The Simplified Method (TSM) for Solar Thermal under Lot1 and Lot2

**Proposal**

Position Paper from Solar Heating & Cooling stakeholders on a simplified method for calculating the solar thermal contribution in a package in the scope of the review of the energy labelling and ecodesign regulations for space and water heaters

### Contents

1. **Executive Summary** .................................................................................................................................. 3
2. **Introduction** ................................................................................................................................................... 5
3. **Terms, definitions, and symbols** .................................................................................................................. 6
4. **A solar hybrid label** ................................................................................................................................. 7
   4.1. Beyond an installer label ............................................................................................................................ 7
   4.2. Addressing the hybrid systems trend ......................................................................................................... 7
   4.3. Reflecting the climatic zone on the label ................................................................................................... 8
   4.4. Retrofitting existing systems .................................................................................................................... 8
5. **A simplified approach** ............................................................................................................................... 9
   5.1. Fundamentals ............................................................................................................................................ 9
   5.2. Solar Device Efficiency (SDE) .................................................................................................................. 9
   5.3. Using Gross Solar Yield (GSY) ................................................................................................................ 10
   5.4. Using polynomial functions .................................................................................................................... 10
   5.5. Easily available data ............................................................................................................................... 11
   5.6. Simple integration on regulations and on the market ............................................................................. 11
   5.7. Better market surveillance ....................................................................................................................... 11
6. **Simple utilization by installers** .................................................................................................................... 12
   6.1. Ease-of-use .............................................................................................................................................. 12
   6.2. Using look-up tables .............................................................................................................................. 13
   6.3. Hybrid system product fiche and technical document ........................................................................... 16
   6.4. Calculating the solar hybrid efficiency .................................................................................................... 17
7. **Clear procedure for manufacturers** .......................................................................................................... 17
   7.1. Complementing current product fiche and technical document ................................................................. 17
   7.2. Preparing the reference/look-up tables .................................................................................................. 17
7.3. Supporting installers and consumers ................................................................. 17

8. Facilitating market surveillance .......................................................................... 18
  8.1. Manufacturer role ............................................................................................. 18
  8.2. Ease of verification ............................................................................................ 18

9. Calculation method for the Solar Device Efficiency ........................................... 18
  9.1. Main elements ..................................................................................................... 18
  9.2. The Gross Solar Yield concept .......................................................................... 19
  9.3. Solar Device Efficiency ..................................................................................... 20
  9.4. Estimating heat demand .................................................................................... 22
  9.5. Developing polynomial functions ..................................................................... 22

10. Calculation of special cases of solar systems or products ................................ 24
  10.1. Thermosiphon systems .................................................................................... 24
  10.2. Co-generating solar collectors ......................................................................... 24

11. Additional options or combinations ................................................................... 25
  11.1. Storage ............................................................................................................... 25
  11.2. New water heating load profiles 3XL and 4XL ............................................... 25
  11.3. Additional temperature level for space heating ............................................... 25
  11.4. Displaying Annual energy savings .................................................................. 25

ANNEX I - References ............................................................................................... 26

ANNEX II – Assessment of the tool .......................................................................... 28
1. Executive Summary

Soon after the Lot1 & Lot2 regulations came into force, in September 2015, it has become evident that the implementation of the package label faced difficult hurdles in the different European markets.

Solar thermal systems, except solar water heaters, do not require a product label and are reflected in the ErP for space and water heaters as components of a package. The current calculation procedures for solar devices are complex for manufacturers, authorities and installers, requiring for each combination (no. collectors, water store, etc.) the use of software tools (some available online) that provide the parameters required for the package label calculation. Such complexity is detrimental for the general market development of solar thermal systems, and even more for SMEs working in this field.

**Easy to use**

Radically easier for installers, it only requires them to know the efficiency of the back-up heater, to identify the load profile and check the newly introduced Solar Device Efficiency in the look-up table included in the product documentation. The current process would require an installer to use an online tool and process over 15 parameters to calculate the label of a package with solar.

**PRODUCT FICHE WATER HEATING HYBRID SYSTEM**

<table>
<thead>
<tr>
<th>Water heater energy efficiency of water heater</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Declared Load profile:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solar Device Efficiency (water heating):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water heating energy efficiency of hybrid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water heating energy efficiency label class:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 2: Example of proposed calculation fiche for solar hybrid label.

---

**Figure 1:** Online SOLCAL tool, used to calculate parameters required for a package label with a solar device.
Diverse Solar Hybrids

Hybridization is one of the key trends in the heating sector. The proposed method allows for the combination of any solar collector with one or more heaters. It is suitable thus covering the current solutions in the market but also open to new solutions, including also co-generating devices such as PVT collectors. All these combinations can be defined by the installer or by a manufacturer providing a “package”.

Covering all climatic zones

The performance of different solutions, including solar thermal systems, depends on climatic conditions. The proposed solar hybrid label can be defined for one specific climatic zone where the system is installed or indicate the performance in each climatic zone, offering an option for specific solutions implemented by an installer or combinations placed in the European market by manufacturers.

Retrofitting existing systems

The concept of an installer label for a solar hybrid allows also to provide such label when retrofitting solar thermal into an existing heating system. This is of great importance as the solar thermal retrofitting market is the most relevant in several European countries.

Solid method

Based on several years of experience using and refining the Gross Solar Yield, it identifies the best calculation as a function between the collector specific Solar Device Efficiency and the efficiency of the back-up heater. The lookup tables in the product fiche add the simplicity that is essential for a solid implementation in the market.
2. Introduction

Soon after the Lot1 & Lot2 regulations came into force, in September 2015, it has become evident that the implementation of the package label faced different hurdles in the different European markets. This has been reported to Solar Heat Europe/ESTIF by its members and partners, it has also been identified by European projects such as Labelpack A+, EEPLIANT and ECOTEST and is also reported by VHK in its studies for the review of Lot1 & Lot2.

Solar thermal systems, except solar water heaters, do not require a product label and are reflected in the ErP for space and water heaters as components of a package. The current calculation procedures for solar devices are complex for manufacturers, authorities and installers, requiring for each combination (no. collectors, water store, back-up heater, etc.) the use of software tools (some available online, such as the Labelpack A+ tool) that provide support for the package label calculation. Such complexity is detrimental for the general market development of solar thermal systems, and even more for SMEs working in this field.

Furthermore, it underestimates the contribution of solar thermal systems. One of the reasons is related to solar thermal being considered within the regulation as an additional heater while, in practice, solar thermal systems are the preferential heater whenever solar energy is available. The heat generated by solar thermal systems is essentially free (besides being also carbon free). In practice, this means that solar thermal energy is used first, and a supplementary heater is used as a back-up system to supply the heat demand when this cannot be fully covered by solar. Hence, the solar device is the preferential heater and the back-up system the secondary heater, contrary to what could be assumed considering the current Lot1 & Lot2 regulations.

