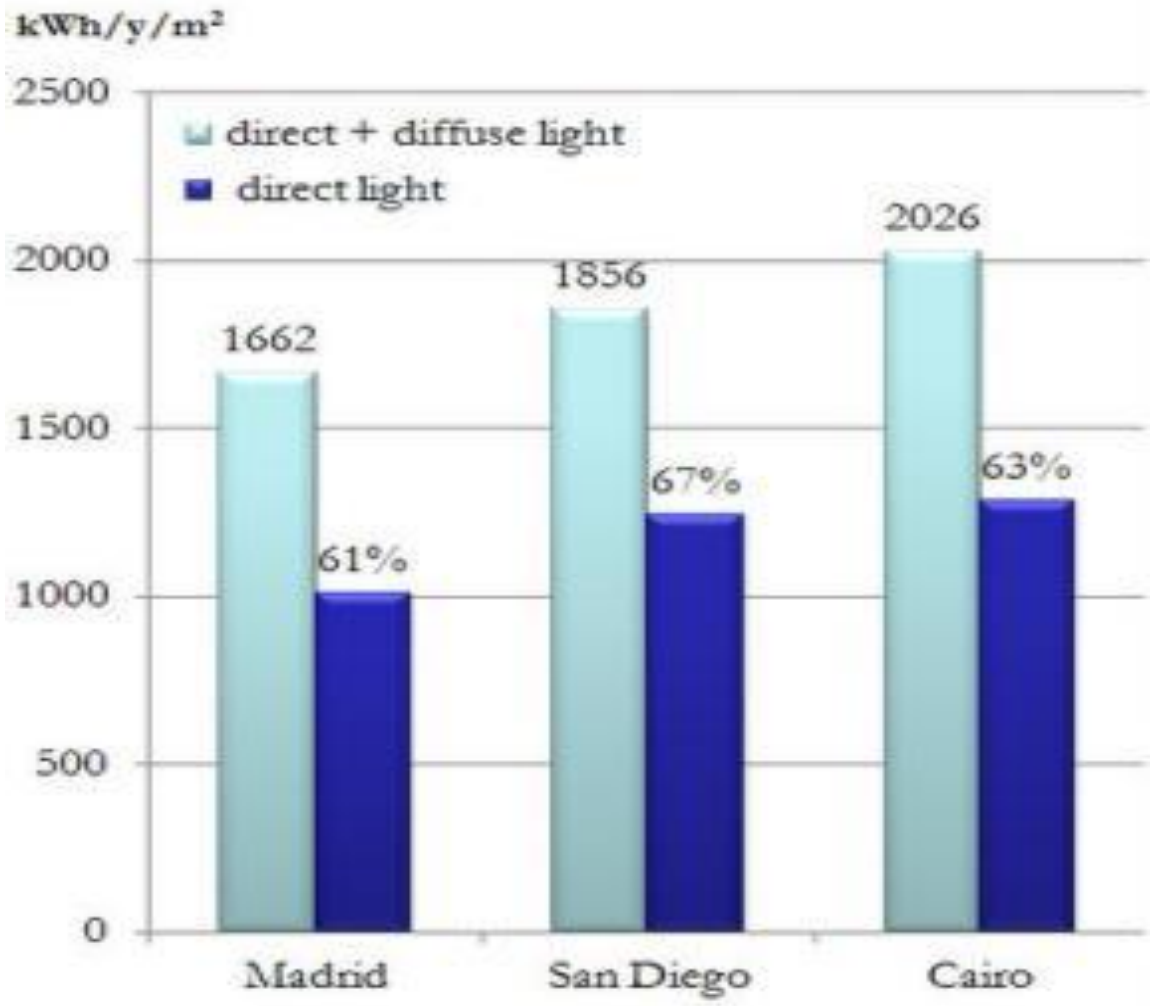
Source: TVP Solar SA

High Vacuum Flat-plate Collector – TVP



Peak efficiency operated at Tm-Ta=140°C as a function of internal pressure

Direct and diffuse solar radiation available at selected locations worldwide



