SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

Collection of documents prepared along the Task for industry and market

TASK60
PVT SYSTEMS

Collection of documents prepared along the Task for industry and market

SHC Task 60/Report D7

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Date: November 4th, 2020

Report number: D7

DOI: 10.18777/ieashc-task60-2020-0008

Front page: the logo of Task 60 figuring the part of the solar spectrum that is best used by a thermal absorber in yellow and a PV cell in blue (design by a SPF subcontractor)

IEA Solar Heating and Cooling Technology Collaboration Programme (IEA SHC)

The Solar Heating and Cooling Technology Collaboration Programme was founded in 1977 as one of the first multilateral technology initiatives ("Implementing Agreements") of the International Energy Agency. Its mission is *"To enhance collective knowledge and application of solar heating and cooling through international collaboration to reach the goal set in the vision of solar thermal energy meeting 50% of low temperature heating and cooling demand by 2050."*

The members of the IEA SHC collaborate on projects (referred to as Tasks) in the field of research, development, demonstration (RD&D), and test methods for solar thermal energy and solar buildings.

Research topics and the associated Tasks in parenthesis include:

- Solar Space Heating and Water Heating (Tasks 14, 19, 26, 44, 54)
- Solar Cooling (Tasks 25, 38, 48, 53)
- Solar Heat for Industrial or Agricultural Processes (Tasks 29, 33, 49, 62, 64)
- Solar District Heating (Tasks 7, 45, 55)
- Solar Buildings/Architecture/Urban Planning (Tasks 8, 11, 12, 13, 20, 22, 23, 28, 37, 40, 41, 47, 51, 52, 56, 59, 63)
- Solar Thermal & PV (Tasks 16, 35, 60)
- Daylighting/Lighting (Tasks 21, 31, 50, 61)
- Materials/Components for Solar Heating and Cooling (Tasks 2, 3, 6, 10, 18, 27, 39)
- Standards, Certification, and Test Methods (Tasks 14, 24, 34, 43, 57)
- Resource Assessment (Tasks 1, 4, 5, 9, 17, 36, 46)
- Storage of Solar Heat (Tasks 7, 32, 42, 58)

In addition to our Task work, other activities of the IEA SHC include our:

- International Conference on Solar Heating and Cooling for Buildings and Industry
- SHC Solar Academy
- Solar Heat Worldwide annual statics report
- Collaboration with solar thermal trade associations

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For more information on the IEA SHC work, including many free publications, please visit www.iea-shc.org

Contents

1 Purpose

This report gathers all documents and links to information that Task 60 has produced over the course of the 3 years of the Task to promote its activities and the PVT technologies.

It is a track of the communication of the Task also helpful for future Task set up.

https://task60.iea-shc.org

2 Brochure

2.1 Logo

Aim: build an identity for Task 60

Realisation: SPF

2.2 Flyer as a Postcard

Aim: business card of Task 60 during conferences

Realisation: SPF

2.3 Poster

Aim: inform about Task 60 during conferences

Realisation: JC Hadorn

Task 60

PVT Systems

SHC SOLAR HEATING & COOLING PROGRAMME
INTERNATIONAL ENERGY AGENCY

TASK60 PVT SYSTEMS

Application of PVT collectors and hybrid solutions in energy systems

Areas of Work

- PVT systems in operation
- PVT performances characterization
- PVT modelling
- PVT systems Design examples

Scope

What is PVT?

A PVT (PhotoVoltaic and Thermal) collector is a solar device able to provide both heat and electricity. A PVT system is an installation able to provide heating, cooling and electricity along the year to any consumer (building, process, network, grid) at a suitable temperature and voltage. The electricity can be internally consumed or delivered to a grid.

Optimizing a PVT system means harvesting the most of solar energy over a year at a minimum cost per kWh. This comprises both heat and electricity.

PVT collectors or PVT systems?

The development of new PVT collectors is a matter of the industrial sector and new collectors are on the market with industries willing to participate in our IEA activity. The proposed project will therefore concentrate on the application of PVT collectors. The aim is to assess existing solutions and to develop new system solution principles in which the PVT technology really offers advantages over classical "side by side installations" of solar thermal collectors and PV modules.

Objectives

1. Provide an overview on the present (2018-2020) state-of-the-art of the PVT technology
2. Gather operating experiences with the systems in which PVT collectors are integrated.
3. Improve the testing, modeling and adequate technical characterization of PVT collectors
4. Find the best PVT solutions for all kind of applications

The optimization is not only a technical issue

Optimizing the production of heat and electricity whether to be consumed immediately or later, stored locally or injected into a network needs economic parameters, such as local electricity tariffs and their variations. This project will address this issue using specific methods and tools.

