



|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|--|--|--|--|--|--------------------------------------|--|----------------------------------|--|------------------------------------|--|----------------------|---|---|------------|-------|--|-------|--|-------|--|-------|--|-------|--|
| <b>Annex to Solar Keymark Certificate - Summary of EN ISO 9806:2013 Test Results</b>   |  |  |  |  | <b>Licence Number</b>                |  | <b>011-7S2843 F</b>              |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  | <b>Date issued</b>                   |  | <b>2018-03-14</b>                |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  | <b>Issued by</b>                     |  | <b>TÜV Rheinland Energy GmbH</b> |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Licence holder</b>  |  | <b>SOLARier Gesellschaft für erneuerbare Energie mbH</b> |  |  | <b>Country</b>                       |  | Austria                          |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Brand (optional)</b>  |  | SOLARier   |  |  | <b>Web</b>                           |  | http://www.solarier.at           |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Street, Number</b>  |  | Bach 8   |  |  | <b>E-mail</b>                        |  | office@solarier.at               |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Postcode, City</b>  |  | 4209 Engerwitzdorf                                       |  |  | <b>Tel</b>                           |  | +43 (0) 7235 / 89 7 89 - 0       |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Collector Type</b>  |  |  |  |  | Flat plate collector, glazed         |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Collector name</b>  |  |  |  |  | <b>Gross area (<math>A_G</math>)</b> |  | <b>Gross length</b>              |  | <b>Gross width</b>                 |  | <b>Gross height</b>  |   | <b>Power output per collector</b><br>G <sub>b</sub> = 850 W/m <sup>2</sup> ; G <sub>d</sub> = 150 W/m <sup>2</sup> ; u = 3 m/s<br>$\vartheta_m - \vartheta_a$ |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  | m <sup>2</sup>                       |  | mm                               |  | mm                                 |  | mm                   |   | 0 K   |            | 10 K  |  | 30 K  |  | 50 K  |  | 70 K  |  | 90 K  |  |
| Systemkollektor S 2.29 m <sup>2</sup>  |  |  |  |  | 2.29                                 |  | 2 079                            |  | 1 100                              |  | 116                  |   | 1 608   |            | 1 537 |  | 1 375 |  | 1 190 |  | 981   |  | 748   |  |
| Systemkollektor S 4.47 m <sup>2</sup>  |  |  |  |  | 4.44                                 |  | 2 079                            |  | 2 140                              |  | 116                  |   | 3 123   |            | 2 983 |  | 2 670 |  | 2 310 |  | 1 904 |  | 1 452 |  |
| Systemkollektor S 6.65 m <sup>2</sup>  |  |  |  |  | 6.61                                 |  | 2 079                            |  | 3 180                              |  | 116                  |   | 4 650   |            | 4 442 |  | 3 976 |  | 3 440 |  | 2 836 |  | 2 163 |  |
| Systemkollektor S 8.83 m <sup>2</sup>  |  |  |  |  | 8.77                                 |  | 2 079                            |  | 4 220                              |  | 116                  |   | 6 171   |            | 5 895 |  | 5 276 |  | 4 565 |  | 3 763 |  | 2 870 |  |
| Systemkollektor S 11.01 m <sup>2</sup>   |  |  |  |  | 10.93                                |  | 2 079                            |  | 5 260                              |  | 116                  |   | 7 687   |            | 7 344 |  | 6 573 |  | 5 687 |  | 4 688 |  | 3 575 |  |
| Systemkollektor S 13.19 m <sup>2</sup>   |  |  |  |  | 13.09                                |  | 2 079                            |  | 6 300                              |  | 116                  |   | 9 207   |            | 8 796 |  | 7 871 |  | 6 811 |  | 5 615 |  | 4 282 |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Power output per m<sup>2</sup> gross area</b>   |  |  |  |  | 703                                  |  | 672                              |  | 601                                |  | 520                  |   | 429   |            | 327   |  |       |  |       |  |       |  |       |  |
| <b>Performance parameters test method</b>  |  |  |  |  | Quasi dynamic                        |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Performance parameters (related to AG)</b>  |  |  |  |  | $\eta_{0,b}$                         |  | c1                               |  | c2                                 |  | c3                   |   | c4  |            | c6    |  | Kd    |  |       |  |       |  |       |  |