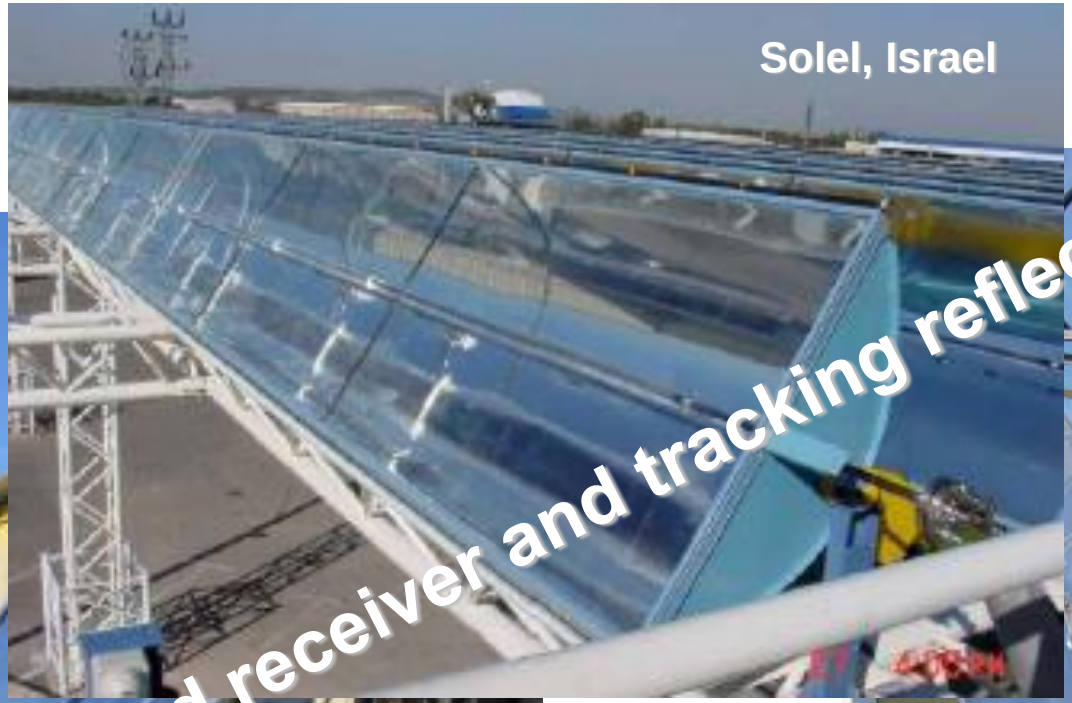
Source: METEONORM data

High Vacuum Flat-plate Collector – TVP (CH)

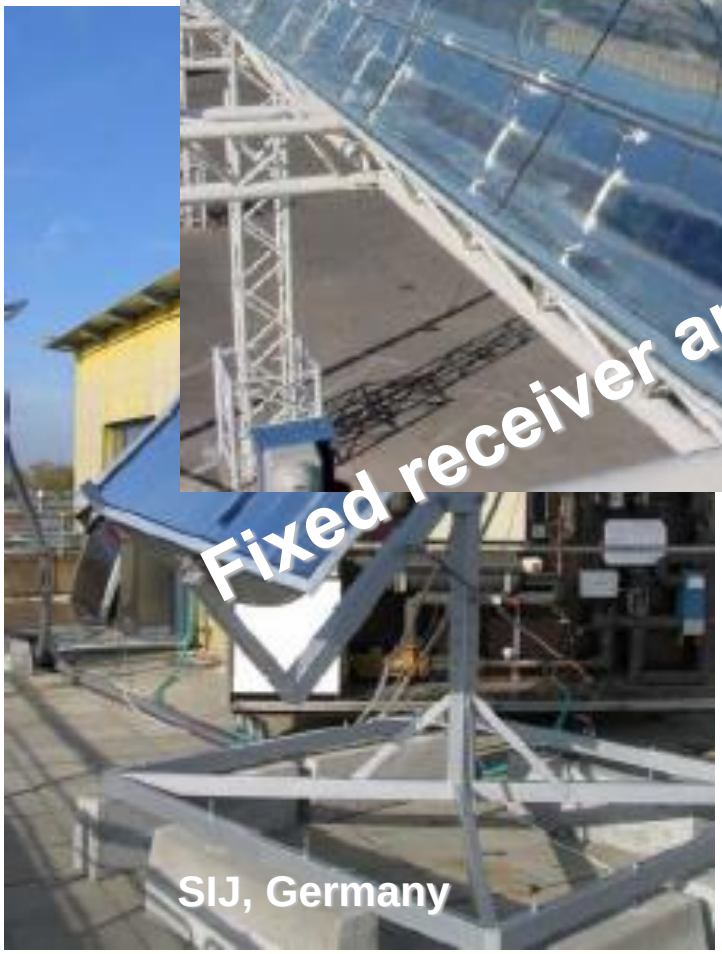
High vacuum flat-plate collector by TVP SOLAR in Masdar City (Abu-Dhabi, UAE)

