



Ritter OEM solar collectors

.....• Evacuated tube collectors by Ritter

*By conviction...
because PERFORMANCE and QUALITY count!*



.....• Basis for the analysis

- Collector comparison „Solar Keymark“: The main quality label for solar thermal
- „QAIST“-Results: „Quality Assurance in Solar Thermal Heating and Cooling Technology“
- Serial quality „Solar Keymark“
- Ritter quality management in series production

.....• Selection criteria

- Energy output and efficiency
- Quality / Serial quality
- Further advantages



Selection criteria

Energy output and efficiency



Source

Solar Keymark Data

Energy output and efficiency

Collector comparison Solar Keymark

Collector comparison **Solar Keymark**

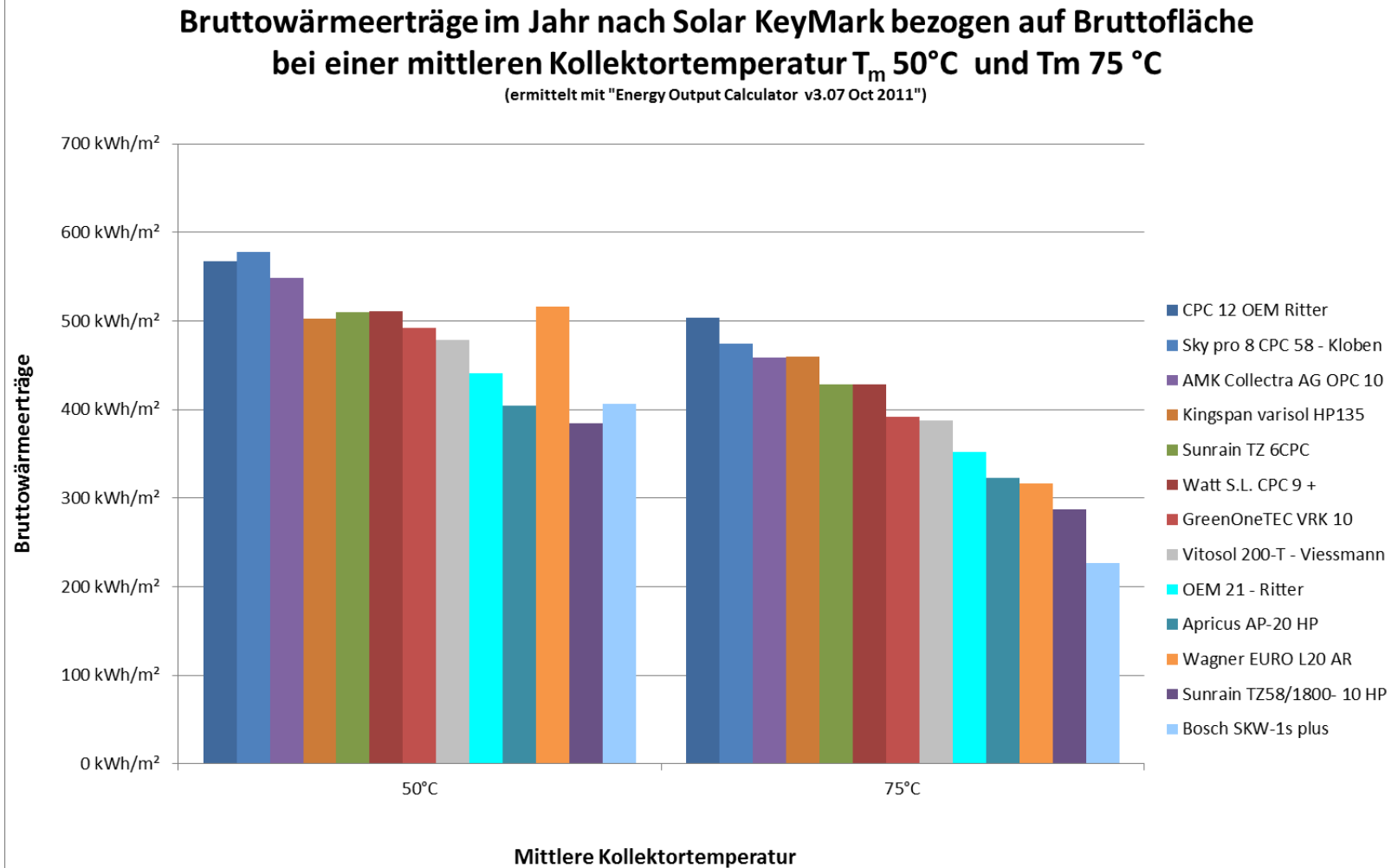
Comparison between collectors from China and Europe with the OEM evacuated tube collectors made by Ritter (Basis: gross area)

Construction/ Manufacturer:

- With mirror and U-Pipe
Sunrain; Watt; Ritter
- Without mirror Heat-Pipe (China)
Apricus; Sunrain
- Without mirror Heat-Pipe (EU; single glass tube):
Kingspan; Viessmann;
in comparison with Ritter OEM 21 (direct flow)