It is essential that a new calculation addressed the issues referred, providing a simple and reliable solution, that takes properly into account the advantages of solar thermal systems. With this proposal, we present a simplified method that allows for a better, fairer, and more pragmatic implementation of the regulation for space and water heaters when combining solar heat with other space and water heating products.

🔥 Solar thermal is the only 100% CO2-free technology in Lot1 and Lot2
🔥 Solar heat supplies most of water heating and a considerable part of space heating needs
☀️ Solar thermal is available on site, where thermal energy is needed
💧 Solar thermal has very low lifecycle costs
🔥 Solar thermal has very high recyclability of materials
🔥 Solar thermal sales in Europe are mainly supplied by European manufactured systems
3. Terms, definitions and symbols

For better understanding a summary of new and adapted terms and abbreviations, their definitions and the belonging symbols is provided hereunder:

<table>
<thead>
<tr>
<th>Term</th>
<th>Abbr.</th>
<th>Definition</th>
<th>Symbol</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual collector efficiency</td>
<td></td>
<td>The average efficiency of a solar collector for a certain temperature level as ratio of GTY to annual irradiation $H$ displayed in the Solar Keymark Certification for reference locations reflecting the climate zones of the regulation</td>
<td>$\eta_a$</td>
</tr>
<tr>
<td>Annual irradiation</td>
<td></td>
<td>Annual incident energy found by integration of irradiance on a tilted surface</td>
<td>$H$</td>
</tr>
<tr>
<td>Back-up heater efficiency for water heating</td>
<td></td>
<td>The efficiency of a supplementary heat generator for water heating not considering the heat losses of a storage tank</td>
<td>$\eta_{wh, nonsol}$</td>
</tr>
<tr>
<td>Back-up heater efficiency for space heating</td>
<td></td>
<td>The efficiency of a supplementary heat generator for space heating not considering the heat losses of a storage tank</td>
<td>$\eta_{s, nonsol}$</td>
</tr>
<tr>
<td>Gross Electric Yield</td>
<td>GEY</td>
<td>Reference electric yield for a certain temperature level/application</td>
<td>-</td>
</tr>
<tr>
<td>Gross Solar Yield</td>
<td>GSY</td>
<td>Reference energy yield as sum of GEY+GTY for a certain temperature level/application implemented as annual value in the calculation</td>
<td>-</td>
</tr>
<tr>
<td>Gross Thermal Yield</td>
<td>GTY</td>
<td>Reference thermal yield for a certain temperature level/application</td>
<td>-</td>
</tr>
<tr>
<td>Hybrid efficiency for space heating</td>
<td></td>
<td>Multiplication of SDE(s) with back-up heater efficiency</td>
<td>$\eta_{s, hyb}$</td>
</tr>
<tr>
<td>Hybrid efficiency for water heating</td>
<td></td>
<td>Multiplication of SDE(wh) with back-up heater efficiency</td>
<td>$\eta_{wh, hyb}$</td>
</tr>
<tr>
<td>Non-solar heat contribution to the heat demand</td>
<td></td>
<td>Part of the heat demand provided by the back-up heater</td>
<td>$Q_{nonsol}$</td>
</tr>
<tr>
<td>Solar Device Efficiency for space heating</td>
<td>SDE(s)</td>
<td>The space heating efficiency of a ‘solar only system’ as a preferential heat generator. Heat losses of the storage tank are considered as they are covered by the SDE(wh) in a combined system</td>
<td>$\eta_{s, sol}$</td>
</tr>
<tr>
<td>Solar Device Efficiency for water heating</td>
<td>SDE(wh)</td>
<td>The water heating efficiency of a ‘solar only system’ as a preferential heat generator taking into account all heat losses of the storage tank including those of an optional space heating application that occur in</td>
<td>$\eta_{wh, sol}$</td>
</tr>
</tbody>
</table>
4. A solar hybrid label

4.1. Beyond an installer label

The proposed method can be easily applied by installers when combining a solar thermal system with another type of space and water heater. The fact that the calculation is simplified allows for the use of a smaller number of parameters that can be easily found and applied by the installer in the proposed calculation.

This will be compatible to the proposal of an installer label presented in the review studies. Furthermore, it allows also to provide such an installer label when retrofitting solar thermal into an existing heating system (see below).

This label, easy to apply by installers, can also be applied by manufacturers that place a hybrid combining solar with other space and water heater as one product in the market. In such case, manufacturers of such combinations could still provide a labelled solution to the market, as already happens currently.

4.2. Addressing the hybrid systems trend

As referred in the review reports by VHK\(^2\), there is a trend to combine different technologies as hybrid solutions. This hybrid systems could be available in a single or in separate casings. In fact, the overwhelming majority of solar thermal systems in the market is a solar hybrid, as it combines solar with another solution, in general in separate casings.

While the options regarding how to deal with such hybrids is still under discussion, the current proposal allows for the integration with different approaches. The fact (further detailed

\(^2\) Space and combination heaters - Review Study - Task 6 - Options
hereunder) that The Simplified Method is using the Solar Device Efficiency which is then
calculated using the performance of the preferential heater (as one single technology or as an
hybrid) facilitates its application under the provisions in the current regulation or with
alternative methods as put forward by the VHK experts in previous reports.

Therefore, it will be possible to have a solar hybrid as a combination of solar with a single
(technology) space and water heater (as it is already common in the market, e.g.: solar in
combination with a gas condensing boiler) or a solar hybrid that is combining solar with a
hybrid system. We can find in the market examples of the later, where an electric heat pump
and the gas boiler are combined in one hybrid solution (single casing), allowing for a
trigeneration option by coupling it with a solar thermal system.

4.3. Reflecting the climatic zone on the label

It is clear that the performance of solar thermal systems depends on
the climatic zone where the solar hybrid is installed. While thinking of
an installer label it is seems to mandatory to also consider the specific
climates where the system is installed.

The referred solution might be problematic when a manufacturer is
placing a solar hybrid in the market that can be installed in different
climatic zones.

Therefore, the new proposal also considers that the regulation should
foresee a label indicating the efficiency class for the three climatic
zones. Taking on the example for the labelling of air conditioners²
and the assessment in the review study³, the same kind of approach
to the label can be considered.

4.4. Retrofitting existing systems

The retrofit of existing heaters with a solar thermal system constitutes the main opportunity
for solar thermal in several markets. Retrofitting solar thermal allows reducing emissions and
energy consumption of an existing system. This is an important option complement existing
systems that still have a relevant lifetime ahead. On one side it allows for an immediate
reduction of emissions and consumption on the current system, while still allowing to continue
to use solar thermal with a new system in the future.