Parabolic Trough Collectors

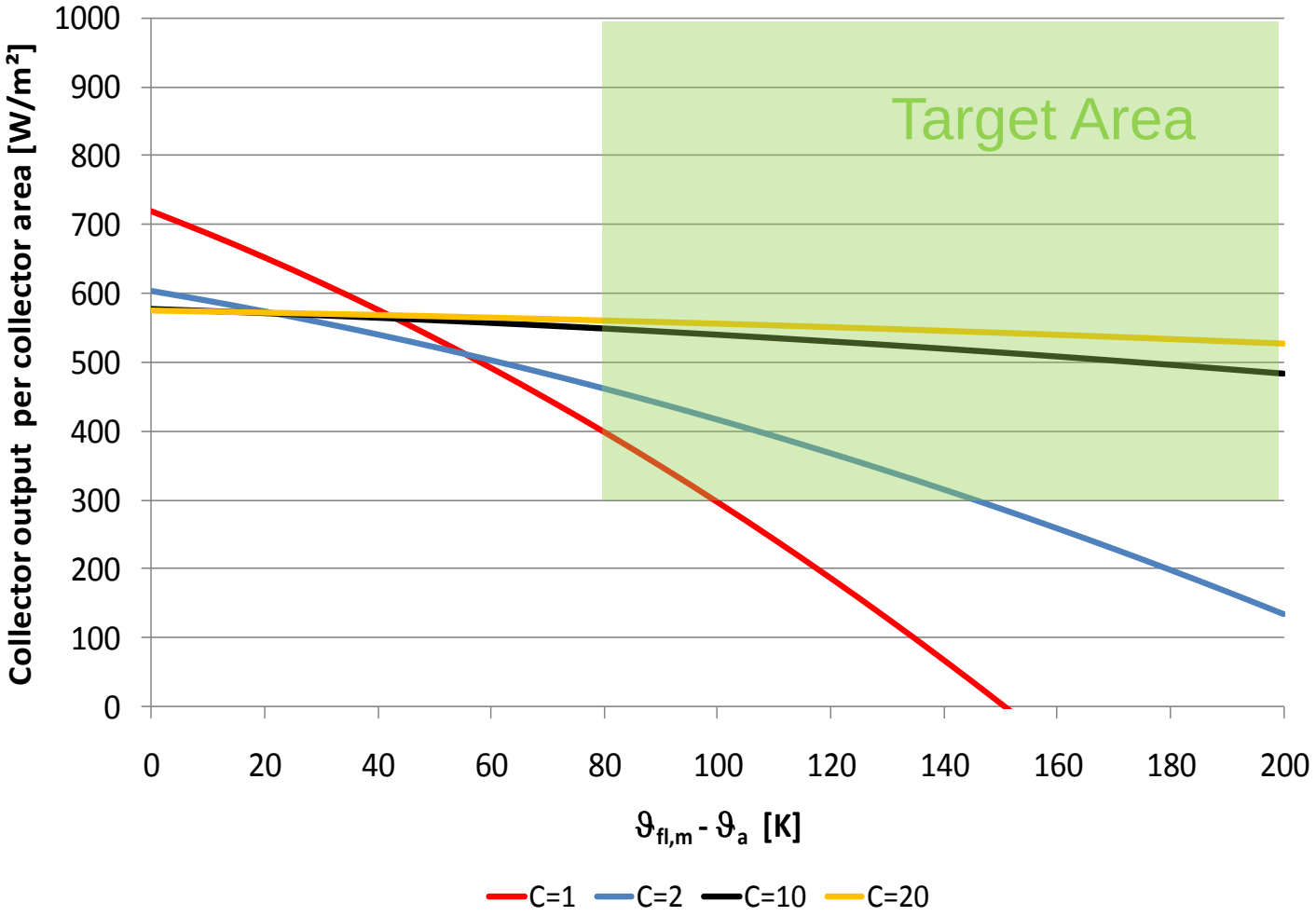
< 120 - 250 °C



Fixed receiver and