Duration

From 01.2018 to 12.2020.

A PV and T collector with a similar appearance an be one elegant solution to produce both heat and electricity (courtesy: supplier).

PVT combined in a single product easy to integrate in roofs or facades and even under concentration (courtesy: MB. Solarus, Dualsun)

Participating countries:

- *Australia*
- *Austria* (SUBTASK LEADER)
- *Canada*
- *China*
- *Germany* (SUBTASK LEADER)
- *Denmark*
- *France*
- *Italy*
- *The Netherlands*
- *R South Africa*
- *Spain* (SUBTASK LEADER)
- *Sweden*
- *Switzerland* (SUBTASK LEADER)
- *UK*

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More on: | www.iea-shc.org TASK 60

3 Press releases

3.1 On Solarthermalword.org

2020

Little support for PV-thermal despite high yields

Submitted by Baerbel Epp on August 27, 2020

PVT applications do not receive nearly as much support as solar thermal or PV systems do. Incentive schemes especially often do not include funding for PV-thermal components. In addition, special PVT grants are offered only in Germany but not in Austria, France, Italy, the Netherlands, Switzerland or the UK, according to a survey carried out by international research group IEA SHC Task 60, Application of PVT Collectors, in the first half of 2019. The survey findings are included in an 18-page report titled 2020 Subsidies for PVT collectors in Selected Countries (see the attached PDF). More PVT-related publications can be found on the task's website.
Photo: DualSun

"Current PVT support is less than satisfactory, at least in the countries we analysed," said Jean-Christophe Hadorn, Leader of Task 60. "This needs to improve, especially since PVT allows you to maximise solar yields across available roof space – an essential advantage when it comes to densely populated areas and multi-storey buildings."

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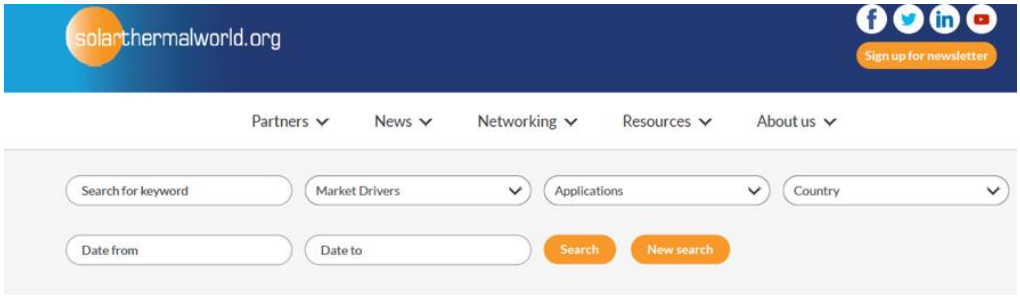

Fact sheets show 30 operational PV-thermal systems

Submitted by Baerbel Epp on July 1, 2020

PV-thermal installations are extremely versatile systems, and their manufacturers can cater to a wide variety of customers, single- and multi-family building owners, hotels, swimming pools and even production facilities among them. To illustrate how far PVT technology has come in recent years, global research platform Task 60, *Application of PVT collectors*, included 30 case studies in its latest report, Existing PVT systems and solutions (see the attached document). The first chapter of the document, published in May, provides an overview of PVT deployment around the world. It is based on a PVT manufacturer survey on which *solarthermalworld.org* reported in this news item.

Each case study consists of a general description and a hydraulic scheme, as well as a photo and a table containing key system parameters. The four-page fact sheets were drawn up by Task 60 industry and research participants from 10 countries, namely the UK, Switzerland, Spain, the Netherlands, Italy, France, Germany, Denmark, the Czech Republic and Australia.

"As PVT is still a new technology, the fact sheets are hoped to motivate building owners to take a look at this option when they see that hotels or swimming pools are using it successfully," explained Jean-Christophe Hadorn, Leader of Task 60.