Energy output and efficiency

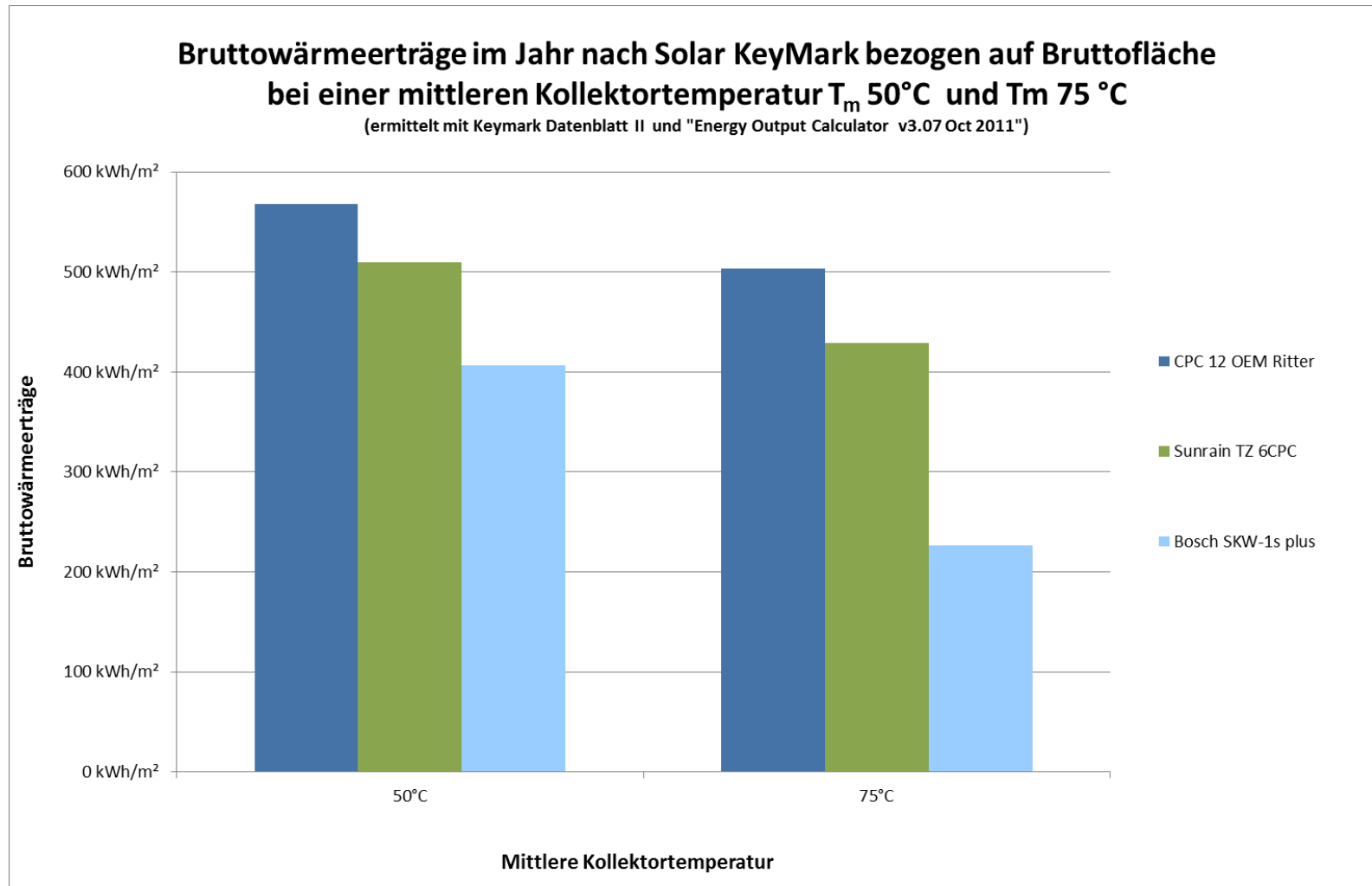
Collector comparison Solar Keymark / Overview



* Bosch SKW1s plus = Junkers FCC 1-S = Buderus CKN 1.0-S = Vulcano FCC 1-S = Worcester Solar lito