tracking reflector



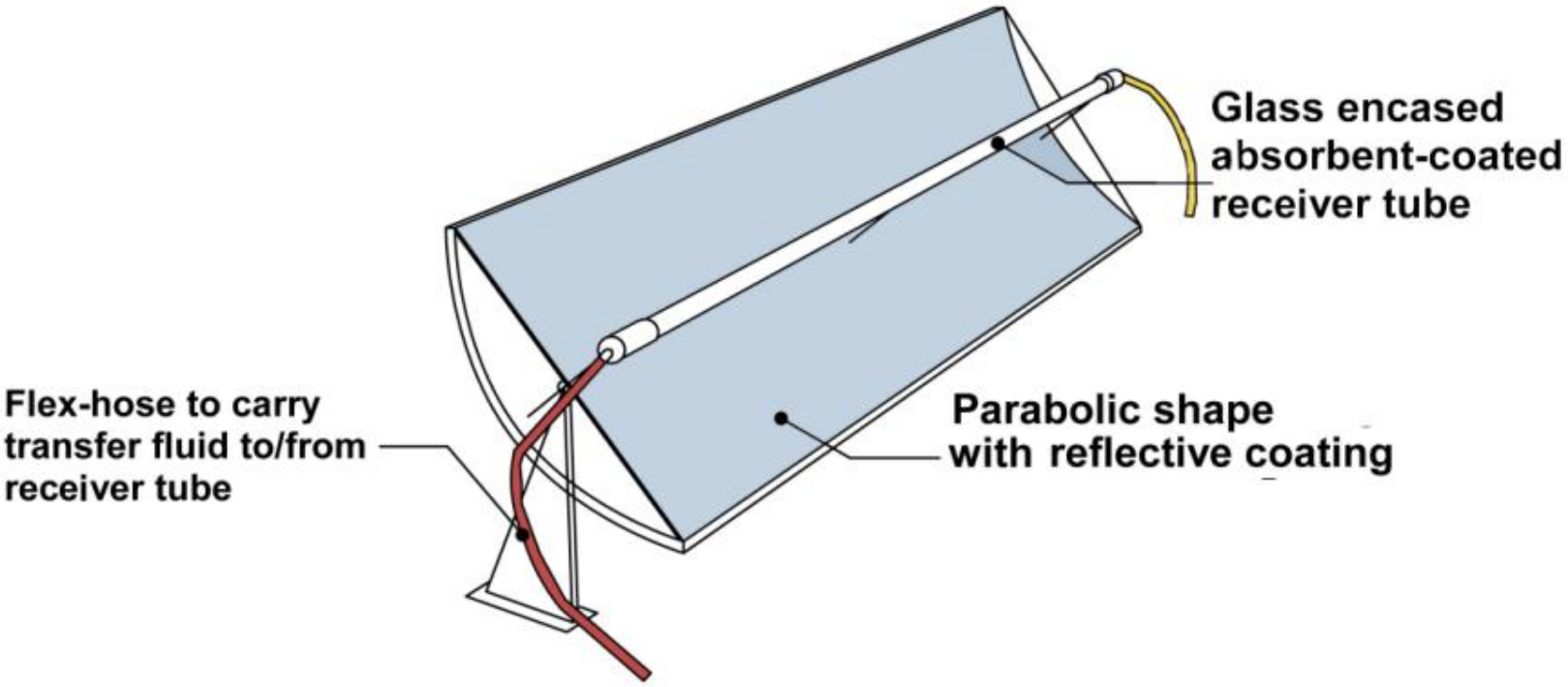
Theoretical Output of Concentrating Collectors