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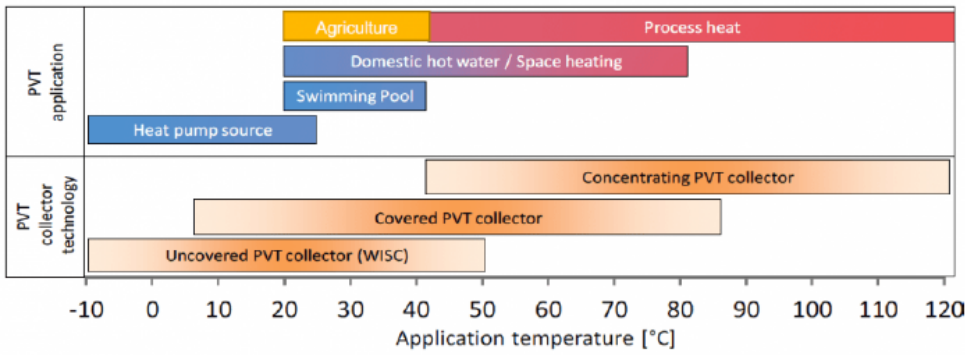

Hybrid solutions maximise solar yield per area

Submitted by Baerbel Epp on April 29, 2020

A record 840 people registered for the PVT solutions for buildings and industry webinar in order to learn more about the wide range of applications in which hybrid PV-Thermal systems can be used. This two-in-one technology offers attractive payback periods whenever a constant amount of heat is needed all year round and electricity is consumed on site. The event was part of a series of Solar Academy webinars supported by Task 60, *Application of PVT collectors*, and organised jointly with ISES, the International Solar Energy Society. Task 60 is one of currently nine international research platforms set up under the auspices of the IEA Solar Heating and Cooling programme (IEA SHC). A recording of the event and the presentations given at the webinar are available here. To reach a wider audience, Task 60 has also created a Wiki page on PVT.
Source: IEA SHC Task 60

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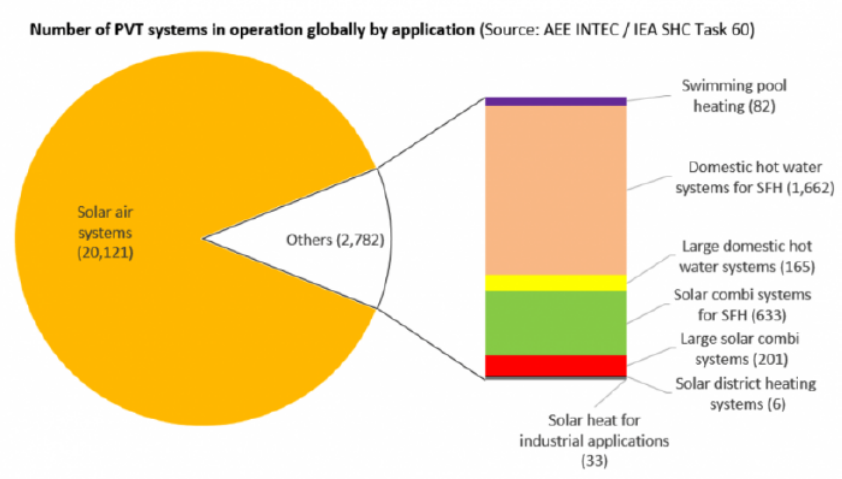
2019



PV-Thermal collector area tops 1 million

Submitted by Baerbel Epp on June 21, 2019

PV-Thermal systems, which generate heat and electricity from the same collector, are gaining ever more traction: For the first time, they have now been included in the Solar Heat Worldwide report. Data supplied by 26 manufacturers from 11 countries indicates that more than 1 million m^2 of PVT collector area has been sold globally so far. The above chart shows the number of operational PVT systems, broken down by application. The dominant and driving force in the market are solar air systems. They come mainly from France, where nearly all of them are designed to use air as the heat transfer medium. Manufacturers also said they had sold 1,662 domestic PVT hot water systems.
Source: AEE INTEC / IEA SHC TASK 60

The survey was conducted under the auspices of international research platform Application of PVT collectors, which was set up by the IEA Solar Heating and Cooling programme. "Our aim was to give an overview of PVT systems and solutions available for sale and seek out best practice examples that showcase the most intriguing PVT applications," Thomas Ramschak, a researcher working at Austrian institute AEE INTEC, said. The institute's findings are shown in chapter 4.4 (pp. 23 to 29) of Solar Heat Worldwide.

…Continued

Dr Korbinian Kramer: PV-Thermal elements allow more energy output from the same roof

Submitted by Baerbel Epp on December 26, 2019

The first tested and certified PV-Thermal elements are available on the market. Korbinian Kramer explains the advantages and disadvantages of this technology. The interview was carried out at the SHC 2019 conference in Santiago at the beginning of November.