The concept of an installer label for a solar hybrid allows also to provide such label when
retrofitting solar thermal into an existing heating system. With the available set of parameters
of products available after 2015 or even some years before, it is possible to provide the
calculation of the advantages that a solar thermal system would bring to an already installed

2 ENER Lot10: 206/2012 and 626/2011: Room air conditioning appliances, local air coolers and comfort fans
3 Study on consumer understanding of the energy label for air conditioners and heat pumps ≤ 12kW
space and/or water heater, such as a condensing gas boiler, enhancing efficiency and reducing GHG emissions.

5. A simplified approach

5.1. Fundamentals

Solar Heat Europe supports the principle of a simplified method for the calculation of the contribution of solar thermal systems in the context of Lot1 & Lot2. In this sense, the proposal included by the VHK experts in their task 6 reports (both for Lot1 and Lot2) has been taken up as a good starting point for the discussion on a simplified approach. The Simplified Method builds on the referred proposal that assumes an additional efficiency level as a function of installed m² of collectors. The main advantage of such proposal would be the simplicity of its application by installers. In addition, it would facilitate the possibility of calculating a package label in the case of a retrofit, i.e., when a new solar thermal system is combined with an existing heater.

As pointed out at the Stakeholders Consultation Meeting of Jan 2019, this method has clear advantages. However, it does not reflect the energy yield of the collector that is strongly depending on the type and make of collector as well as on the operating temperature. From experience in local subsidy schemes, it is known that using m² only would lead to market distortion und wrong incentives. It was also referred that other factors affecting the performance of solar thermal systems should also be taken into account.

In this sense, Solar Heat Europe gathered a group of experts in order to come to a joint proposal that would respect the following principles:
- Using solar thermal yield as a basis for the calculation;
- Using easily available data;
- Simple utilization by installers, manufacturers and public authorities;
- Using methods that take into account factors affecting the performance of the solar thermal system, such as seasonality and solar fraction.

5.2. Solar Device Efficiency (SDE)

A solar thermal system is able to supply the largest part of the hot water and substantial part of the heating demand before a non-solar heat generator (usually referred in solar thermal systems as a back-up heater, such as a boiler, a heat pump or an electric heater) has to support it. In analogy to other heat generators, the solar contribution is quantified with the new factor called “Solar Device Efficiency”, SDE. It is explained in more detail below, in section 9.3.

This SDE is the cornerstone for the proposed simplification. In brief, it is possible to identify the solar efficiency of a combination of collectors supplied to the market by a manufacturer. Therefore this allows that, as part of the product information, it is possible for manufacturers to include a reference table that indicates the solar efficiency of the specific collector,
according to different load profiles, be it for space or for water heating, in different climatic zones.

This solution brings several advantages, as the more complex part of the calculation will be done upstream by the test labs carrying out the tests on the solar collectors.

In this way it will simplify the role of the installer, it will provide comparable information for the consumer and it will facilitate the role of public authorities in verifying the compliance with the regulation, in relation to the Solar Device Efficiency data used by installers when supplying a solar hybrid to a customer.

5.3. Using Gross Solar Yield (GSY)

The determination of the SDE needs meaningful input and, in contrast to the simple use of collector area, the “Gross Solar Yield” (GSY) includes information about the thermal performance of a collector. This means that high performance collectors have better GSY per m² of collector area than low performance collectors.

To ensure that the method is easy to use, it is essential that the required data is broadly available, of easy access and presented in a clear way. In this regard, the GSY is a great option, both for new systems (recently placed in the market) or for solar collectors placed in the market before the implementation of the current regulations. Computing the GSY does not require any re-testing or new theories.

The GSY is therefore a fair term for analysis of the contribution of solar thermal systems to the efficiency of a space and/or water heating system. For this reason, the GSY is currently being added to the European collector standard.

The GSY is further explained under section 9.2.

5.4. Using polynomial functions

The GSY has the meaning of a reference energy yield for a certain temperature level. Over the year there is a seasonal course of the GSY due to the different irradiation and other weather conditions such as outside temperature and wind speed, which is represented for all collectors in good approximation by a reference collector. It is therefore sufficient to determine the actual usable yield using the annual demand profile for one single reference collector as an example for different dimensioning, e.g. smaller or larger systems with less or more reference yield.

The principle applies when collector arrays provide the same reference yield, as they also produce the same amount of useful solar energy. By proportionately covering the heat demand, the efficiency of the solar system is determined as Solar Device Efficiency and can be represented as a characteristic polynomial curve depending on the demand profile. With this simplified approach, it is no longer necessary to subject each individual collector to a separate annual calculation. Entering the GSY of an individually designed solar system in the polynomial equation directly provides the result in a transparent way and can also be displayed as a
graphic if required. The information to distinguish between different performing collectors is included in their individual GSY solely.

5.5. Easily available data

The GSY information is easily available in Solar Keymark certificates, which are publicly available (for free) in the Solar Keymark database, currently for the four locations Athens, Würzburg, Davos and Stockholm. The software used for this calculation is available free of charge. Adding the ErP locations Helsinki and Strasbourg as well and to make the necessary tables for each collector model available is easily possible.

Furthermore, for new or recent products, this information shall be available in the product fiche that the manufacturers must upload into EPREL.

![Figure 5: Extract of the test report included in a Solar KEYMARK certificate](image)

5.6. Simple integration on regulations and on the market

The TSM replaces both the current SOLCAL and SOLICS method for water heating and the (questionable) current formula in the space heating package fiche to determine the solar contribution. Moreover, the solar method for water and space heating are now essentially the same.

The TSM is currently being integrated in the collector standard EN 12975 and can then be referenced by the revised CDR 811 to 814 regulations. The regulations need to be revised on the requirements for the product fiches and technical documentations to fit to the new TSM.

All information needed for the handling of solar hybrid systems are included in the new product fiche and technical document for a collector module and the existing documentation for the back-up water of space heater.

5.7. Better market surveillance

The Simplified Method also represents a major advantage for market surveillance authorities. Under the current regulations, it is unclear how market surveillance of a package label should be done, namely what could be the role or the intervention on market surveillance authorities towards installers and consumers that purchased the new system for which a package label is required. Taking into account the complexity of the calculations required for the package label under the current regulation, the lack of a clear and effective market surveillance approach, in order to ensure the proper application of the current regulation, is a relevant problem that needs to be addressed.
As shown also in the ECOTEST project, the measuring uncertainties for some of the currently used parameters are such that market surveillance is virtually impossible. It was also shown that the gross yield figures are much more reliable and therefore much better suited for market surveillance.

The Simplified Method proposed implies that the main information will be accessible with the product, being the manufacturers responsible of ensuring that the look up tables provided with their products are in line with The Simplified Method.

6. Simple utilization by installers

6.1. Ease-of-use

To express the variability of solar thermal energy generation and to consider interaction with other appliances, a simple function will not be enough. Therefore, a table is required to reflect variations depending on the different climatic conditions and the load profiles. Both have an important impact on the performance of a solar thermal system in combination with the back-up heater.