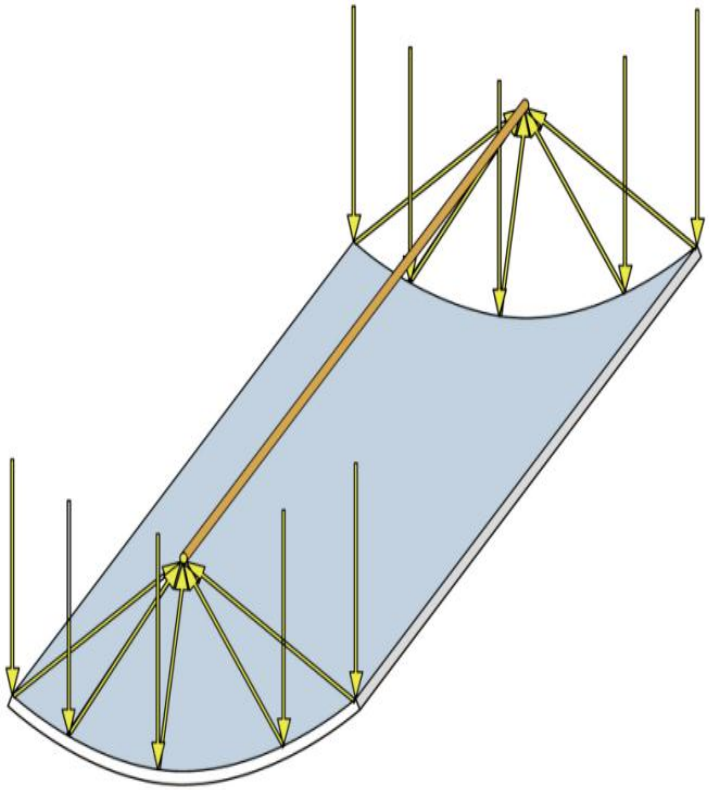
C = Concentration factor

Source: Stephan Fischer, ITW

Parabolic Trough Collector



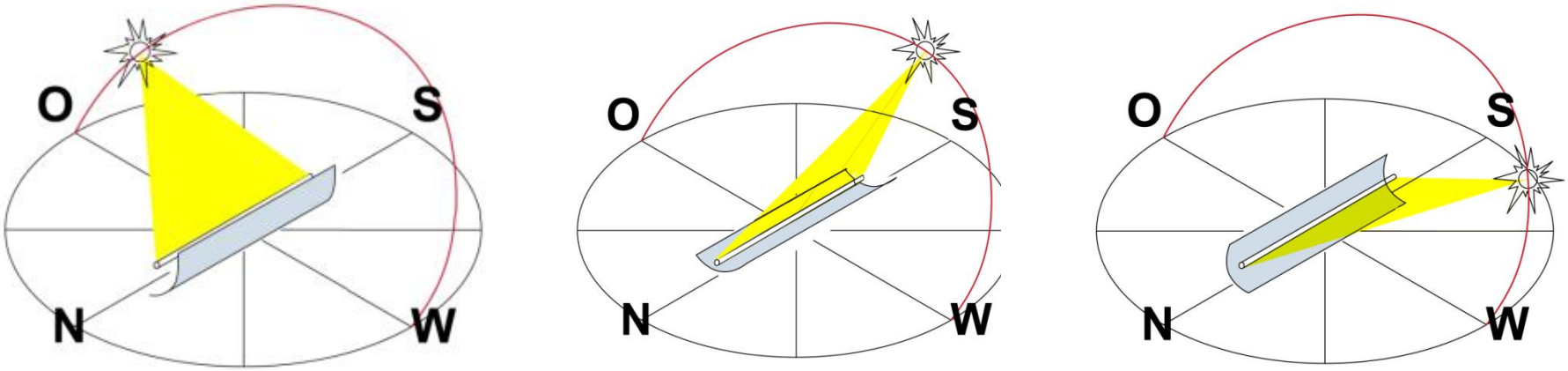
Working Principle - PTC



Parallel sun rays being concentrated onto the focal line of the collector

Small parabolic trough collector on the test rig of AEE INTEC

Tracking of the sun



Collector axis oriented north-south

Parabolic Trough Collector

120-250 °C

www.smirro.de

www.nep-solar.com

Source: Elimar Frank - SPF

Parabolic Trough Collector

120-250 °C

www.soltigua.com

www.solitem.com

Source: Elimar Frank - SPF

Parabolic trough collector system

Field of Parabolic Trough collectors of Solitem on the roof of the Alanod production facility, Germany