Dr Korbinian Kramer is chair at the test lab of Fraunhofer Institute for Solar Energy Systems in Germany and specialist on PV-Thermal technology.

Video: Bärbel Epp, solrico
Camera: Randy Martin, IEA SHC

More information:
http://task60.iea-shc.org/
https://www.ise.fraunhofer.de/en.html

Germany *Chile* *PV-thermal collectors* *PVT collectors* *PVT* *SHC 2019* *SWC 2019* *Fraunhofer ISE* *IEA SHC* *ISES*

…Continued

“The market requires simple plug-and-play solutions”

Submitted by Baerbel Epp on February 22, 2019

Spanish-based supplier Endef is seeing increased demand for both its covered and uncovered PV-thermal systems produced in-house in Saragossa. Last year was the first in which the business installed devices at non-commercial buildings in Spain and implemented projects abroad. Endef is a member of the IEA Solar Heating and Cooling Programme’s Task 60 about PVT collectors, systems and solutions. “We take part in Task 60 to advance, jointly with companies, universities and research centres, the implementation of correct PVT solutions in the market,” said Elías Lorenzo, who works in the company’s marketing department.
Photo: Endef

Two years after Endef was founded in 2012, the business launched its first PVT product named Ecomesh. In 2018, it introduced Ecovolt, a non-covered unit. As it also sells conventional photovoltaic and solar thermal systems, there seems to be little more than a niche market for its PTV units. Still, they are the only ones directly manufactured by the company.

PVT product	Ecomesh	Ecovolt
Technology	Covered	Uncovered
Market launch	2014	2018

…Continued

2018

Israeli firm offers large variety of PVT systems

Submitted by Baerbel Epp on November 5, 2018

Homes, hospitals, hotels, industrial facilities and greenhouses (see photo): These are some of the many uses for turnkey PV systems produced by Millennium Solar, an Israeli business which was set up in 1999 and specialises in PV-Thermal (PVT) technologies. Founder and Managing Director Ami Elazari is also a participant in the Application of PVT Collectors research platform, established under the auspices of the IEA Solar Heating and Cooling Programme (IEA SHC). "We can contribute in-field experience in PVT to the platform and learn something new on the R&D side," he explained the benefits of his involvement.
Photo: Millennium Solar

Millennium Solar is a small but fairly flexible company. It has a permanent staff of 5, including the managing director. Therefore, yearly turnover can vary substantially based on how many deals were inked. Typically, the figure ranges from USD 10 million to USD 250 million. The company's list of projects includes 260 MW_p of PV plants, located all around the world. PV panels are delivered by manufacturers from eight countries.

…Continued

Switzerland: Rising Interest in PVT Technologies

Submitted by Baerbel Epp on June 1, 2017

The Swiss-based SPF - Institute of Solar Technology has recently published a report on behalf of EnergieSchweiz, a programme by the Swiss Federal Office of Energy, about the market situation of PV-thermal technologies (PVT) in Switzerland and across all of Europe (see attached document in German). The researchers from SPF have found that there are various market-ready and proven products available. They counted around 300 PVT installations in Switzerland alone. A particularly good example is shown on the photo: a PVT installation integrated into the facade of an office building.
Photo: Caotec

"The PVT market has gained momentum in recent years," the authors write. In a non-exhaustive survey SPF identified 53 PVT manufacturers in 17 countries. They attribute the positive development of the market to reduced PV costs and attractive system solutions combining PVT technology and heat pumps. Nearly two-thirds of the manufacturers come from Central Europe, including ten from Germany, eight from Italy and five each from France and Switzerland. Half of the businesses from those countries have obtained a Solar Keymark certificate for at least one of their PVT collectors.

…Continued

French PVT market is picking up

Submitted by **Baerbel Epp** on December 22, 2017

The IEA's Solar Heating and Cooling Programme will create its own international research platform on PVT systems in January 2018. Researchers and industry representatives from 13 countries so far will then start evaluating new PVT systems for HVAC solutions. This IEA SHC task, which is planned to run until the end of 2020, is being announced at a time when the PVT market in several European countries, such as France and Switzerland, is picking up speed. Experts with an R&D or manufacturing background are welcome to join the platform (see the contact details at the end of this news article).
Photo: Dualsun

News France Switzerland Germany Qatar Austria Spain PVT systems research platform BIPV IEA SHC Dualsun Hadorn Business Consulting ADEME Solar Heat Europe AEE Intec Fraunhofer ISE Tecnalia GORD SPF Rapperswil