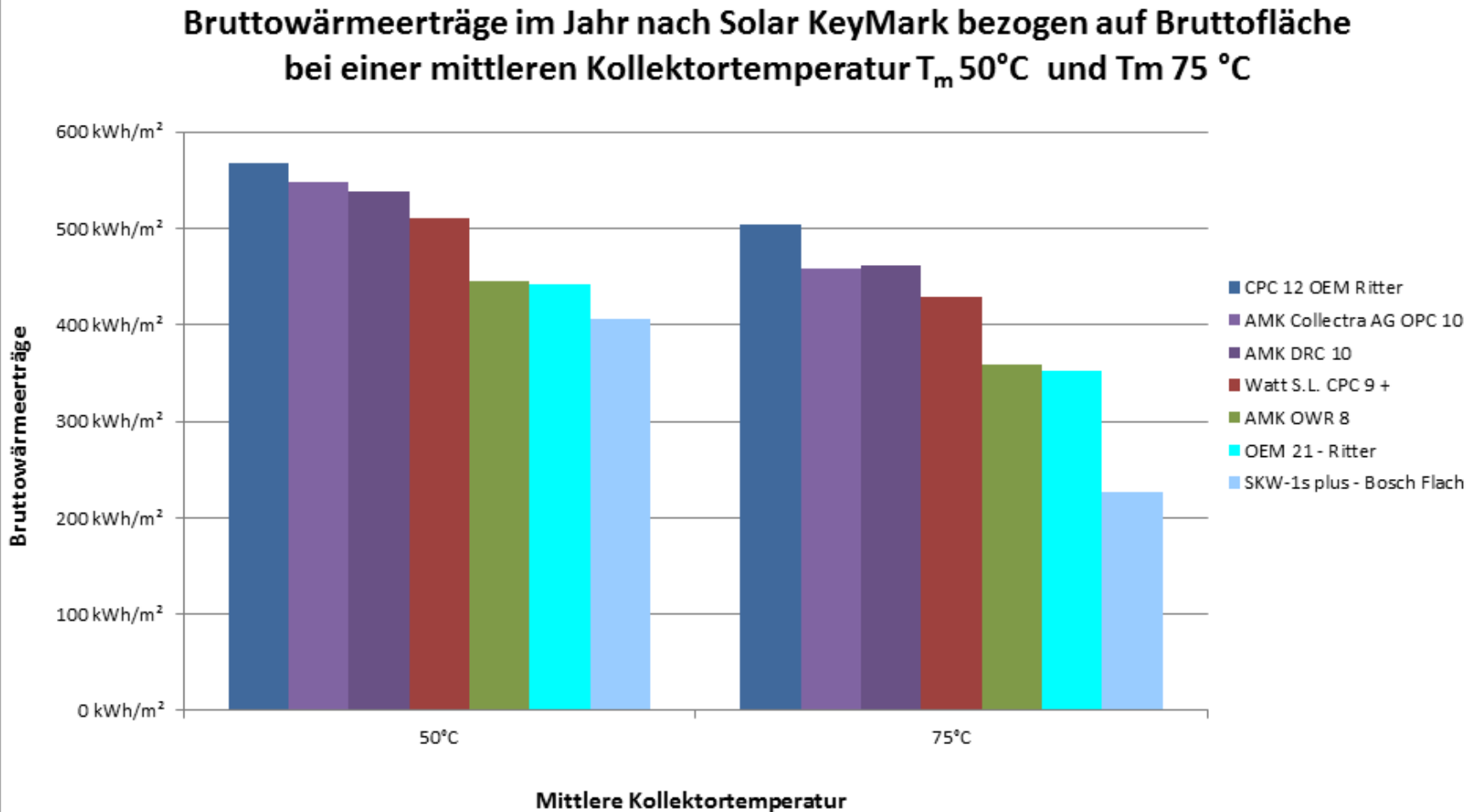
Energy output and efficiency

Comparison CPC-Technology Ritter/China U-Pipe



Energy output and efficiency

Comparison CPC-Technology Ritter/Europa U-Pipe

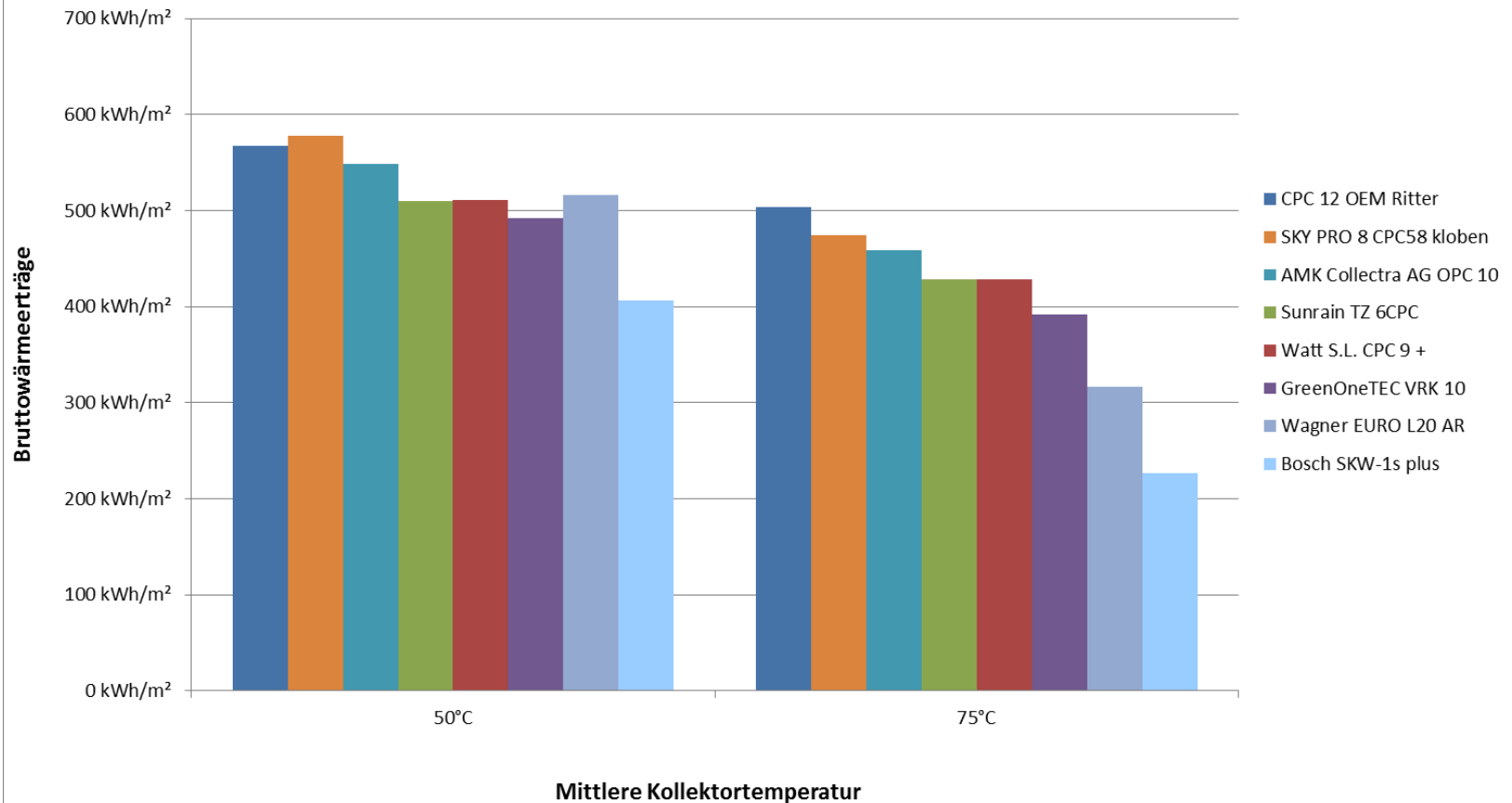


Energy output and efficiency

Comparison CPC-Technology Ritter/Europa U-Pipe

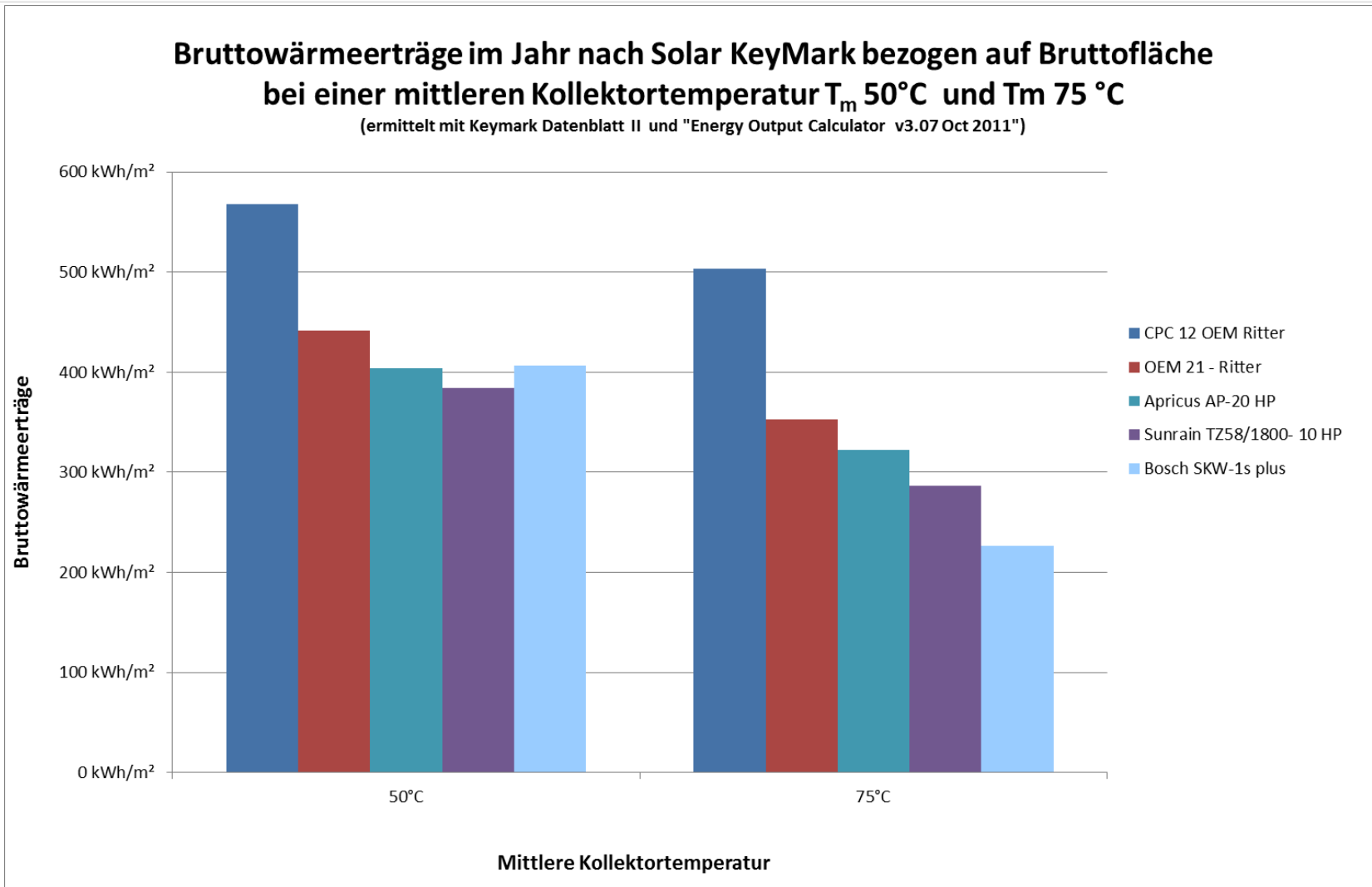
Bruttowärmeerträge im Jahr nach Solar KeyMark bezogen auf Bruttofläche bei einer mittleren Kollektortemperatur T_m 50°C und T_m 75 °C