108 m² of collector surface

Production of saturated steam

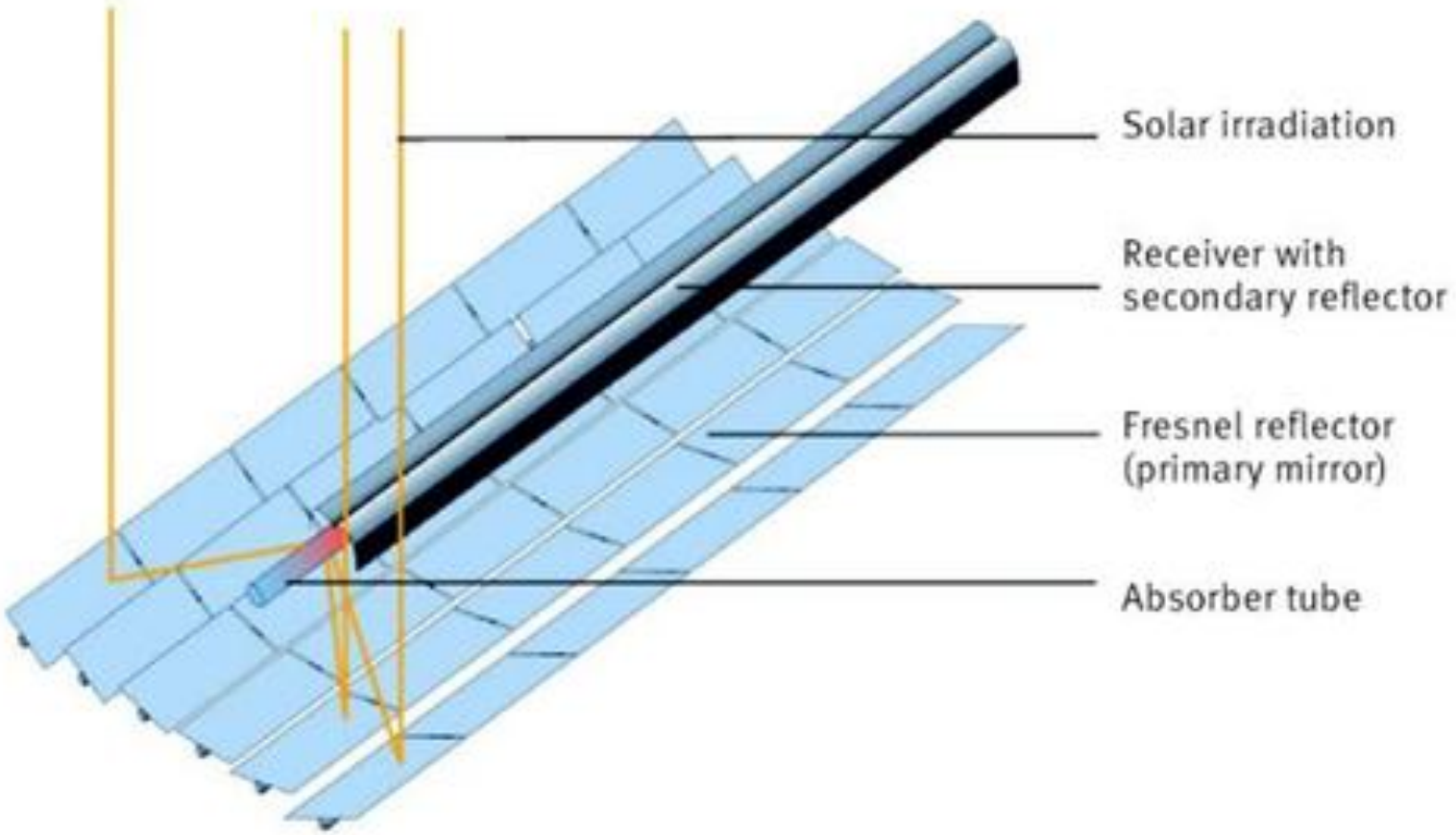
Consumer:
Steam line of 4 bar, 143°C

Source: Karim Said, Solitem

Linear Concentrating Fresnel Collectors

< 120 - 250 °C

Linear concentrating fresnel collector

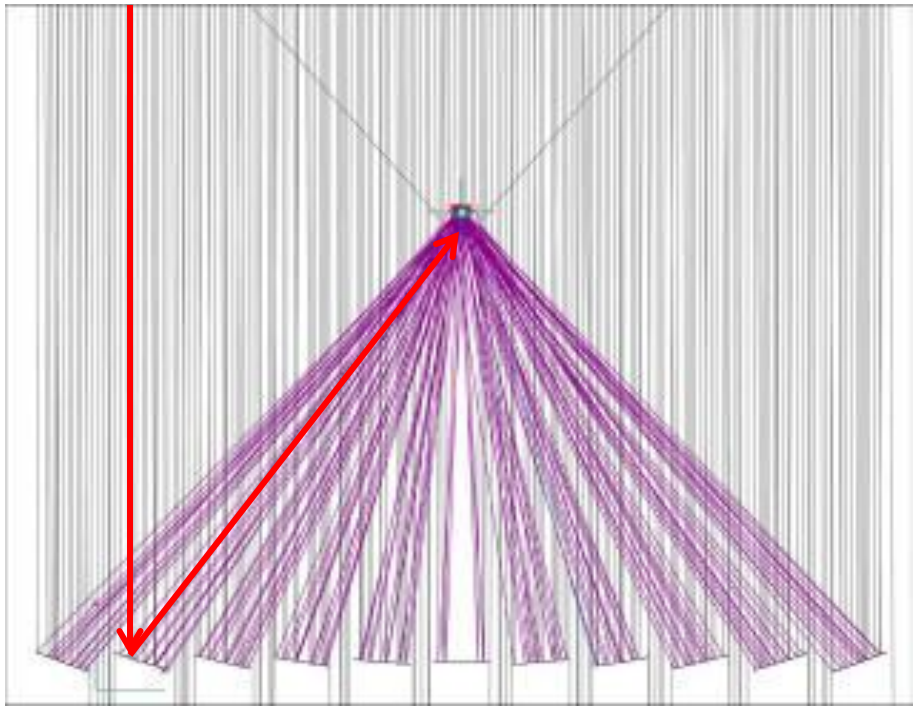


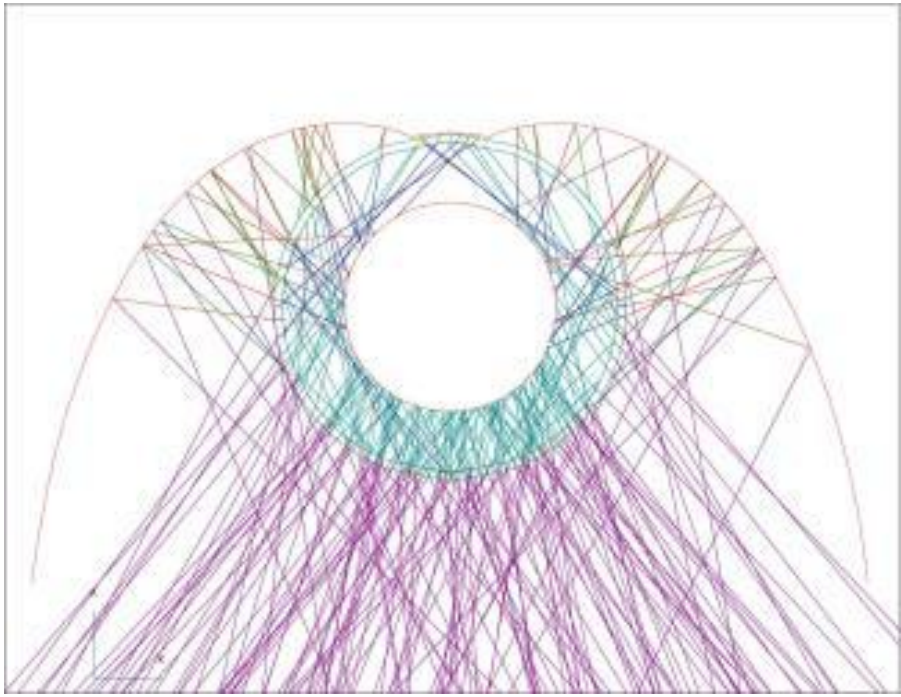
Source: W. Weiss and M. Rommel: Process heat collectors, IEA SHC Task 33