Thus, the table would have as entries:

- Gross Solar Yield of the solar thermal collector
- Climatic region
- Load profile

Such tables would differentiate between water heating service (Lot2) and space heating (Lot1).

To further ease the use of these tables, the GSY is replaced by the number of collectors or packages of different collector sizes. These tables are published by the solar thermal manufacturers, using the corresponding yield for different numbers of collectors or packages. The calculation behind the tables can be done by the manufacturer or his testing laboratory and is not visible anymore to the installer.

The use of the Solar Device Efficiency (SDE) thus provides a clear indication of the contribution of the solar thermal collectors to the system and allows the result to be a function of the SDE and the performance of the back-up heater. It would require, nonetheless, additional calculations by the installer.
6.2. Using look-up tables

The installers need to follow a simple procedure for a water heating (see example) or a space heating hybrid system. The calculation process follows the steps indicated below:

- **Select load profile**
- **Check solar collector look-up table (from manufacturer)**
- **Identify Solar Device Efficiency**
  \[ \eta_{wh, sol} \text{ or } \eta_{sh, sol} \]  
  *(for 3 climate zones)*
- **Get back-up heater efficiency**
  \[ \eta_{wh, nonsol} \text{ or } \eta_{s, nonsol} \]
- **Determine hybrid efficiency**
  \[ \eta_{wh, hyb} = \eta_{wh, sol} \times \eta_{wh, nonsol} \]  
  or  
  \[ \eta_{sh, hyb} = \eta_{s, sol} \times \eta_{s, nonsol} \]
- **Identify package solar hybrid label**  
  *(for 3 climate zones)*

The process reduces drastically the number of calculations and the number of parameters required, in comparison with the process for the calculation of the package label included in the current regulation, especially for water heaters.

There are some aspects that are particular to water or space heaters, while the template for the look-up tables can be similar, being the main difference the identification of the load profile.
The procedure to determine the label class for a solar water heating hybrid can be further detailed as follows:

<table>
<thead>
<tr>
<th>Step</th>
<th>Subject</th>
<th>What to do</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Assembly requirements</td>
<td>Load profile applicable Lp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collector module product fiche SDE table water heating</td>
<td>NoMod</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Number of collector modules applied</td>
<td>NoMod</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Back-up water heater water product fiche 4</td>
<td>η_{wh,nonsol}</td>
<td></td>
</tr>
<tr>
<td>II</td>
<td>Read values from SDE table water heating (x.1)</td>
<td>Read value for three climate zones on the cross cell of row ‘NoMod’ and columns ‘Lp’</td>
<td>Three SDE(wh) values</td>
</tr>
<tr>
<td>III</td>
<td>Calculate hybrid efficiencies</td>
<td>Calculate hybrid efficiency for three climate zones</td>
<td>η_{wh,hyb} = η_{wh,sol} x η_{wh,nonsol}</td>
</tr>
<tr>
<td>IV</td>
<td>Read label classes</td>
<td>Read class from CDR 812/2013, annex II, table 2, for η_{wh} and load profile</td>
<td>Label class</td>
</tr>
</tbody>
</table>

Considering the need to facilitate the use of the table, taking also into account the values for different climates, one of the possibilities for the look-up table could be as proposed below.

Table x.1 – Solar Device Efficiency for water heating. The look-up example is marked in red: 3 modules and load profile: XXL.

<table>
<thead>
<tr>
<th>No</th>
<th>Supplier name:</th>
<th>Product name:</th>
<th>Model name:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average climate</td>
<td>Colder climate</td>
<td>Warmer climate</td>
</tr>
<tr>
<td></td>
<td>Load profile:</td>
<td>Load profile:</td>
<td>Load profile:</td>
</tr>
<tr>
<td></td>
<td>M</td>
<td>L</td>
<td>XL</td>
</tr>
<tr>
<td>1</td>
<td>178%</td>
<td>137%</td>
<td>111%</td>
</tr>
<tr>
<td>2</td>
<td>280%</td>
<td>212%</td>
<td>165%</td>
</tr>
<tr>
<td>3</td>
<td>361%</td>
<td>282%</td>
<td>216%</td>
</tr>
<tr>
<td>4</td>
<td>422%</td>
<td>345%</td>
<td>265%</td>
</tr>
<tr>
<td>5</td>
<td>450%</td>
<td>450%</td>
<td>356%</td>
</tr>
<tr>
<td>...</td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

The look-up table for water heaters includes the current load profiles defined in the regulation. Still it is possible to integrate additional load profiles in case these are adopted in the current review.

---

4 In case of a package where the η_{wh,nonsol} is not available the procedure described in the ‘Guidelines accompanying the regulations 811 & 812/2013’, chapter 5.4, can be used.
Space heaters

The procedure to determine the solar space heating hybrid label class is similar to the one described before for water heaters.

### Table x.2 – Solar Device Efficiency for space heating. The look-up example is marked in red: 3 modules and Prated = 14 kW.

<table>
<thead>
<tr>
<th>No.</th>
<th>Average climate</th>
<th>Colder climate</th>
<th>Warmer climate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pdesign in kW:</td>
<td>Pdesign in kW:</td>
<td>Pdesign in kW:</td>
</tr>
<tr>
<td></td>
<td>&lt; 3</td>
<td>&lt; 6</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>1</td>
<td>107%</td>
<td>103%</td>
<td>102%</td>
</tr>
<tr>
<td>2</td>
<td>114%</td>
<td>107%</td>
<td>104%</td>
</tr>
<tr>
<td>3</td>
<td>121%</td>
<td>110%</td>
<td>106%</td>
</tr>
<tr>
<td>4</td>
<td>128%</td>
<td>114%</td>
<td>108%</td>
</tr>
<tr>
<td>5</td>
<td>142%</td>
<td>121%</td>
<td>113%</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td>...</td>
<td>...</td>
</tr>
</tbody>
</table>

Likewise, the look-up table could be similar, being the main difference the load profile.