(ermittelt mit Keymark Datenblatt II und "Energy Output Calculator v3.07 Oct 2011")



Energy output and efficiency

Comparison CPC-Technology Ritter/China Heat-Pipe

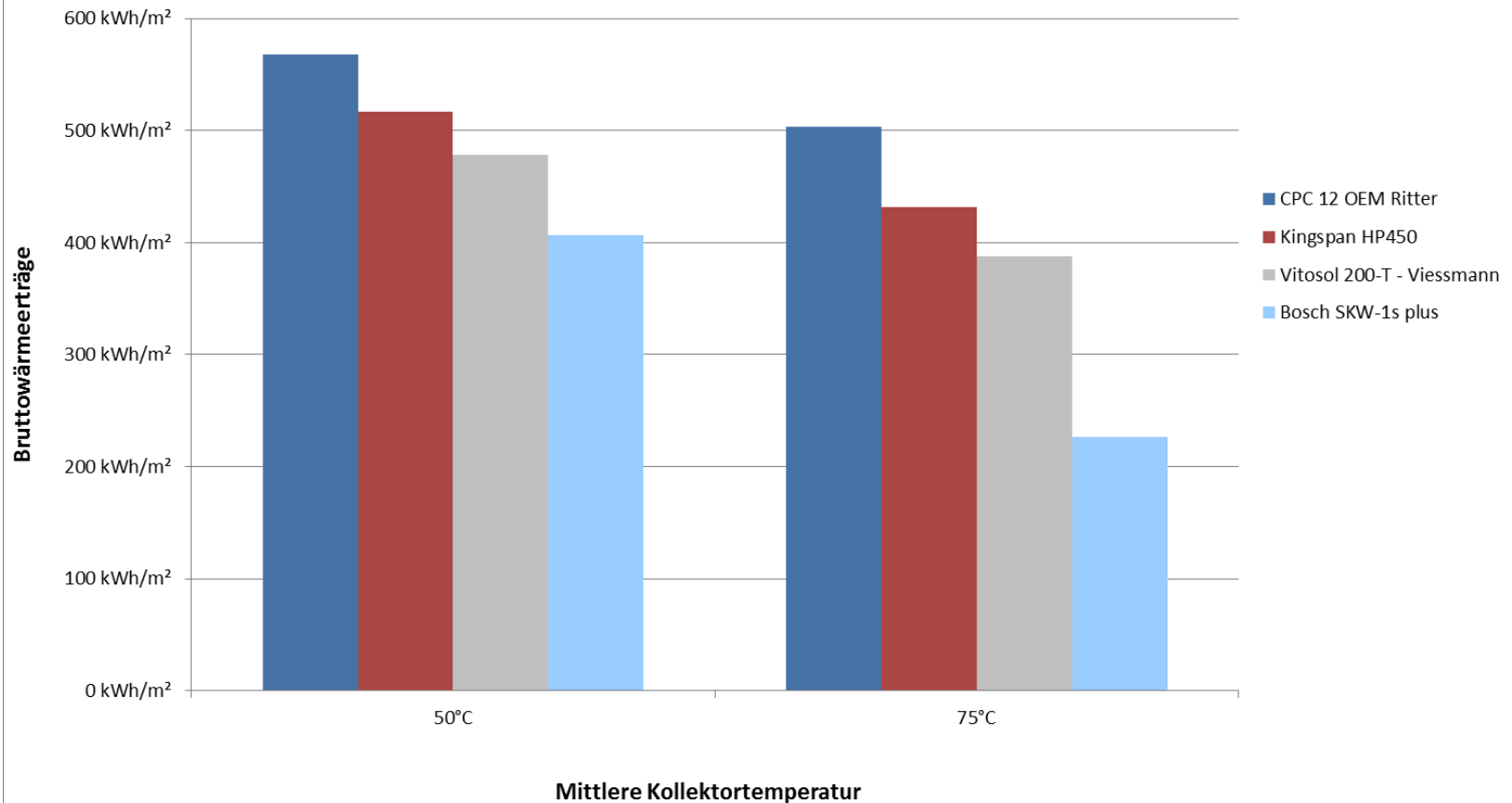


Energy output and efficiency

Comparison CPC-Technology Ritter/Europa Heat-Pipe

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Energy output and efficiency

Advantages of the Ritter CPC-Collectors

- The difference between aperture area and gross area is very small
→ Extreme high energy yield even at small collector gross area (requires small roof area)
- CPC-Reflector (**C**ompound **P**arabolic **C**oncentrator)
→ Highly reflective and weather proof
→ With its optimised shaped mirror the reflector catches sunlight even at unfavourable irradiation angels and therefore uses direct as well as diffuse sunlight
→ Allows constant energy yield throughout the day
- Due to the circular absorber design of the vacuum tubes, the tubes always work with ideal orientation to the sun
- Minimized heat losses even at very low ambient temperatures and high collector temperatures

Quality / Serial quality



Source

QUAIST

Solar Keymark Data

Quality / QUAIST

Durability of solar collectors

The durability of solar collectors is object of several national and international research projects

→Results of the QAIST-Project:

„Quality Assurance in Solar Thermal Heating and Cooling Technology“

→Project supported by the EU in the context of „Intelligent Energy Europe“ (IEE)

21 collectors of the years 2008 – 2011 were testet within the study.

U-Pipe (direct flow) and Heat-Pipe collectors

All collectors were tested under the following sequences:

a.Efficiency test (DIN 12975-2)

b.1 year of dry exposure (stagnation outside)

c.Renewed efficiency test (DIN 12975-2)

Institues involved in the study:

- | | | |
|--|---|----------------------------------|
| 1. LES – LNEG (Portugal): 1 x ETC (DF); 1 x ETC (HP) | 4. ITW (Germany): 1 x ETC (DF) with CPC-Reflektor; 4 x ETC (HP) | 7. CSTB (France) : 2 x ETC (HP). |
| 2. TÜV Rheinland (Germany): 2 x ETC (HP) | 5. SPF (Switzerland): 1 x ETC (HP) | 8. ISFH (Germany): 4 x ETC (HP). |
| 3. Fraunhofer ISE (Germany): 1 x ETC (DF); 2 x ETC (HP). | 6. AIT (Austria) : 1 x ETC (DF); 1 x flat collector. | 9. SP (Sweden): 1 x ETC (HP). |

Quality / QUAIST

Durability of solar collectors

Results QUAIST study

- 11 of the 21 tested collectors showed obvious decrease of performance after 1 year of dry exposure.