Solar cooling system with Fresnel concentrator collectors for a show-case football stadium in Doha, Qatar

Source: Industrial Solar

WORKING PRINCIPLE

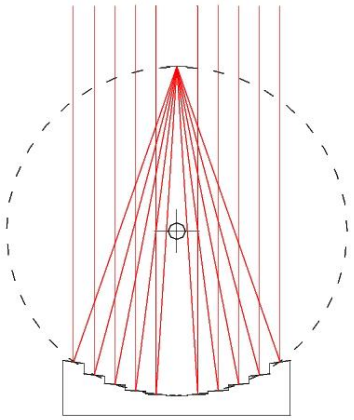


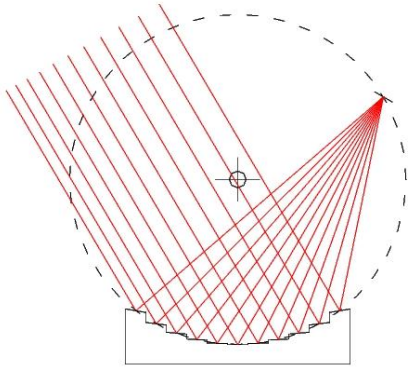


Raytracing with vertical irradiation.
Left: cross section of the whole collector
Right: cross section of the receiver with secondary concentrator