The identification of the load profile for space heaters can be done using the guidelines in the current regulation. This can result in a supporting table to determine the best fitting $P_{\text{design}}$ based on the estimated space heating demand, as exemplified below:
6.3. Hybrid system product fiche and technical document

For each solar hybrid system, a product fiche, technical document, and label is drafted. The product fiches for water and space heating should be revised. Below we present a suggestion, which can be further discussed and developed:

**PRODUCT FICHE WATER HEATING HYBRID SYSTEM**

Declared Load profile:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average</td>
<td>189</td>
<td>171</td>
<td>335 %</td>
</tr>
</tbody>
</table>

Solar Device Efficiency (water heating):

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water heater energy efficiency of water heater</td>
<td>90 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Water heating energy efficiency of hybrid:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water heating energy efficiency of hybrid</td>
<td>170</td>
<td>154</td>
<td>302 %</td>
</tr>
</tbody>
</table>

Water heating energy efficiency label class:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water heating energy efficiency label class</td>
<td>A+</td>
<td>A++</td>
<td>A++</td>
</tr>
</tbody>
</table>

Water heating energy efficiency class ofhybrid water heating system:

<table>
<thead>
<tr>
<th>G</th>
<th>F</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>A+</th>
<th>A++</th>
<th>A+++</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>&lt;2%</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>L</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>XXL</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>3XL</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>4XL</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
</tr>
</tbody>
</table>

**PRODUCT FICHE SPACE HEATING HYBRID SYSTEM**

Pdesign

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Device Efficiency (space heating)</td>
<td>14 kW</td>
<td>104</td>
<td>105</td>
</tr>
</tbody>
</table>

Space heater energy efficiency of space heater:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heater energy efficiency of space heater</td>
<td>95 %</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Space heating energy efficiency of hybrid:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating energy efficiency of hybrid</td>
<td>.99</td>
<td>100</td>
<td>99 %</td>
</tr>
</tbody>
</table>

Space heating energy efficiency label class:

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space heating energy efficiency label class</td>
<td>A+</td>
<td>A+</td>
<td>A+</td>
</tr>
</tbody>
</table>

Space heating energy efficiency class ofhybrid space heating system:

<table>
<thead>
<tr>
<th>G</th>
<th>F</th>
<th>E</th>
<th>D</th>
<th>C</th>
<th>B</th>
<th>A</th>
<th>A+</th>
<th>A++</th>
<th>A+++</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;30%</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>≥150%</td>
</tr>
</tbody>
</table>

It should be noted that, in case of three different space heating efficiencies for three climate zones, the single input box would need to be split into three boxes.
6.4. Calculating the solar hybrid efficiency

The look-up table can be complemented by a calculation for the package efficiency and the reference table from the regulations (space heating or water heating, depending on the case), for installer’s (or other user) convenience.

| Solar Device Efficiency $\eta_{h,real}$ | 121% | 1) |
| back-up efficiency $\eta_{h,nominal}$ | 95%  | 2) |
| Package efficiency $\eta_{h,hyb}$      | 115% | 3) = 1) x 2) |

7. Clear procedure for manufacturers

7.1. Complementing current product fiche and technical document

The product fiche and technical document contain the product identification, the basic product parameters to calculate the Solar Device Efficiencies (surveillance purposes) and two tables with the Solar Device Efficiencies.

The current text in the regulations need to be revised to reflect the requirements related to the proposed The Simplified Method.

7.2. Preparing the reference/look-up tables

The information for the product fiche and the technical document are obtained from the EN 12975 test results. The drafting of the SDE tables is an additional processing step using the method described in section 9. The calculation method for the look-up tables is currently being included in the EN 12975.

7.3. Supporting installers and consumers

Compared with the current situation the procedure for the installer, assembling solar hybrid systems, becomes much simpler. The need to collect specifications for the tank, pump and control is no longer present. Moreover, the complex calculation of the solar performance, using the SOLCAL\(^5\) or SOLICS method, is replaced with a simple look-up table and calculation multiplication formula.

The information supply from components suppliers to installers and ultimately to consumer is the same as currently.

---

\(^5\) The current SOLCAL calculation can be done online with the SOLCAL tool at the Labelpack A+ website.
8. Facilitating market surveillance

8.1. Manufacturer role

The tasks for the supplier of the systems are reduced significantly in the same way as the tasks for the installer. However, the collector manufacturer will have to edit the newly defined product fiche and technical document for their collector modules.

8.2. Ease of verification

The surveillance tasks will be much simpler and more accurate. As the more complex calculations will under the manufacturers’ responsibility, there is a clear checkpoint for the surveillance authorities, contrary to the case with the current package label.

As the manufacturer will have to provide more information with their products, including the look-up table, it will be possibility to confirm, based on the product fiche, technical document and the publicly available method TSM, the Solar Device Efficiency indicated.

9. Calculation method for the Solar Device Efficiency

9.1. Main elements

The contribution of a solar thermal device to the overall performance of a heating device is mainly defined by the solar heating source, which is the solar collector. This potential contribution is given by the Gross Solar Yield (GSY) figures (explanation below) considering the local climate and radiation conditions as well as the operating temperatures. The main advantage of the GSY over other possible rating parameters is its dependency from the design and size of the collector.

It is evident that seasonality is an important factor when considering solar applications:

i) In summertime, even small collector fields will already cover the whole domestic hot water (DHW) demand. There is no space heating (SH) load. Making the fields bigger will not have a substantial impact anymore on the overall efficiency. Energy produced in excess of the needs is lost and does not contribute to the rating. If a certain yield is provided, the summer efficiency will be caped and remains rather insensitive to the thermal yield of the collector field.

ii) In wintertime reasonably dimensioned solar thermal collector fields will cover the SH/DHW loads only partly. The energy supplied by the collectors is fully absorbed by the system. The back-up heater supplies the missing energy. This means however that the usable solar yield is very high as there is no excess production.

Even if it is evident that for all locations the solar contribution is much higher in summer than in winter, it is important to keep this in mind for the better understanding of the effects, when a solar device and a back-up heater form a hybrid system.
In a solar thermal system, the available solar energy is considered as primary heat source. Once the solar thermal system is installed, it is delivering energy at no additional cost. Even simple controllers will make sure that solar thermal energy is used by the heating system whenever it is available.

Based on this primary principle, and considering the above-mentioned seasonality effects, it has been demonstrated that the solar contribution to an existing system could be quantified using simple polynomials to calculate look-up tables based on the gross energy yield figures.

The proposed approach includes some assumptions such as a professional installation of the system, a decent dimensioning of the thermal storage, an intelligent and functional controller. The auxiliary power for pumps and controllers is not considered due to the negligible impact on the total system efficiency. Furthermore, this allows considering thermosiphon systems that are operated without pumps without further modifications.

Distribution losses and pipe losses are considered with a lump sum similar to the current regulation. If deemed necessary, and if in line with the regulations for other heating appliances, auxiliary loads and losses can be modified also for solar thermal appliances. The effects on the efficiency are however marginal due to the seasonality effects outlined above.

With these assumptions, it is possible to define the rather simple look-up tables of Solar Device Efficiency. The SDE is the ErP efficiency of a solar water or space heating system before adding another heat generator. It can be considered as modifier, quantifying the improvement of efficiency in combination with other heat generators in a hybrid system.

9.2. The Gross Solar Yield concept

The Gross Solar Yield of a collector is defined as the energetic yield provided by a collector operating at a fixed temperature over a certain period under well-defined climatic conditions.

