Task 60

PVT SYSTEMS

Application of PVT collectors and new solutions in HVAC systems

Work Plan
Information Plan

[May 4, 2018]
1. **Background**

PVT systems start to be found in many applications: one family houses, dwellings, industrial processes and even district heating. The collector must combine PV technology with a thermal component, working with air or liquid, with a front cover or not, and even it can be under light concentration. To support this emerging market for solar industries, the current IEA Task has been set up.

2. **Scope**

The scope is on applications with PVT collecting devices in systems of any size and any type of consumers.

3. **Objective and Organization**

The objectives of the Task are to:

1. Provide an overview on the present (2018-2020) state-of-the-art of the PVT technology worldwide.

2. Gather the results and the operating experience made with the systems in which PVT collectors are integrated.

3. Improve the testing, modeling and adequate technical characterization of PVT collectors in order to enhance (and simplify) the correct inclusion of the PVT technology in simulation programs and planning tools.

4. Address all types of PVT collectors since the current markets have made no clear choices.

5. Find more typical PVT solutions beside the two applications which are well known, i.e. (1) regeneration of bore-hole storages and (2) pre-heating of DHW for multi-family houses. The aim of the Task is to identify other possible solutions which are relevant under other framing conditions (weather conditions, building regulations, electricity regulations and tariffs) or applications in process plants which require heat and electricity (thermally driven desalination systems may be mentioned as an example, or space heating with heat pump and ice storage).

6. Explore potential cost reductions in the balance of systems (BOS), i.e. piping technology and materials, hydraulics, controls etc.
To achieve these objectives, the work is organized into the following Subtasks:

**Subtask A:** PVT Systems in operation

**Subtask B:** PVT Performance characterization

**Subtask C:** PVT Systems modelling

**Subtask D:** PVT Systems design examples and dissemination and market support

### 4. Process

The Task starts on [January 1st, 2018] and ends on [December 31, 2020].

Task meetings will be held twice a year. In addition, Subtask meetings or working group meetings may be held in between Task meetings.

Each Subtask will issue a management report at the end of 2020, following the IEA SHC standard table of contents for such a report.
5. Subtasks

Subtask A: PVT Systems in operation  
Lead: Thomas Ramschak, Austria

Objective

The main objective of Subtask A is to gather data and report information on heating and cooling systems with PVT collectors in operation.

Specific objectives of Subtask A are to collect data and bring knowledge on:

- Description of the installation
- Design parameters
- Monitored results
- Experience from the installation and operation
- Best practices.

Activities (details in the Annex text)

A1: Inventory and information data sheet on existing PVT systems and solutions on the market  
This activity will survey all available projects within the Task and if possible outside and describe them with the same format on a data sheet that will be published on the Task website. The plant data must also be accompanied by monitoring data so that simulation of the installation can be performed by Subtask C. Classify in market segments and size all the projects.

A2: Comparison of systems with respect to technical and economical considerations (with Subtask D)  
This activity will compare solutions for each segment and each size, that have been realized and followed by participants or authors with criteria that Subtask D will issue.

A3: Comprehensive recommendations for improvements of future PVT systems  
This activity will produce best practice and recommendations for future plants with PVT collectors so that the performances (both energy and economics) can be improved in a better way for new comers to the technology.

Deliverables

Each activity will have its own set of outcomes. In order not to maximize the number of reports but to make it more convenient for a reader to get the complete information easily, activities will be combined for their final reports. For instance, activity A2 and A3 will be reported in the same report, probably under different chapters, but the results are so linked that it makes no sense to separate the information.

<table>
<thead>
<tr>
<th>No.</th>
<th>Deliverable</th>
<th>Month</th>
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<tbody>
<tr>
<td>RA1</td>
<td>Report 1 for activity A1: Collection of data sheet on existing PVT systems and solutions</td>
<td>April 2019</td>
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<tr>
<td>RA2</td>
<td>Report 2 for activity A2 and A3 combined: Comparison of systems with recommendations for improvements for future PVT systems</td>
<td>October 2020</td>
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<tr>
<td>RA3</td>
<td>Report 3: Subtask report with management issues</td>
<td>October 2020</td>
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Subtask B: PVT Performance characterization  
Lead: Korbinian Kramer, Germany

Objective
The main objective of Subtask B is to provide testing methods of PVT collectors of all kind that can become an international standard.

Specific objectives of Subtask B are to establish:
- Testing methods
- Collector models
- Performance definitions in its context
- PVT systems efficiency definitions.

Activities
B1: Describe or develop standardized method for testing all kinds of PVT collectors (water, air, concentrated,…) and for reporting the characteristic curves, based on existing or new standards or data. This activity will have to look for the current methods and standards before trying to analyze gaps between what is and what should be to better fit the market needs.

