SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Task 60

PVT SYSTEMS

Application of PVT collectors and new solutions in HVAC systems

Work Plan
Information Plan

[May 4, 2018]

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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 wth PVT collectors so that the performances (boh 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.

No.	Deliverable	Month
RA1	Report 1 for activity A1: Collection of data sheet on existing PVT systems and solutions	April 2019
RA2	Report 2 for activity A2 and A3 combined: Comparison of systems with recommendations for improvements for future PVT systems	October 2020
RA3	Report 3: Subtask report with management issues	October 2020

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. Day time and night time operations are different specially when PVT are used with a heat pump. 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 “efficiciency 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

No.	Deliverable	Month
RB1	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	October 2018
RB2	Report 2 for activity B4: Design Guidelines for PVT collectors and systems	October 2020
RB3	Report 3: Subtask report with management issues	October 2020

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

No.	Deliverable	Month
RC1	Report 1 for activities C1+C2: Numerical Simulation Tools for the simulation of PVT collectors and systems	December 2018
RC2	Report 2 for activity C3: PVT systems simulation and validation	October 2020
RC3	Report 3 for activity C4 + C5: Optimised PVT systems for different market segments, sizes and climates	October 2020
RC4	Report 4: Subtask report with management issues	October 2020

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

No.	Deliverable	Month
RD1	Report 1 for activities D1+D2: Performance assessment of PVT systems	April 2020
RD2	Report 2 for activity D3: Control strategies for PVT systems	October 2020
RD3	Report 3 for activities D4+D5: Collection of documents prepared along the Task for industry and market	Every October meeting
RD4	Report 4: Subtask report with management issues	October 2020

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.

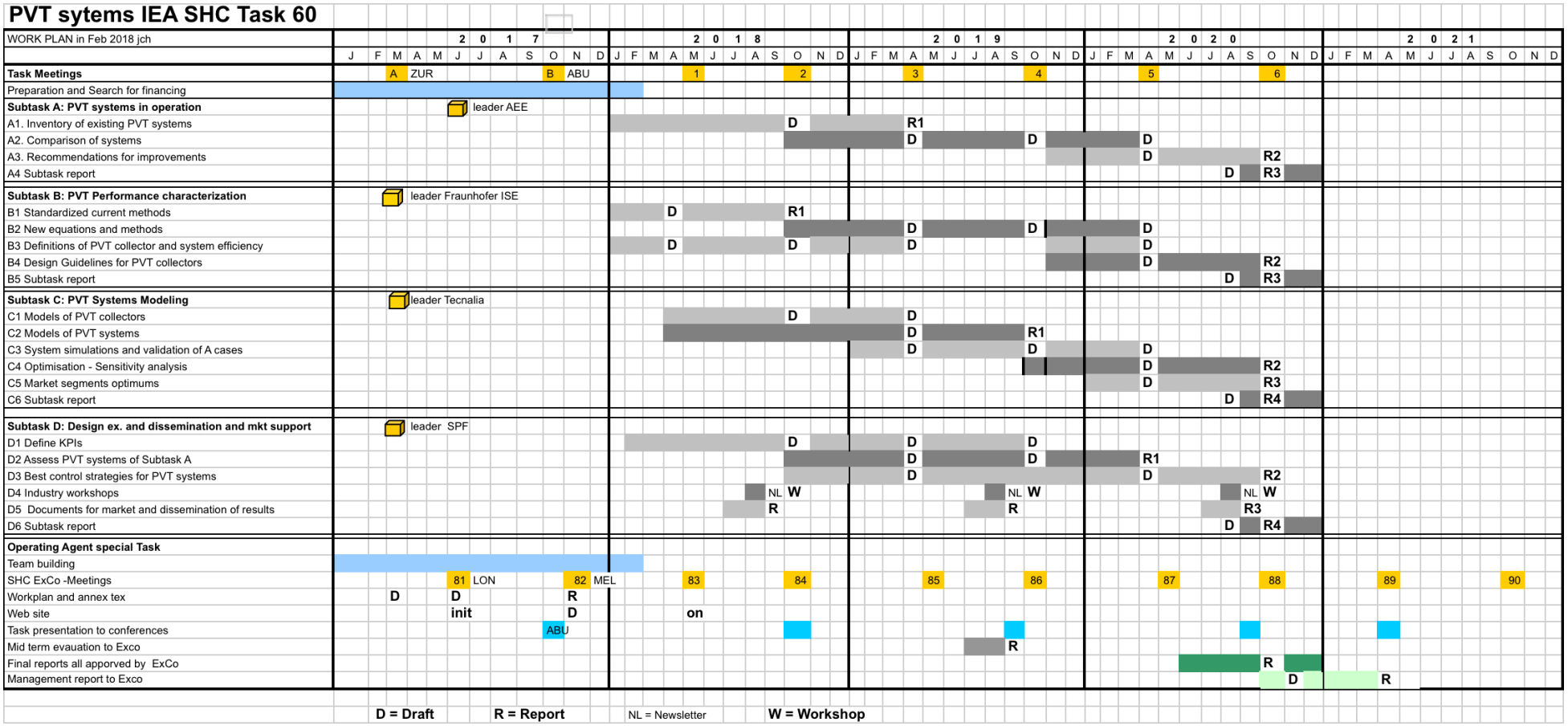
The web site will be on the www.iea-shc.org web platform.