The instantaneous efficiency used for the dedicated simulation of systems including solar thermal collectors, is a complex function of more than 20 parameters. For general rating purposes the instantaneous efficiency can be generalized by computing the so called Gross Solar Yield (GSY) for a defined temperature level in a defined climate via simulation in hourly values and summed up to annual values. This method was developed at first in Switzerland in 1985 and later introduced as ScenoCalc in the Solar Keymark certification scheme.

The GSY is now a mandatory component of the Solar Keymark certificate and is displayed as “Annual Collector Output” on the data sheets for four standard locations throughout Europe. This approach is considering that solar thermal systems have different efficiencies in capturing thermal energy from the available solar radiation. Therefore, the capacity of a solar thermal collector to capture energy per m² can vary considerably between different models, geographic locations, and modes of operation.

The Global Solar Yield is the sum of the Gross Thermal Yield typical for pure solar thermal collectors and the Gross Electrical Yield which can be generated and used for hot water preparation. The Gross Solar Yield is therefore a measure for the energy supply of a collector
without considering a specific system configuration. The gross thermal yield figures are therefore widely used to rating and comparing the energetic performance of collectors.

For the reasons outlined above and as demonstrated in the scientific work of Stefan Abrecht\textsuperscript{6}, the Gross Solar Yield concept is also suitable for the quantification of the contribution of a solar collector to an existing system.

As referred, the Gross Thermal Yield (GTY) component of SGY is implemented in existing tools (Solar Keymark Scenocalc, SPF Collector catalogue). For the specific case of co-generating collectors such as PVT collectors, the gross electric yield (GEY) can be defined to quantify the electric yield using the same principles as for GTY.

Although gross thermal yield figures are in use for a long time they have not yet been defined in European standard. It is planned anyway to include the gross thermal yield concept in the pending revision of the EN 12975. As it is not a new concept, it can be expected that this is possible in very short time period of time (few months).

9.3. Solar Device Efficiency

The first question refers to how a solar device can improve the efficiency of a boiler in a package.

The definitions for the efficiencies are given in the regulation 811 and 812

\begin{equation}
\eta = \frac{Q_{load, tot}}{E_{PE, tot}}
\end{equation}

\textsuperscript{6} Annual efficiency - Easy understanding of collector performance, Abrecht, S., 2018
While the terms can be split up for solar hybrid systems in load shares provided by the solar device and by non-solar heat generators

\[ Q_{\text{load, tot}} = Q_{\text{sol}} + Q_{\text{nonsol}} \] (2)

The primary energy use is

\[ E_{P,E,\text{tot}} = E_{\text{sol}} + E_{\text{backup}} \] (3)

Which is

\[ E_{P,E,\text{tot}} = E_{\text{backup}} = E_{\text{nonsol}} \] (3)*

as solar energy is generated with approximated zero use of primary energy.

With

\[ \eta_{\text{backup}} = \eta_{\text{nonsol}} = \frac{Q_{\text{nonsol}}}{E_{\text{nonsol}}} \] (4)

The hybrid efficiency is then

\[ \eta_{\text{hyb}} = \frac{Q_{\text{sol}} + Q_{\text{nonsol}}}{E_{\text{nonsol}}} = \frac{Q_{\text{sol}}}{E_{\text{nonsol}}} + \eta_{\text{nonsol}} \] (1)*

And further

\[ \eta_{\text{hyb}} = \eta_{\text{nonsol}} \cdot \frac{Q_{\text{sol}}}{Q_{\text{nonsol}}} + \eta_{\text{nonsol}} = (1 + \frac{Q_{\text{sol}}}{Q_{\text{nonsol}}}) \cdot \eta_{\text{nonsol}} \] (1)**

Introducing the solar device efficiency \( \eta_{\text{sol}} \)

\[ \eta_{\text{sol}} = (1 + \frac{Q_{\text{sol}}}{Q_{\text{nonsol}}}) \] (5)

The equation results in:

\[ \eta_{\text{hyb}} = \eta_{\text{sol}} \cdot \eta_{\text{nonsol}} \] (1)***

The solar device efficiency \( \eta_{\text{sol}} \) is based on heat demands for space or water heating. Thus, it can be calculated for each specific solar thermal system both for water heaters and combination heaters and independently from each other.

In brief, the conclusion reached is that the package calculations can be limited to one multiplication - see formula (1)*** - to combine a back-up heater and a solar system.
9.4. Estimating heat demand

While for other parameters it is possible to apply an assumption that will simplify the calculations, there is one aspect that needs special attention, in particular taking into account the characteristics of the methods proposed: the heat demand.

- **Water heating**

For DHW, the current load profiles (M, L, XL, XXL) as defined in the ErP are used. This is reflected in the look-up tables presented hereabove.

- **Space heating**

In the case of space heating, no heat demand patterns are available from the regulation. It is therefore necessary to make reasonable assumptions there. Several options were assessed, including the ErP Heat Pump approach (defining a \( P_{\text{rated}} \) and maximum operation hours \( \text{hrs}_{\text{max}} \)). Finally, the proposal evolved into a Heat demand look-up table for installers.

This table is based on a number (8 are proposed) heat demands to meet the range of possibilities within Ecodesign, with a reasonable gradation and meeting the previous selection of \( P_{\text{design}} \). The heat demands have been calculated backwards to \( P_{\text{design}} \), \( P_{\text{rated}} \) according to Standard EN15502-1 (gas boilers). Moreover, there is an additional option to determine the heat demand of existing heating systems by its energy consumption.

9.5. Developing polynomial functions

Two normalized polynomials one for water and one for space heating have been developed. Implementing the different sets of constants for 3 climate zones and possibly 6 different water heating is the basis to calculate the results. The goal was to determine directly the SDE without an intermediate step of \( Q_{\text{nomal}} \) so that it is an easy one step application for manufacturers. The Polynomials are exemplary derived from a monthly assessment of the usable solar energy \( Q_{\text{sol}} \) using GTY in a monthly resolution from ScenoCalc simulation for a typical collector and the water and space heating demand of a typical system. For water heating the mean value of the GTY at 25°C and 50°C was applied as GSY(low):
GSY(low) = 0.5 x [GY (25°C) and GY (50°C)]

The GSY(low) corresponds to the need to heat up the water from 10°C to 55°C with an average temperature at 38°C (simplified mixed single bin).

For space heating the same GSY(low) was applied with an additional 20% surplus to meet the average system temperature of 25°C of typical low temperature heating systems. All polynomial equations were developed with GSY(low) as single input Parameter for 3 climate zones.

The investigation of further system configurations showed that polynomials for water and space heating for the purpose of lot 1 and lot 2 can be used independently so that any combination of different water and space heating profiles can be assessed.

The practical determination of the solar SDE for an individual collector type is done accordingly using the GSY(low) derived from the SK datasheet as input in the associated polynomial equations. The validity of the calculation is restricted by lower and upper limits.