…Continued

3.3 Articles in magazines

in AEE magazine 02/20, nachhaltige technologien, Austria

reprinted with permission in :

“Sonnenenergie“, a German magazine published by Deutsche Gesellschaft für Sonnenenergie e.V. (International Solar Energy Society, German Section)

Steigendes Interesse an PVT-Systemen

Jean-Christophe Hadorn

PVT-Technologie ist eine Hybridtechnologie, die ein Photovoltaikmodul (PV)-Modul und einen thermischen Solarkollektor kombiniert. Dadurch können gleichzeitig Elektrizität und Wärme aus Sonnenenergie gewonnen werden, ohne dabei mehr Platz zu beanspruchen als ein reiner PV-Kollektor. Kühlung kann während der Nacht direkt über den thermischen Absorber des PVT-Kollektors oder indirekt über eine durch den Strom der PV-Module versorgten Kühleinheit erfolgen.
Sinkende Preise für PV-Module haben die Hybridisierung seit einigen Jahren attraktiv gemacht und unter günstigen Bedingungen können die Anlagen eine gute Kapitalrendite aufweisen. Die Amortisationszeit beträgt oft weniger als 5 Jahre.

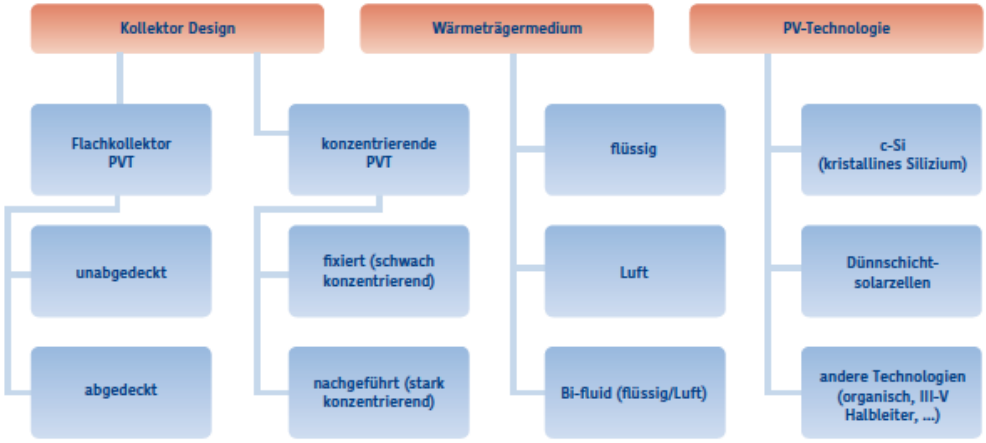
Vorteile

Die Technologie ist etwas komplexer als nur ein PV- oder ein thermischer Kollektor, bietet aber erhebliche Vorteile.

- PVT nutzt die gleiche Fläche wie ein PV- oder Solarthermiemodul, um Strom und Wärme und auch Kühlung zu liefern.
- Die Hälfte eines Daches mit PV-Modulen und die Hälfte eines Daches mit Solarthermiemodulen kann durch ein Volldach mit PVT zu etwas höheren Kosten ersetzt werden, liefert aber fast die doppelte PV- und die doppelte Wärmeenergie.
- Die Solarstromproduktion eines PVT-Kollektors ist nicht geringer als die eines reinen PV-Kollektors. Sie kann sogar etwas höher sein, wenn der PV-Kollektor aufgrund des thermischen Moduls bei Temperaturen betrieben werden kann, die unter denen eines reinen PV-Moduls liegen.
- Die thermische Energie kann zur Vorwärmung oder Erwärmung des Brauchwassers der Gebäudebewohner verwendet werden, direkt oder als Wärmequelle für den Verdampfer einer Wärmepumpe, und ist nur etwa 10-20% geringer als die eines rein solarthermischen Kollektors.
- Das PV-Modul kann Elektrizität für eine Pumpe oder teilweise für eine Wärmepumpe liefern. In einigen Fällen (z. B. Warmwasser-Wärmepumpen) ist es auch möglich, dass die gesamte elektrische Energie durch das PV-Modul zur Verfügung gestellt wird, sodass eine hundertprozentige solare Lösung möglich ist.
- PVT-Kollektoren erzeugen kein Geräusch wie eine Wärmepumpe und haben keine besonderen Auswirkungen, wenn der PVT-Kollektor richtig integriert ist.
- Die Lebensdauer eines gut konzipierten PVT-Kollektors sollte zwischen 20 und 40 Jahren liegen.