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

	PVT industry	Certification bodies	Policy makers	Architects	HVAC planners	R&D scientists	Teaching	SHC EXCO and IEA	
Subtask A	x					x			R1. Report A1: Collection of data sheet on existing PVT systems and s
		x		x					R2. Report A2A3: Comparison of systems with Subtask D with recomm
							x		R3. Subtask report with management issues
Subtask B	x	x				x			R1: Report B1B2B3: methods for testing PVT collectors (water, air, co
	x			x		x	x		R2: Design Guidelines for PVT collectors and systems
								x	R3: Subtask report with management issues
Subtask C	x					x			R1: Report C1C2: Numerical Simulation Tools for the simulation of PVT
	x					x			R2: PVT systems simulation and validation
	x				x				R3: Optimised PVT systems
								x	R4: Subtask report with management issues
Subtask D	x								R1: Report D1D2: performance assessment of PVT systems
	x				x	x			R2: Report D3: Control strategies for PVT systems
	x					x	x		R3: Report D4D5: Collection of documents prepared along the Task fo
								x	R4: Subtask report with management issue
Operating Agent								x	RA 3 annual reports
								x	R4 Final management report
	x			x	x				R5 Presentation at conferences

7. Activity and Time Table Summary

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


PVT sytems IEA SHC Task 60
WORK PLAN in Feb 2018 jch
2017
2018
2019
2020
2021
Task Meetings
A ZUR
B ABU
1
2
3
4
5
6
Preparation and Search for financing
Subtask A: PVT systems in operation
leader AEE
A1. Inventory of existing PVT systems
A2. Comparison of systems
A3. Recommendations for improvements
A4 Subtask report
Subtask B: PVT Performance characterization
leader Fraunhofer ISE
B1 Standardized current methods
B2 New equations and methods
B3 Definitions of PVT collector and system efficiency
B4 Design Guidelines for PVT collectors
B5 Subtask report
Subtask C: PVT Systems Modeling
leader Tecnalia
C1 Models of PVT collectors
C2 Models of PVT systems
C3 System simulations and validation of A cases
C4 Optimisation - Sensitivity analysis
C5 Market segments optimums
C6 Subtask report
Subtask D: Design ex. and dissemination and mkt support
leader SPF
D1 Define KPIs
D2 Assess PVT systems of Subtask A
D3 Best control strategies for PVT systems
D4 Industry workshops
D5 Documents for market and dissemination of results
D6 Subtask report
Operating Agent special Task
Team building
SHC ExCo -Meetings
81 LON
82 MEL
83
84
85
86
87
88
89
90
Workplan and annex tex
Web site
init
on
Task presentation to conferences
ABU
Mid term evauation to Exco
Final reports all apporved by ExCo
Management report to Exco
D = Draft
R = Report
NL = Newsletter
W = Workshop

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