B2: Consider equations and methods for testing day time and night time operations of PVT collectors. Daytime operation are affected by solar radiation and night time by possibly under dew point operations. The methods for testing PVT collectors should be analyzed and gaps for market needs identified. Without adequate testing the characteristic curves and data to be used for prevision in simulation models are not available.

B3: Develop definitions of PVT systems efficiency. PVT produces heat and electricity. Definitions of what is to be considered and how under “efficiency of component” and “efficiency of a PVT system” are to be clearly stated so that comparisons become possible and reporting become consistent through locations and years.

B4: Design Guidelines. The guidelines to better design a PVT collector and/or a system with PVT collectors are welcome by the industry in order to avoid mistakes and to offer more reliable and less costly over the lifetime products. Systems best practice will also be covered in Subtask A and Subtask D activities. Coordination will be necessary at system level. Here Subtask B will focus on PVT collector design per se (ie. as a component) primarily.

Deliverables

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<tbody>
<tr>
<td>RB1</td>
<td>Report 1: for activities B1+B2+B3: methods for testing PVT collectors (water, air, concentrator,…) with measured results and day time and night time operations, and definitions of PVT systems efficiency</td>
<td>October 2018</td>
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<tr>
<td>RB2</td>
<td>Report 2 for activity B4: Design Guidelines for PVT collectors and systems</td>
<td>October 2020</td>
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<tr>
<td>RB3</td>
<td>Report 3: Subtask report with management issues</td>
<td>October 2020</td>
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Subtask C: PVT Systems modelling  
**Lead:** Asier Sanz, Spain

**Objective**

The main objective of Subtask C is to provide models of systems with PVT collectors.

Specific objectives of Subtask C are to:
- Survey current models
- Develop needed models
- Validate models against real data on collectors and systems.

**Activities**

C1: Numerical Simulation Tools for the simulation of PVT collectors based on Subtask B results. PVT collectors models are necessary. There are some on the market but gaps might be found and new models or models enhancement must be done to be able to simulate Subtask A projects.

C2: Numerical Simulation Tools for the simulation of PVT systems based on Subtask B recommendations for definitions of efficiency. When it comes to systems simulation (Projects n Subtask A), analyst must have the tool and the ways to report results in a consistent and comparative manner. This activity will get to provide analyst with the adequate tools and figures of merits of any kind of systems having a PVT collector field as the primary solar source of energy.

C3: Simulate existing PVT systems monitored in Subtask A and validate the tools. With the tools developed or proposed by activity C2, projects identified on Subtask A will be simulated to reproduce the observed results thus validating the modelling.

C4: Conduct sensitivity analyses on simulated systems to find and report optimal solutions, including control strategies. Once C3 has validated the model description of a project, variations around parameters can be made in order to find better combinations or control strategies for a given load than those that were chosen for the particular project.

C5: Find most efficient systems in different market segments through simulations and conduct economical analysis if possible. Defining market segments or market applications will lead to several configurations of systems, and using simulation for each configuration the optimal desing in terms of sizing and arranging the components will be derived from simulations. Economical considerations such a the cost of energy delivered might be taken as an objective function on top of energy efficiency or share of renewables as a criteria.

**Deliverables**

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<tbody>
<tr>
<td>RC1</td>
<td>Report 1 for activities C1+C2: Numerical Simulation Tools for the simulation of PVT collectors and systems</td>
<td>December 2018</td>
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<tr>
<td>RC2</td>
<td>Report 2 for activity C3: PVT systems simulation and validation</td>
<td>October 2020</td>
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<tr>
<td>RC3</td>
<td>Report 3 for activity C4 + C5: Optimised PVT systems for different market segments, sizes and climates</td>
<td>October 2020</td>
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<tr>
<td>RC4</td>
<td>Report 4: Subtask report with management issues</td>
<td>October 2020</td>
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Subtask D: PVT Systems design examples and dissemination and market support
Lead: Andreas Haeberle, Switzerland

Objective
The main objective of Subtask D is to evaluate the overall performance of PVT systems and designs and to disseminate the Task produced information and knowledge to all identified stakeholders.

Specific objectives of Subtask D are to:
- Define a methodology to assess PVT systems and compare the
- Assess PVT systems described in Subtask A
- Analyze best control strategies for PVT systems under economical constraints
- Support workshops for the industry
- Produce information documents and distribute them to all stakeholders.

Activities
D1: Define performance assessment methodology for PVT systems and all KPIs necessary and useful. Criteria to compare and evaluate different designs must be set up in this activity. They must be relevant to the market needs and must be quantifiable.