| <b>Units</b>   |  |  |  |  | -                                    |  | W/(m <sup>2</sup> K)             |  | W/(m <sup>2</sup> K <sup>2</sup> ) |  | J/(m <sup>3</sup> K) |   | -   |            | s/m   |  | -     |  |       |  |       |  |       |  |
| <b>Test results</b>  |  |  |  |  | 0.716                                |  | 3.010                            |  | 0.013                              |  | 0.000                |   | 0.000   |            | 0.000 |  | 0.882 |  |       |  |       |  |       |  |
| <b>Incidence angle modifier test method</b>  |  |  |  |  | Quasi dynamic - outdoor              |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Bi-directional incidence angle modifiers</b>  |  |  |  |  | No                                   |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Incidence angle modifier</b>  |  |  |  |  | Angle                                |  | 10°                              |  | 20°                                |  | 30°                  |   | 40°   |            | 50°   |  | 60°   |  | 70°   |  | 80°   |  | 90°   |  |
| <b>Transversal</b>   |  |  |  |  | $K_{\theta T, coll}$                 |  | 0.99                             |  | 0.98                               |  | 0.95                 |   | 0.90  |            | 0.82  |  | 0.67  |  | 0.36  |  | 0.18  |  | 0.00  |  |
| <b>Longitudinal</b>  |  |  |  |  | $K_{\theta L, coll}$                 |  | 0.99                             |  | 0.98                               |  | 0.95                 |   | 0.90  |            | 0.82  |  | 0.67  |  | 0.36  |  | 0.18  |  | 0.00  |  |
| <b>Heat transfer medium for testing</b>  |  |  |  |  | Water-Glycole                        |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Flow rate for testing (per gross area, <math>A_G</math>)</b>  |  |  |  |  | dm/dt                                |  | 0.020                            |  | kg/(sm <sup>2</sup> )              |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Maximum temperature difference for thermal performance calculations</b>   |  |  |  |  | $(\vartheta_m - \vartheta_a)_{max}$  |  | 90                               |  | K                                  |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Standard stagnation temperature (<math>G = 1000 \text{ W/m}^2</math>; <math>\vartheta_a = 30 \text{ }^\circ\text{C}</math>)</b>                   |  |  |  |  | $\vartheta_{stg}$                    |  | 200                              |  | °C                                 |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Effective thermal capacity, incl. fluid (per gross area, <math>A_G</math>)</b>  |  |  |  |  | C/m <sup>2</sup>                     |  | 7.11                             |  | kJ/(K m <sup>2</sup> )             |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Maximum operating temperature</b>   |  |  |  |  | $\vartheta_{max, op}$                |  | 180                              |  | °C                                 |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Maximum operating pressure</b>  |  |  |  |  | $p_{max, op}$                        |  | 600                              |  | kPa                                |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Testing laboratory</b>  |  |  |  |  | TÜV Rheinland Energy GmbH            |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |
| <b>Test report(s)</b>  |  |  |  |  | 21238974.001_REV01                   |  |                                  |  |                                    |  |                      | <b>Dated</b>  |   | 28.02.2018 |       |  |       |  |       |  |       |  |       |  |
| <b>Comments of testing laboratory</b>  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      | Datasheet version: 5.01, 2016-03-01   |   |            |       |  |       |  |       |  |       |  |       |  |
|  |  |  |  |  |                                      |  |                                  |  |                                    |  |                      | <br>Genau. Richtig.<br><br>TÜV Rheinland Energy GmbH<br>Am Grauen Stein<br>51105 Köln |   |            |       |  |       |  |       |  |       |  |       |  |
| DIN CERTCO • Alboinstraße 56 • 12103 Berlin, Germany<br>Tel: +49 30 7562-1131 • Fax: +49 30 7562-1141 • E-Mail: info@dincertco.de • www.dincertco.de |  |  |  |  |                                      |  |                                  |  |                                    |  |                      |   |   |            |       |  |       |  |       |  |       |  |       |  |