<table>
<thead>
<tr>
<th>Coefficient</th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>lower limit</th>
<th>upper limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>average</td>
<td>-0.22</td>
<td>1.93</td>
<td>0.55</td>
<td>0.36</td>
<td>100%</td>
<td>450%</td>
</tr>
<tr>
<td>colder</td>
<td>-0.52</td>
<td>1.94</td>
<td>0.60</td>
<td>0.28</td>
<td>240%</td>
<td>500%</td>
</tr>
<tr>
<td>warmer</td>
<td>1.17</td>
<td>0.59</td>
<td>0.83</td>
<td>0.50</td>
<td>500%</td>
<td>500%</td>
</tr>
</tbody>
</table>

Calculation for "water heating" (general)

\[
\eta_{wh, sol} = a \cdot \left( \frac{GSY}{Q_{wh}} \right)^2 + (b + d \cdot f_{profile}) \left( \frac{GSY}{Q_{wh}} \right) + c
\]

Load profile factor: \( f_{profile} = \left( \frac{Q_{wh}}{Q_{H-profile}} - 1 \right) \)

<table>
<thead>
<tr>
<th>Load profile</th>
<th>M</th>
<th>L</th>
<th>XL</th>
<th>XXL</th>
<th>3XL</th>
<th>4XL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Load profile factor</td>
<td>( f_M )</td>
<td>( f_L )</td>
<td>( f_{XL} )</td>
<td>( f_{XXL} )</td>
<td>( f_{3XL} )</td>
<td>( f_{4XL} )</td>
</tr>
<tr>
<td>( f_{profile} )</td>
<td>0</td>
<td>0.92</td>
<td>1.38</td>
<td>1.64</td>
<td>2.43</td>
<td>3.56</td>
</tr>
</tbody>
</table>

Calculation for "space heating"

\[
\eta_{s, sol} = a \cdot \left( \frac{GSY}{Q_s} \right)^2 + b \cdot \left( \frac{GSY}{Q_s} \right) + c
\]
10. Calculation of special cases of solar systems or products

10.1. Thermosiphon systems

The current proposal for The Simplified Method (TSM) can also be applied to thermosiphon systems, such as the typical systems used in Southern Europe (e.g.: Greece, Cyprus). Most systems include a back-up immersion heater, being as such possible to use the TSM. When the collector is tested separately the TSM can be applied directly. In systems where collector and tank form an inseparable unit (e.g. ICS – Integrated collector storage) the results of testing and evaluation of a solar only system according EN 12976 with the EU-tapping profiles can be used to derive the GSY of this system. Practically it is the $Q_{\text{isol}}$ of a defined maximum profile. The maximum profile is determined for warmer climate and used also for average and colder climate. It is the smallest profile where the $Q_{\text{nonsol}}$ of the investigated system is just higher than the corresponding $Q_{\text{nonsol}}$ limit of the table below. Thus GSY/$Q_{\text{isol}}$ can be calculated for each climate zone as the difference between the water heating demand $Q_d$ and $Q_{\text{nonsol}}$ for the maximum profile. The validation of the method has been done comparing collector tests and system tests using the same collectors.

<table>
<thead>
<tr>
<th>Water heating profile</th>
<th>M</th>
<th>L</th>
<th>XL</th>
<th>XXL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat demand $Q_d$</td>
<td>1523</td>
<td>2799</td>
<td>4427</td>
<td>5626</td>
</tr>
<tr>
<td>$Q_{\text{nonsol}}$ - lower limits warmer climate</td>
<td>520</td>
<td>950</td>
<td>1500</td>
<td>1900</td>
</tr>
</tbody>
</table>

10.2. Co-generating solar collectors

Co-generating collectors according to EN ISO 9806 are collectors generating heat and electricity at the same time such as the well-known PVT collectors. Other technologies are possible and under development. The gross yield concept figures are however independent of the used technology as the effectively measured thermal and electrical output is used to compute the GTY and GEY.

If the electric energy is used for heating purposes, it is reasonable to include it in the efficiency rating of the system. The simplest way of using electricity for heating is a Joule immersion heater. In this case, the electric power is fully converted to heat. The use of heat pumps or other more sophisticated technologies would for sure result in higher efficiencies but also need a separate calculation. As a conservative estimate and for the sake of simplicity, it is therefore proposed to simply add the GEY to the GTY resulting in the Goss Solar Yield. The SDE look-up tables are then computed the same way using this GSY.
11. Additional options or combinations

11.1. Storage
Reflecting the need, strongly expressed by some stakeholders to better reflect the impact of storage (an identified gap in the current method), the option to combine with the proposed methods has been considered. The main challenge was to reflect both volume and efficiency (label class) of the thermal store, while keeping the simplified approach (having tables from collector manufacturers and simple calculations by installers).

Regarding the volume, one of the options is to index the storage tank volume to the size of the solar collector field. In practice this means to have a reference volume included on the manufacturer tables, reflecting the recommended volume for the corresponding number of collectors. This would be included for information purposes only, to facilitate the work of the installer, not replacing is own assessment of the best solution.

Regarding the efficiency class of the boilers, the proposal is to add an additional step at the last stage of the calculation in order to reflect the impact of the efficiency (lower thermal losses). The default tank considered is a C class. For instance, when choosing an A class tank an additional bonus of 10% is considered via multiplication with a tank factor (f_{tank}=1.1) or for a D class a penalty of 5% is applied (f_{tank}=0.95 factor).

11.2. New water heating load profiles 3XL and 4XL
Considering ongoing discussion within the expert WGs, it was considered relevant to be prepared to deliver solutions for 3XL and 4XL load profiles. The look-up tables and the calculation tool can easily be adapted in order to integrate additional load profiles.

11.3. Additional temperature level for space heating
If there is a need to provide explicitly calculations for SDE in heating systems with medium flow temperatures up to 55°C, additional values GSY (medium) for the collectors can be supplied for.

11.4. Displaying Annual energy savings
It is possible to use TSM to calculate annual energy savings. This is identified as $f_{save}$ and can be calculated based on the SDE for water heating ($f_{tank}$ optional) and space heating.

\[
\begin{align*}
    f_{\text{wh,save}} &= 1 - \frac{1}{\eta_{\text{wh,sol}} \cdot f_{\text{tank}}} \\
    f_{\text{s,save}} &= 1 - \frac{1}{\eta_{\text{s,sol}}}
\end{align*}
\]
ANNEX I - References

- **TSM calculation**

The TSM calculation proposed is available in an excel file, that provides the support for the look-up tables. This tool covers both water and space heating.

A test version of this tool is available for [download](#).

This tool is still under development and the purpose is to provide an indication about how the method applies and how a tool (in this case in an excel spreadsheet) could operate. Such a tool, further developed, could be used by manufacturers, test labs or market surveillance authorities to calculate the look-up tables. It could be the basis for the development of an online tool.