D2: Use the methodology to assess PVT systems of Subtask A, with a relevant reference as benchmark. Having derived a set of criteria in D1, this activity will use the set to evaluate the projects that Subtask A has provided. They will be assessed and compared if possible, at least qualified.

D3: Analyze best control strategies for PVT systems with economical boundaries (with all Subtasks) and provide recommendations to the industry. Working closely with Subtask C, this activity will try to understand and provide better control strategies for each type of PVT systems so that the efficiency both energetically and economically can be maximized or to provide a more robust operation mode.

D4: Prepare and manage industry workshops. Along the task duration, workshops will be organized where local industries and planners will be invited to share experience and knowledge. This is a way to faster disseminate Task outcomes and to faster get feedback and problems detection from real practices.

D5: Prepare documentation for industry and market and disseminate documentation and task results along the course of the Task. This activity is to produce the adequate contents to the target audience (stakeholders see under 6), using all other Subtasks results and findings as the content provider.

Deliverables

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<tbody>
<tr>
<td>RD1</td>
<td>Report 1 for activities D1+D2: Performance assessment of PVT systems</td>
<td>April 2020</td>
</tr>
<tr>
<td>RD2</td>
<td>Report 2 for activity D3: Control strategies for PVT systems</td>
<td>October 2020</td>
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<tr>
<td>RD3</td>
<td>Report 3 for activities D4+D5: Collection of documents prepared along the Task for industry and market</td>
<td>Every October meeting</td>
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<tr>
<td>RD4</td>
<td>Report 4: Subtask report with management issues</td>
<td>October 2020</td>
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6. Task Information Plan

The results of the Task that are detailed in the previous sections will be published as a PDF file on the Task webpage.

Articles for international and national conferences will be issued.

The web site will be on the www.iea-shc.org web platform.

A list of reports and the targeted stakeholders is given in the following table.

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<tr>
<th>Subtask B</th>
<th>R1: Report B1B2B3: methods for testing PVT collectors (water, air, co</th>
<th>R2: Design Guidelines for PVT collectors and systems</th>
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<tr>
<th>Subtask C</th>
<th>R1: Report C1C2: Numerical Simulation Tools for the simulation of PV</th>
<th>R2: PVT systems simulation and validation</th>
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<tr>
<th>Operating Agent</th>
<th>R1: 3 annual reports</th>
<th>R4: Final management report</th>
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|                 | R5: Presentation at conferences |
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[May 4, 2018]
7. Activity and Time Table Summary

The following table shows all activities and milestones of the proposed Task 60 on PVT systems.
### PVT systems IEA SHC Task 60

**WORK PLAN in Feb 2018**

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<thead>
<tr>
<th>Task Meetings</th>
<th>Preparation and Search for financing</th>
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<tbody>
<tr>
<td></td>
<td>Subtask A: PVT systems in operation</td>
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<tr>
<td></td>
<td>A1. Inventory of existing PVT systems</td>
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<td>A2. Comparison of systems</td>
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<td>A3. Recommendations for improvements</td>
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<td>A4. Subtask report</td>
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<td>Subtask B: PVT Performance characterization</td>
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<td>B1. Standardized current methods</td>
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<td>B2. New equations and methods</td>
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<td>B3. Definitions of PVT collector and system efficiency</td>
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<td>B4. Design Guidelines for PVT collectors</td>
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<td>B5. Subtask report</td>
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<td>Subtask C: PVT Systems Modeling</td>
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<td>C1. Models of PVT collectors</td>
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<td>C2. Models of PVT systems</td>
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<td>C3. System simulations and validation of A cases</td>
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<td>C4. Optimisation - Sensibility analysis</td>
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<td>C5. Market segments optimum</td>
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<td>C6. Subtask report</td>
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<td>Subtask D: Design ex. and dissemination and mkt support</td>
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<tr>
<td></td>
<td>D1. Define KPIs</td>
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<td>D2. Assess PVT systems of Subtask A</td>
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<td>D3. Best control strategies for PVT systems</td>
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<td>D4. Industry workshops</td>
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<td>D5. Documents for market and dissemination of results</td>
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<td>D6. Subtask report</td>
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<td>Operating Agent special task</td>
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<td>Shc ExCo Meetings</td>
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<td>Task presentation to conferences</td>
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<td>Mid term evaluation to ExCo</td>
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<td>Final reports at approved by ExCo</td>
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<td>Management report to ExCo</td>
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<table>
<thead>
<tr>
<th>D = Draft</th>
<th>R = Report</th>
<th>NL = Newsletter</th>
<th>W = Workshop</th>
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**Work Plan**

[May 4, 2018]