|   |                       |                     |
|---|-----------------------|---------------------|
| <b>Annex to Solar Keymark Certificate<br/>Supplementary Information</b> | <b>Licence Number</b> | <b>011-7S2843 F</b> |
|   | <b>Issued</b>         | <b>2018-03-14</b>   |

**Annual collector output in kWh/collector at mean fluid temperature  $\vartheta_m$ , based on EN ISO 9806:2013 test results**

| Standard Locations<br>Collector name        | $\vartheta_m$ | Athens  |       |       | Davos                   |       |       | Stockholm               |       |       | Würzburg                |       |       |
|---|---------------|---|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|-------------------------|-------|-------|
|   |               | 25°C  | 50°C  | 75°C  | 25°C                    | 50°C  | 75°C  | 25°C                    | 50°C  | 75°C  | 25°C                    | 50°C  | 75°C  |
| Systemkollektor S 2.29 m <sup>2</sup>       |               | 2 414   | 1 734 | 1 137 | 1 849                   | 1 285 | 812   | 1 353                   | 894   | 550   | 1 472                   | 966   | 580   |
| Systemkollektor S 4.47 m <sup>2</sup>       |               | 4 686   | 3 367 | 2 208 | 3 589                   | 2 494 | 1 576 | 2 626                   | 1 737 | 1 067 | 2 859                   | 1 875 | 1 127 |
| Systemkollektor S 6.65 m <sup>2</sup>       |               | 6 978   | 5 014 | 3 287 | 5 344                   | 3 714 | 2 347 | 3 911                   | 2 586 | 1 589 | 4 257                   | 2 792 | 1 678 |
| Systemkollektor S 8.83 m <sup>2</sup>       |               | 9 260   | 6 653 | 4 362 | 7 092                   | 4 928 | 3 114 | 5 190                   | 3 432 | 2 108 | 5 649                   | 3 705 | 2 226 |
| Systemkollektor S 11.01 m <sup>2</sup>      |               | 11 537  | 8 289 | 5 435 | 8 836                   | 6 140 | 3 880 | 6 465                   | 4 275 | 2 626 | 7 038                   | 4 616 | 2 774 |
| Systemkollektor S 13.19 m <sup>2</sup>      |               | 13 817  | 9 927 | 6 509 | 10 582                  | 7 353 | 4 647 | 7 743                   | 5 120 | 3 146 | 8 428                   | 5 529 | 3 322 |
| Annual output per m <sup>2</sup> gross area |               | 1 056   | 758   | 497   | 808                     | 562   | 355   | 592                     | 391   | 240   | 644                     | 422   | 254   |
| Fixed or tracking collector                 |               | Fixed (slope = latitude - 15°; rounded to nearest 5°) |       |       |                         |       |       |                         |       |       |                         |       |       |
| Annual irradiation on collector plane       |               | 1765 kWh/m <sup>2</sup>                               |       |       | 1714 kWh/m <sup>2</sup> |       |       | 1166 kWh/m <sup>2</sup> |       |       | 1244 kWh/m <sup>2</sup> |       |       |
| Mean annual ambient air temperature         |               | 18.5°C  |       |       | 3.2°C                   |       |       | 7.5°C                   |       |       | 9.0°C                   |       |       |
| Collector orientation or tracking mode      |               | South, 25°  |       |       | South, 30°              |       |       | South, 45°              |       |       | South, 35°              |       |       |

The collector is operated at constant temperature  $\vartheta_m$  (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at [www.solarkeymark.org/scenocalc](http://www.solarkeymark.org/scenocalc)

**Additional Information**

|   |               |    |
|---|---------------|----|
| Collector heat transfer medium  | Water-Glycole |    |
| Hybrid Thermal and Photo Voltaic collector  | No            |    |
| The collector is deemed to be suitable for roof integration   | Yes           |    |
| The collector was tested successfully according to EN ISO 9806:2013 under the following conditions: |               |    |
| Climate class (A, B or C)   | A             | -- |
| Maximum tested positive load  | 2400          | Pa |
| Maximum tested negative load  | 1750          | Pa |
| Hail resistance using steel ball (maximum drop height)  | -             | m  |

**Energy Labelling Information**

|  | Reference Area, $A_{sol}$ (m <sup>2</sup> ) | Data required for CDR (EU) No 811/2013 - Reference Area $A_{sol}$  |  |
|--|---|--|--|
| Systemkollektor S 2.29 m <sup>2</sup>  | 2.29  | Collector efficiency ( $\eta_{col}$ )  | 56 %                                     |
| Systemkollektor S 4.47 m <sup>2</sup>  | 4.44  | Remark: Collector efficiency ( $\eta_{col}$ ) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m <sup>2</sup> , expressed in % and rounded to the nearest integer. Deviating from the regulation $\eta_{col}$ is based on reference area ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013. |  |
| Systemkollektor S 6.65 m <sup>2</sup>  | 6.61  |  |  |
| Systemkollektor S 8.83 m <sup>2</sup>  | 8.77  |  |  |
| Systemkollektor S 11.01 m <sup>2</sup> | 10.93                                       |  |  |
| Systemkollektor S 13.19 m <sup>2</sup> | 13.09                                       |  |  |
|  |   |  |  |
|  |   | Data required for CDR (EU) No 812/2013 - Reference Area $A_{sol}$  |  |
|  |   | Zero-loss efficiency ( $\eta_0$ )  | 0.703 --                                 |
|  |   | First-order coefficient ( $a_1$ )  | 3.01 W/(m <sup>2</sup> K)                |
|  |   | Second-order coefficient ( $a_2$ )   | 0.013 W/(m <sup>2</sup> K <sup>2</sup> ) |
|  |   | Incidence angle modifier IAM (50°)   | 0.82 --                                  |
|  |   | Remark: The data given in this section are related to collector reference area ( $A_{sol}$ ) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.  |  |