→ All 11 collectors with obvious decrease of performance were evacuated tube collectors with Heat-Pipe-System.
- The evacuated tube collectors with U-Pipe (direct flow) as well as 4 tested evacuated tube collectors with Heat-Pipe only showed marginal decrease of their performance

→ This result shows that the phenomenon of the reduction of the thermal efficiency after dry exposure especially occurs with evacuated tube collectors with Heat-Pipes

Quality / QUAIST

Durability of solar collectors

Possible reasons for the negative results of QUAIST:

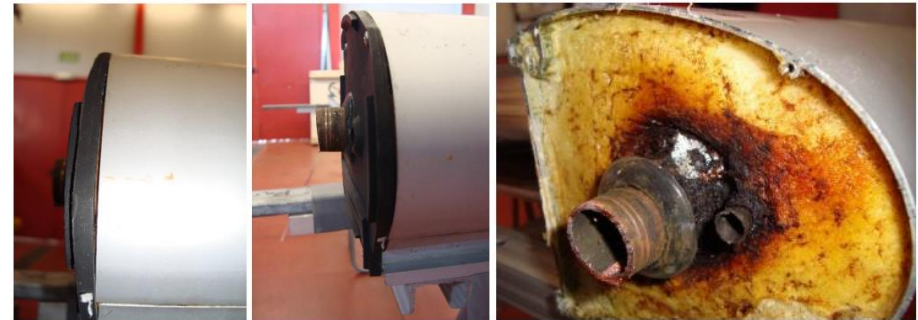
- Leakage of the heat transfer fluid out of the Heat-Pipes
- Aging of the heat transfer fluid inside the Heat-Pipes
- Strong corrosion of the Heat-Pipes in the lower and upper level
- Degregation of the heat insulation and ingress of moisture
- Dehydration of the heat transfer paste

Quality / QUAIST

Durability of solar collectors

Concrete examples

Degradation and swelling of the heat insulation inside the manifold



Strong corrosion of the Heat-Pipes in the lower and upper level.



→ 4 of all tested Heat-Pipes only showed marginal liquid inside; 1 Heat-Pipe was completely empty: efficiency reduction: 17%

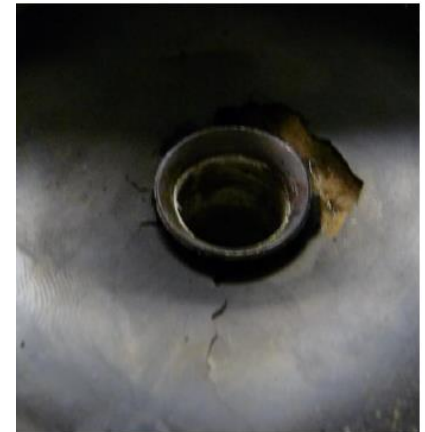
Quality / QUAIST

Durability of solar collectors

Concrete examples

Heavily aged and broken sealing in the transition of the heat pipe and the manifold

- Isolation is no longer protected against humidity.
- 3 out of 10 Heat-Pipes of the collector only contained little amount of liquid inside.
- Efficiency reduction: 16 %

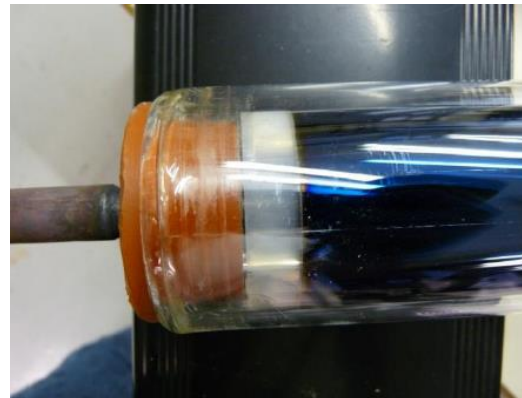


Quality / QUAIST

Durability of solar collectors

Concrete examples

Destroyed sealings of the manifold



- White coating on the inner face of the tube
- 9 Heat-Pipes contained yellow liquid
- 5 Heat-Pipes contained black liquid
- 3 Heat-Pipes contained transparent liquid
- Efficiency reduction: 11 %

Quality / QUAIST

Durability of solar collectors

Concrete examples

Kingspan Collector

Dehydration of the heat transfer paste

→ Efficiency reduction: 7%



Viessmann Collector

One of the Heat-Pipe collectors still achieved a good result, although the heat transfer paste was also dehydrated.

→ Efficiency reduction: 3 %



Quality / QUAIST

Durability of solar collectors

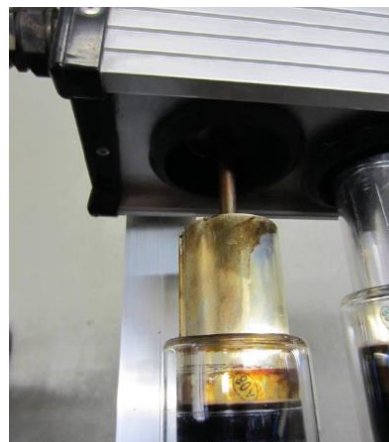
Concrete examples

Colour changes and embrittlement of the **composition**

Corrosion of the heat transfer profile

Destroyed isolation

→ Efficiency reduction: 10%



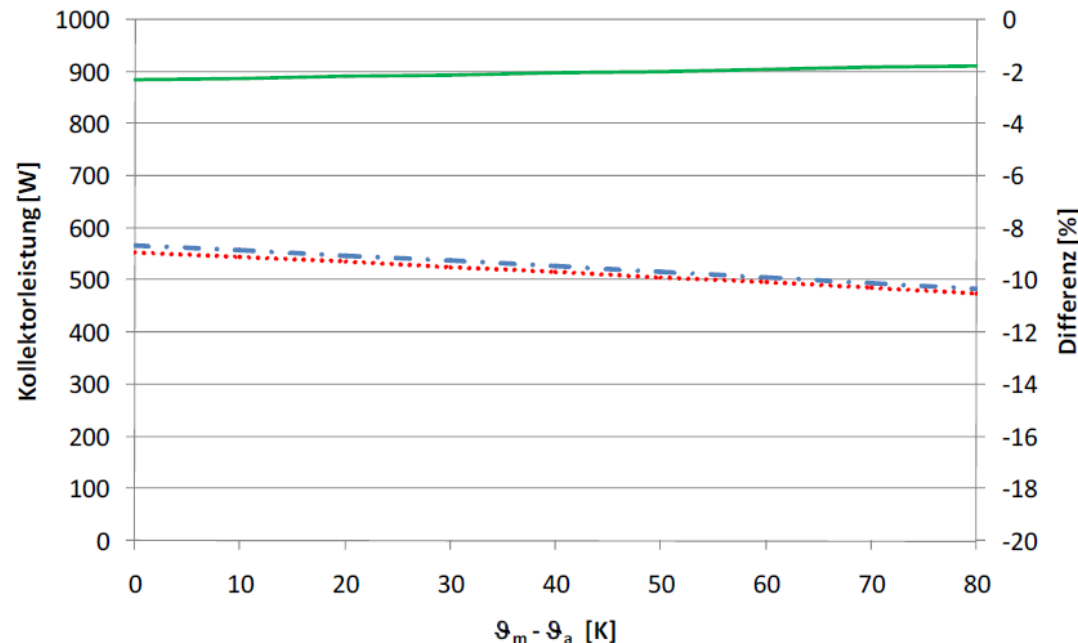
Quality / QUAIST

Durability of solar collectors

QUAIST Results: Measurement for CPC 6 Ritter OEM Collector*

— • C5 / 1. Messung C5 / 2. Messung — Differenz

Abbildung 7: Vergleich zwischen der gemessenen Kollektorleistung vor und nach einem Jahr trockener Exposition von Kollektor C5