- **Information from the VHK reports (and other) used:**

  **Task 3: Solar potential (page 37):**

  In order to establish how much of this solar irradiance could be useful, the EU monthly averages can be weighed against the heating load. This is shown in Table 6 and results in 2259 Wh/m².d.

<table>
<thead>
<tr>
<th>Space heating load % of total</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>Oct</th>
<th>Nov</th>
<th>Dec</th>
<th>AVERAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>20%</td>
<td>20%</td>
<td>13%</td>
<td>6%</td>
<td>6%</td>
<td>16%</td>
<td>19%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Global solar irradiance G, monthly EU averages weighted for population Wh/m²</td>
<td>1668</td>
<td>2446</td>
<td>3478</td>
<td>4562</td>
<td>3040</td>
<td>1853</td>
<td>1281</td>
<td>2259</td>
</tr>
</tbody>
</table>

  The values in the table are given for a horizontal plane. The solar flux for a vertical plane would be 70% higher with South orientation, whereas the East/West orientation gives 35-40% less sun and the North orientation gives 70% less. Overall, assuming that on average there is no preference in orientation, the solar influx for windows should be 20% less than 2259 Wh/m².d, i.e. around 1800 Wh/m².d.
• Task 6: Installer label (page 48):

4.5 Installer label

According to stakeholders in the solar thermal industry the current energy label, with its simple equation and 4 input parameters (Ann. Vol. flare. sol) is too complicated for the installer. Therefore, it is proposed for an Average climate to give 1 percentage point of efficiency for every m² of collector surface.

With the new energy label class limits proposed in Chapter 2, this could mean e.g. for a 15 m² collector surface a jump of 2 classes, e.g. from D to B or - with a high efficiency boiler - even from C to A. Since the starting level is B, the jump will be 1 class.

The condition is that the solar tank should be at least 20 litres per m² of collector surface and the tank energy label rating should be at least "C".

Table 16. New proposed Energy label classes for all central space heaters except low-temperature heat pumps

<table>
<thead>
<tr>
<th>Label class</th>
<th>seasonal efficiency</th>
<th>class width</th>
<th>Examples of typical appliances</th>
</tr>
</thead>
<tbody>
<tr>
<td>A+ +</td>
<td>η ≤ 100</td>
<td>30</td>
<td>WHW (5), mCHP(4), GPCH(4)</td>
</tr>
<tr>
<td>A+</td>
<td>100 ≤ η &lt; 150</td>
<td>20</td>
<td>ANP(3), WHW(4), GPCH(4)</td>
</tr>
<tr>
<td>A</td>
<td>150 ≤ η &lt; 190</td>
<td>20</td>
<td>ANP(4), WHW (4), GPCH(4)</td>
</tr>
<tr>
<td>B</td>
<td>190 ≤ η &lt; 230</td>
<td>20</td>
<td>SCH(1), HYDE(2), nCHP(2)</td>
</tr>
<tr>
<td>C</td>
<td>230 ≤ η &lt; 270</td>
<td>20</td>
<td>SCH(2), HYDE(2), nCHP(2)</td>
</tr>
<tr>
<td>D</td>
<td>270 ≤ η &lt; 310</td>
<td>20</td>
<td>Conden(11), Conden(NF)</td>
</tr>
<tr>
<td>E</td>
<td>310 ≤ η &lt; 350</td>
<td>20</td>
<td>Conden(11), Conden(NF)</td>
</tr>
<tr>
<td>F</td>
<td>350 ≤ η &lt; 390</td>
<td>20</td>
<td>Conden(11), Conden(NF)</td>
</tr>
<tr>
<td>G</td>
<td>η ≥ 390</td>
<td>20</td>
<td>EL(2), ATH(2)</td>
</tr>
</tbody>
</table>

• Task 6: Solar contribution (page 38):

For the solar contribution to efficiency of a package the expression is

Solar efficiency contribution (in %) = (11/11 x Aso1 + TV x Vso1) x sol x (ηcol/100) x S

Where
- ‘11’ is 294/(11 x Prated), where Prated (presumably in kW) relates to the preferential heater;
- Aso1 is solar collector surface in m²;
- ‘TV’ is 115/(11 x Prated), where Prated relates to the preferential heater;
- Vso1 is the solar tank volume in m³;
- ‘sol’ is a factor that depends on the preferential heater (0.9 if fuel boiler, 0.7 if mCHP, 0.45 if heat pump);
- ηcol is the collector efficiency at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1 000 W/m²;
- S is tank (standby loss) Energy Label rating, with A*=0.95; A=0.91; B=0.86; C=0.83; D∼G=0.81.
ANNEX II – Assessment of the tool

The current regulation uses the SOLCAL method for the estimation of two parameters that are required for the calculation of the package label for water heaters: the $Q_{aux}$ and $Q_{nonsol}$. The SOLCAL method is included in the transitional methods and is also published in EN 15316-4-3:2013.

It should be noted that a new EN 15316-4-3:2017 is available, though not yet harmonised for the use in Lot1 and Lot2.

Considering that SOLCAL is the main reference for calculation in the current regulation, the table below shows a comparison with the proposed TSM method, based on fractional energy savings ($f_{save}$) for the ErP average climate reference location.

<table>
<thead>
<tr>
<th>SOLCAL (EN 15316-4-3)</th>
<th>M</th>
<th>L</th>
<th>XL</th>
<th>XXL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>gross area</td>
<td>tank volume</td>
<td>fractional energy saving $f_{save}$</td>
<td></td>
</tr>
<tr>
<td>Simple FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>68%</td>
<td>51%</td>
</tr>
<tr>
<td>Premium FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>72%</td>
<td>66%</td>
</tr>
<tr>
<td>High End Vacuum collector</td>
<td>4.0 m²</td>
<td>300 l</td>
<td>73%</td>
<td>82%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TSM</th>
<th>gross area</th>
<th>tank volume</th>
<th>fractional energy saving $f_{save}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>74% 67% 57% 51%</td>
</tr>
<tr>
<td>Premium FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>76% 70% 61% 55%</td>
</tr>
<tr>
<td>High End Vacuum collector</td>
<td>4.0 m²</td>
<td>300 l</td>
<td>72% 64% 54% 47%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Improvement</th>
<th>gross area</th>
<th>tank volume</th>
<th>fractional energy saving $f_{save}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simple FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>6% 6% 6% 5%</td>
</tr>
<tr>
<td>Premium FPC</td>
<td>6.0 m²</td>
<td>300 l</td>
<td>3% 4% 3% 4%</td>
</tr>
<tr>
<td>High End Vacuum collector</td>
<td>4.0 m²</td>
<td>300 l</td>
<td>-1% 2% 5% 6%</td>
</tr>
</tbody>
</table>

An online tool for the calculation of SOLCAL (both the 2013 and the 2017 versions) is available in the LabelPack A+ website.