CONCENTRATING COLLECTORS

Universitat de les Illes Ballears





Fixed Mirrors and Tracking Receiver

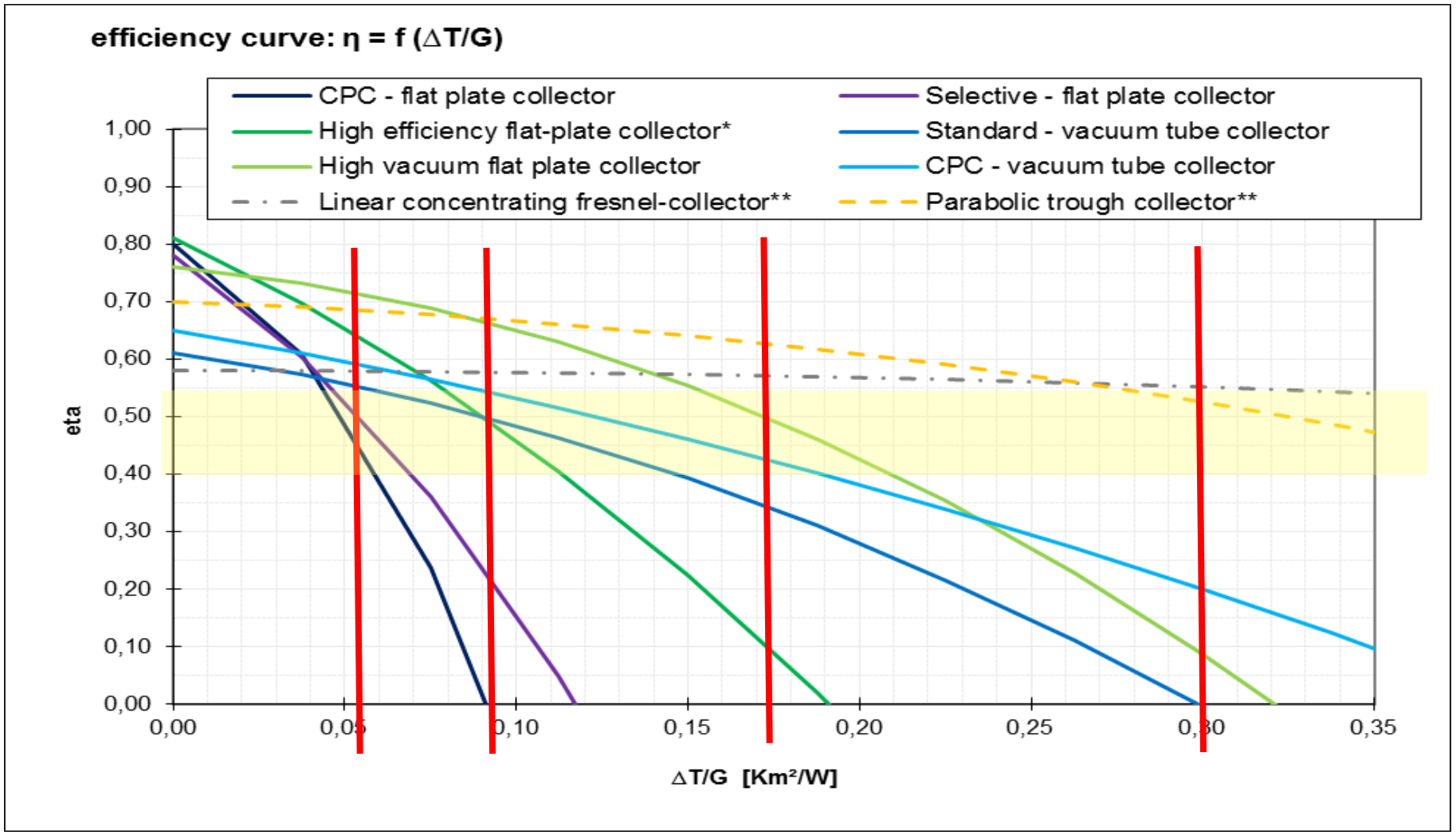
www.tsc-concentra.com

Scheffler Mirrors

Collector efficiency parameters related to aperture area

	η_0	a_1	a_2
	[–]	W/(m²K)	W/(m²K²)
Non concentrating collectors			
Selective - flat plate collector	0.78	3.80	0.03
CPC – flat plate collector	0.80	2.70	0.08
High efficiency flat-plate collector*	0,81	2.71	0.01
Standard – vacuum tube collector	0.61	0.85	0.005
CPC - vacuum tube collector	0.65	1.02	0.002
High vacuum flat plate collector	0.76	0.51	0.007
Concentrating collectors			
Linear concentrating fresnel-collector**	0,58	0,000	0,0004
Parabolic trough collector**	0,70	0,20	0,0016

Collector efficiency curves reflecting the collector efficiency parameters



Thank you for your attention