→ The divergence is within the measuring tolerance

(*presented at the Solarthermal Symposium Staffelstein 2012; Poster Presentation H2: Efficiency comparison of evacuated tube collectors NEW and after 1 year of dry exposure. Dipl.-Ing. Michael Herr, University Stuttgart, ITW)

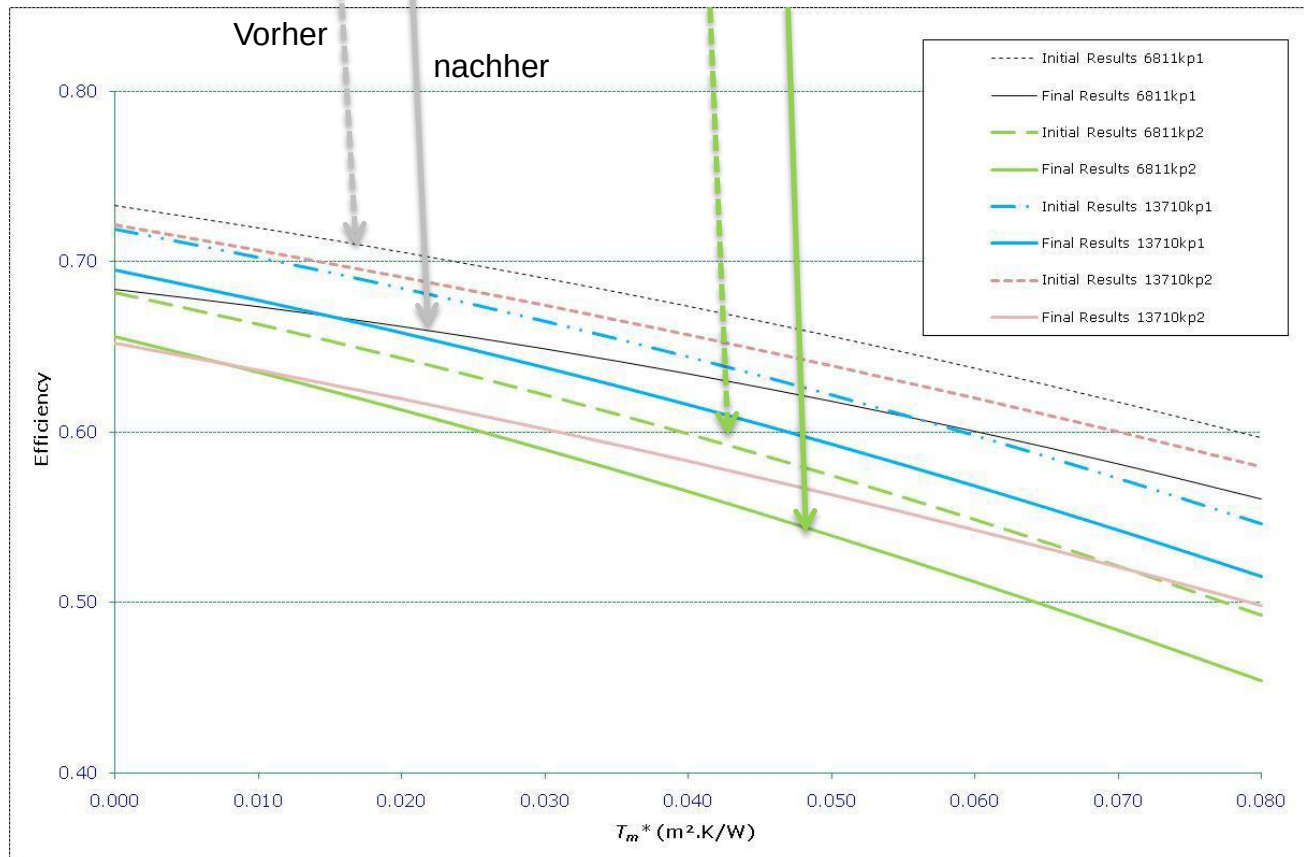
Quality / QUAIST

Durability of solar collectors

QUAIST Results (measured by ISFH-Hameln)

6811kp1: Kingspan HP 450

6811kp2: Viessmann Vitosol 200T



Serial quality

Solar Keymark Data

With the Solar Keymark Data it is possible to evaluate the serial quality of particular products.

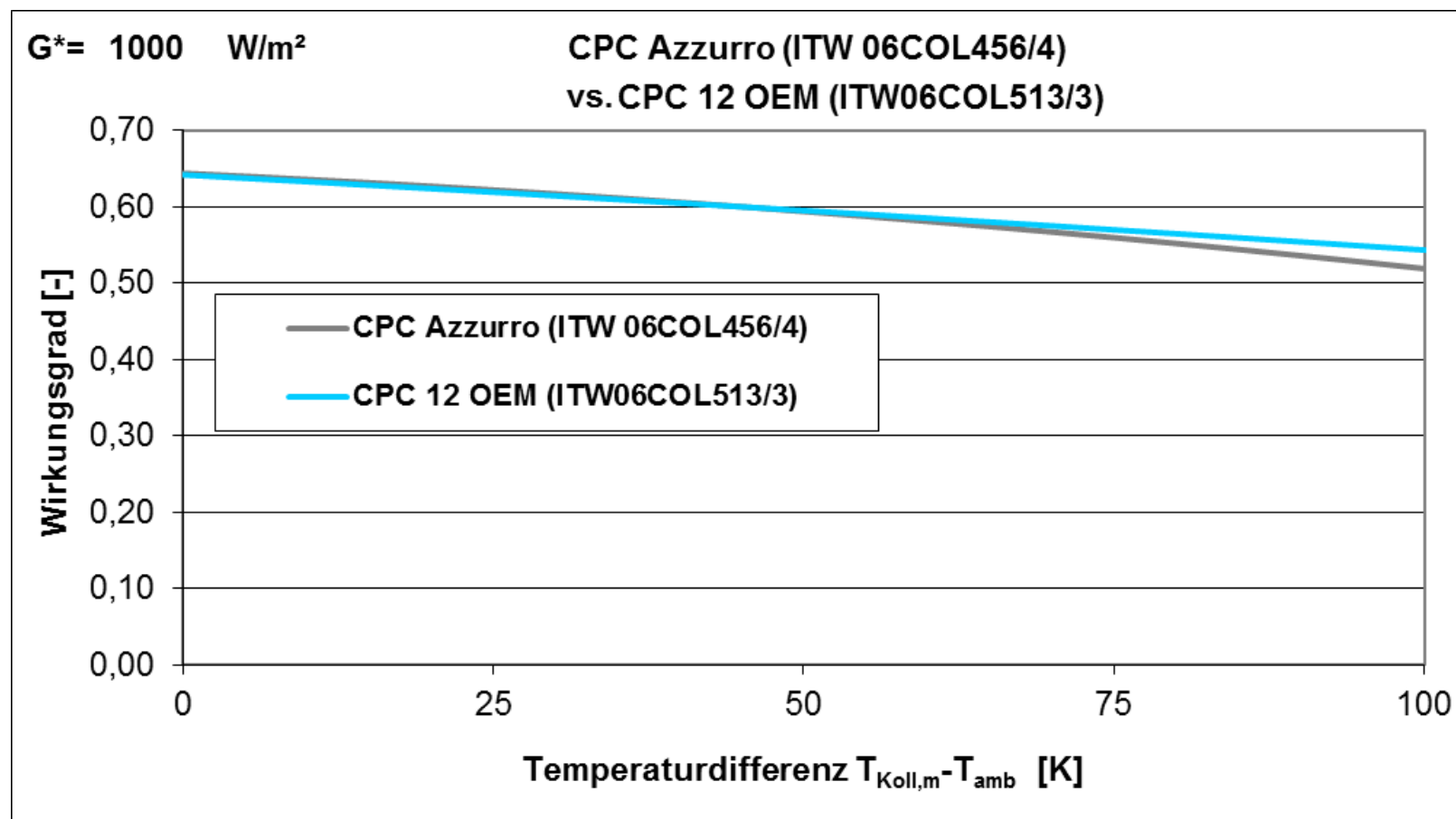
Proceeding:

1. All products with the same construction type can be gathered in a product family.
 - the biggest and the smallest collector are tested
 - the worst result is used for the description of the complete family
 (Since 2011 it is possible to certificate the best product of a family with an individual certificate)
 2. The testing institute chooses reference samples out of 10 collectors, one of the smallest and one of the largest collectors.
- For us there is **serial quality** if the results of the efficiency test from the smallest and the largest collector of the same product family are within the Solar Keymark Network range of equivalence of $\pm 2 \%$.

Serial quality

Solar Keymark Data

Collectors of the Ritter Gruppe: comparison of the product families
Star Azzurro / Paradigma and OEM 6/12/18 of Ritter Solar

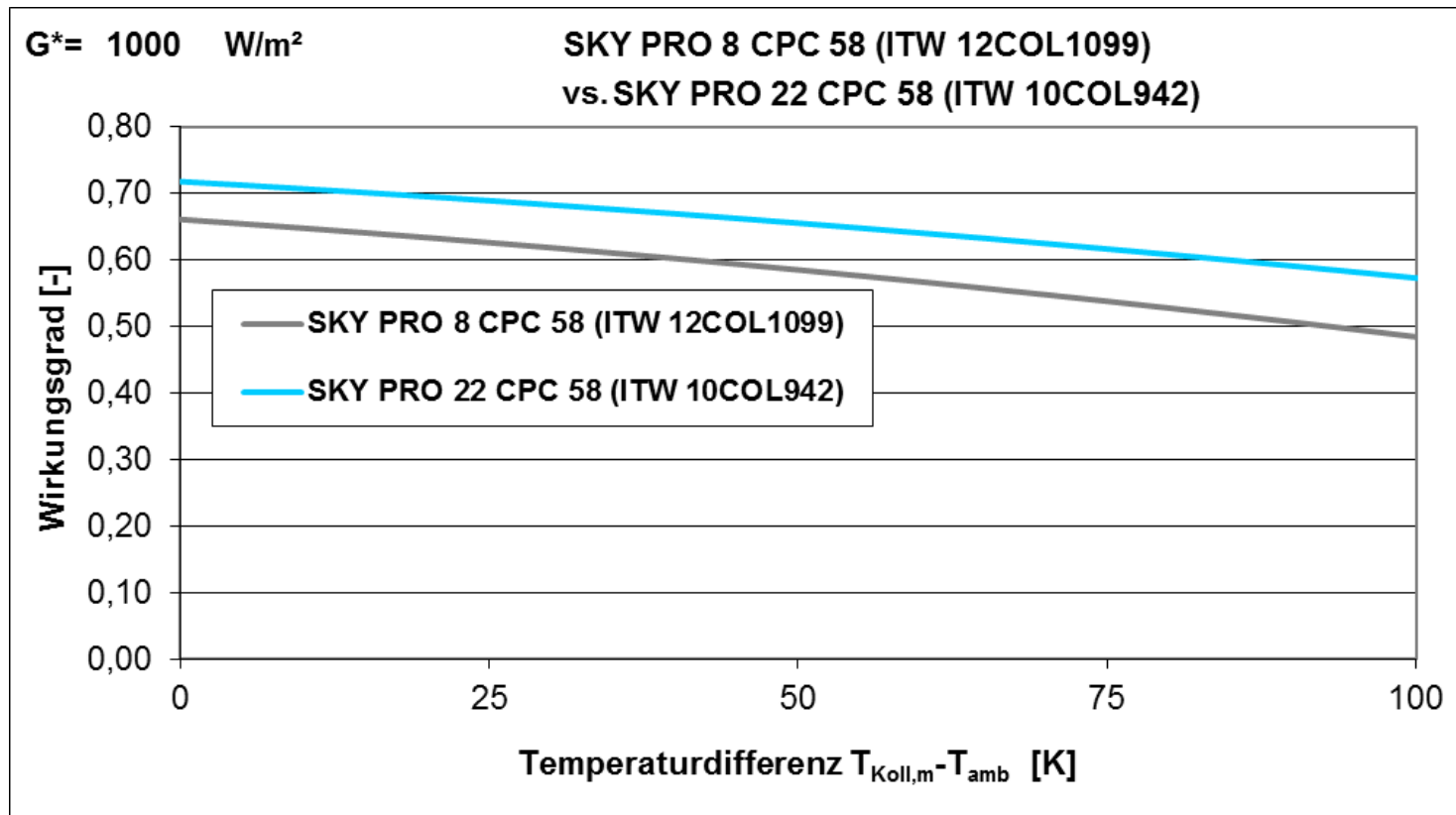


Serial quality

Solar Keymark Data

Comparison of the families SKY Pro / Kloben:

Smallest collector 1,7 m² largest collector 4,7 m²



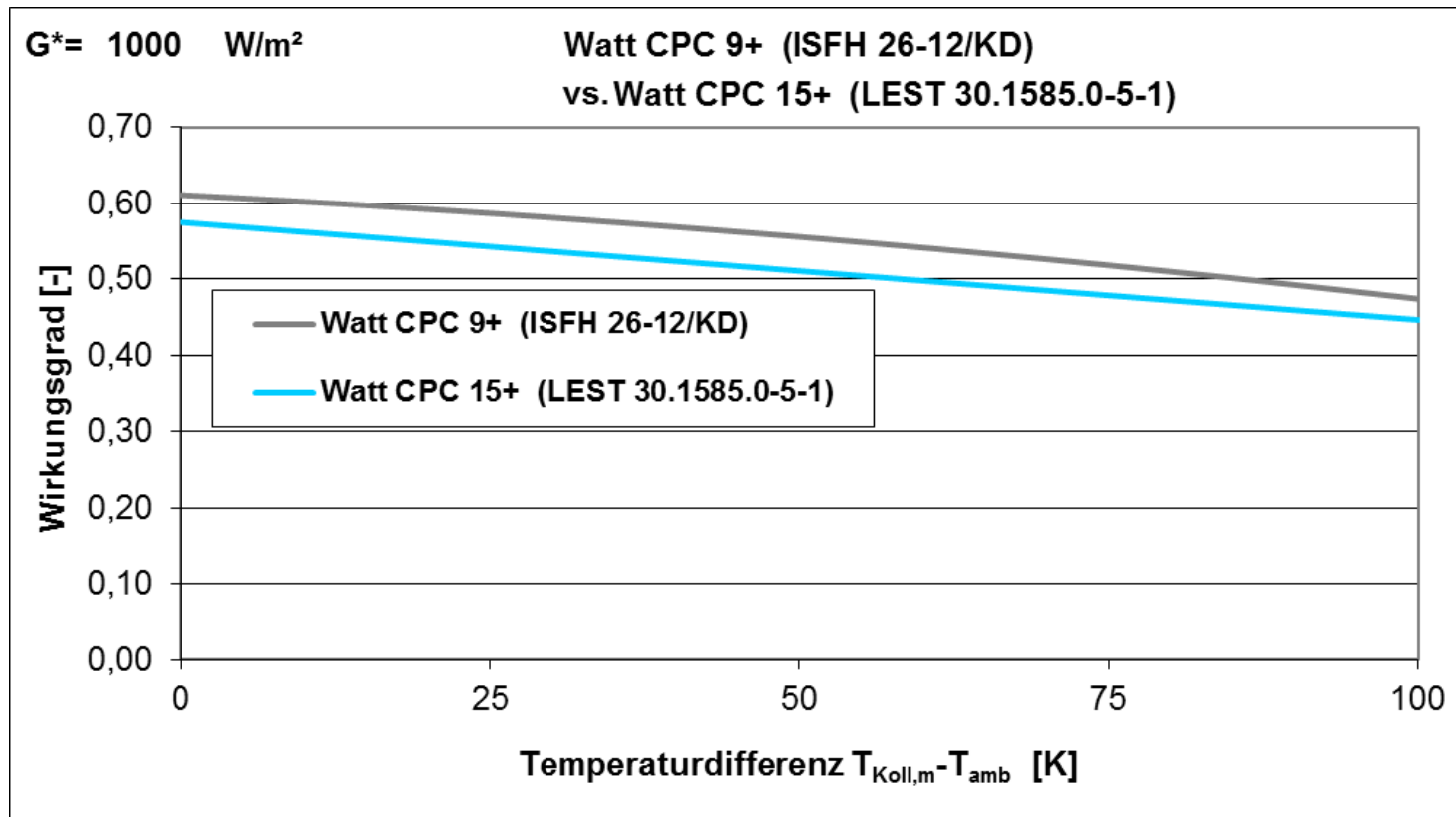
→ The performance curves are obviously outside the Solar Keymark Network range of equivalence of $\pm 2\%$.

Serial quality

Solar Keymark Data

Comparison of the product families CPC 9 + and CPC 15 + Watt:

Smallest collector 2,04 m² largest collector 3,38 m²



→ The performance curves are obviously outside the Solar Keymark Network range of equivalence of $\pm 2\%$.

Serial quality

Internal quality management

Actions of the Ritter Gruppe to achieve a high serial quality:

1) Serial supported tests:

- Dimensional inspection
 - Check of the thermal shock resistance
 - Check of the vacuum quality and durability
 - Check of the U-Values
 - Check of the absorption and emission
 - Visual check of the glass quality and the absorber layer
- These checks are partly integrated in the different production steps

Serial quality

Internal quality management

Actions of the Ritter Gruppe to achieve a high serial quality:

2) Requalification Check:

- Pressure resistance, impact resistance, and transmission of the glass tube.
- These checks are done yearly in additon to the serial supported tests.

Quality/ Serial quality

Advantages of the Ritter CPC-Collectors

- High safety in operation and reliability through assignment of high quality and corrosion resistant materials, like thick-walled borosilicate glass, stainless steel and anodized aluminium
- Everlasting vacuum leak proof due to pure glass connection between inner and outer glass tube, no glass-metal connection, thermos flask principle
- The dry connection of the vacuum tubes to the solar circuit ensure a high safety operation

Quality/ Serial quality

Werksinspektion und Physical Inspection

Ritter CPC-Collectors / Production site Dettenhausen

May 2013:

Factory inspection through ITW and physical inspection of the collectors

→ Results: no discrepancy

→ That means, that all collectors which are produced in Dettenhausen fulfill the requirements of EN 12975 and are awarded with the **Solar Keymark label** until the next inspection in August 2015.

.....• Selection criteria

Further advantages



Construction

Advantages of the Ritter CPC-Collectors

- By using a **circular absorber** and the **CPC-Reflector** direct and diffuse sunlight is gathered in the best possible way
- A preassembled barium **getter** in each tube allows fast indication of the vacuum inside
- Easy and fast tube exchange **without tools** and **without draining** the system due to the dry connection

Construction

Advantages of the Ritter CPC-Collectors

- The heat transfer medium flows through the collector **without** the use of a **heat exchanger**
- Outstanding secure and durable metal connection technology
- Collectors up to **15m² gross area** in a row (requires a 6m pump)
- Outstanding design → IF-Designaward

Assembly / Maintenance

Advantages of the Ritter CPC-Collectors

- Short assembly time through preassembled collectors and user-friendly mounting kits
- Easy connection method for add-on collectors through preassembled connection fittings. **No additional piping or insulation is required**
- Optional location of the flow and return connection at both sides of the collector

Assembly/ Maintenance

Advantages of the Ritter CPC-Collectors

- Easy and fast replacement of the **CPC-Reflector** without the use of tools and even without draining the system due to the dry connection
- The collectors edges are fitted with plastic profiles and the edges of the CPC-Reflector are mounted in the aluminium frame to avoid injuries during installation
- The collector comes wrapped in a **sun protection** foil to allow commissioning even at full sunlight
- **Carrying straps** attached to the collector ensure a save and easy handling on the roof and can be used as transport straps for a crane as well.

Divers

Advantages of the Ritter CPC-Collectors

- **Ressource-efficient:**
 - Minimum material usage and therefore lowest cumulated energy demand
 - The whole collector construction is fully recyclable
- **Field of application:**
 - perfect for water heating, heating support and solar cooling



Ritter / OEM solar collectors