Arten von Kollektoren

Die Klassifizierung kann nach dem Kollektordesign, dem Wärmeträgermedium und den verwendeten PV-Zellen vorgenommen werden (siehe Abbildung).

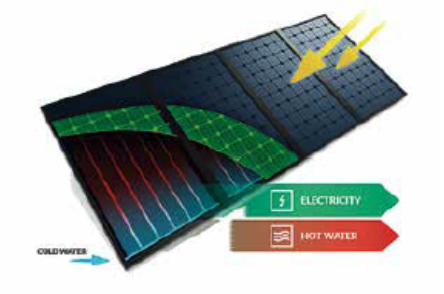


PVT-Typologien Quelle: IEA SHC Task 60

Die gebräuchlichsten Typen sind unverglaste Absorber mit Wasser oder Luft als Wärmeträgermedium und kristalline klassische PV-Zellen, da ihre Kosten am niedrigsten sind. Sie werden in Kombination mit einer Wärmepumpe für Warmwasser und Heizungszwecke eingesetzt. Unverglaste Luftkollektoren werden zum Beispiel zur Raumheizung von Niedrigstenergiehäusern verwendet.
Verglaste Kollektoren können höhere Temperaturen (60 bis 80 °C) erreichen und eignen sich am besten für die ganzjährige Warmwasserbereitung, beispielsweise in Hotels in mediterranem Klima.

Stand der Technik

Die Entwicklung von unverglasten Hybridkollektoren ist bereits weit fortgeschritten. Diese Art von Kollektoren hat sich mit vielen Umsetzungen vor allem in Europa gut etabliert. Die Haltbarkeit des Hybridkollektors wird als gut beurteilt, aber Erfahrungen gibt es erst seit ca. 10 Jahren. Frankreich hat die größte Expertise in Bezug auf unverglaste Luft- und Fluidkollektoren.
Verglaste Kollektoren sind schwieriger zu konstruieren, da höhere Temperaturen z. B. unterschiedliche Ausdehnung der Materialien bewirken oder die Haltbarkeit des Klebers beeinflussen. Gute Produkte sind vor allem aus Spanien, Österreich und Deutschland auf dem Markt, und seit 3 Jahren gibt es einige interessante Anlagen, die umgesetzt wurden.
Evakuierte Röhrenkollektoren wurden vor allem in Großbritannien entwickelt und zeigen gute Leistungen bei höheren Temperaturen für industrielle Prozesse. Die Anwendungen in diesem Bereich nehmen zu.
Es gibt auch Versuche mit konzentrierenden PVT-Kollektoren, aber bisher wurde kein starkes kommerzielles Produkt entwickelt.
Der Markt ist hauptsächlich auf Warmwasserbereitung und Raumheizung mit oder ohne Wärmepumpen für Neubauten ausgerichtet. In einigen Fällen werden die Systeme auch in der Sanierung eingesetzt, wenn ein fossiles Heizsystem auf eine Wärmepumpenlösung umgestellt wird.



Verglaste PVT-Kollektoren
Foto: Abora Solar, Spanien

Zertifizierung

Solarkollektoren werden zum Nachweis ihrer Qualität zertifiziert. Bei PVT-Modulen müssen sowohl das PV-Modul als auch der solarthermische Kollektor nach jedem der gängigen Technikstandards getestet werden, da es derzeit kein einheitliches standardisiertes Verfahren zur gleichzeitigen Prüfung beider Komponenten gibt. Von Industrie und Forschung werden aber Maßnahmen gesetzt, die Standardisierung und Zertifizierung in dieser Richtung weiterzuentwickeln. Solar Keymark hat ein PVT-Label definiert und dieses bereits an Unternehmen vergeben, die PVT-Kollektoren herstellen.

Projekt der Internationalen Energieagentur zu PVT-Systemen

Im Rahmen des Programms für solare Wärme- und Kälteerzeugung der Internationalen Energieagentur (IEA SHC) wird seit 2018 ein Gemeinschaftsprojekt zu PVT-Systemen (IEA SHC Task 60 „PVT-Systems") durchgeführt. Einer der Schwerpunkte unter der österreichischen Leitung von AEE INTEC analysiert den aktuellen PVT-Markt und identifiziert Best-Practice-Systeme unterschiedlicher Anwendungen und Größen.
Für einen umfassenden Vergleich wurden adäquate Modellierungs- und technische Charakterisierungsmethoden entwickelt. Experten aus Forschung, Technik und Industrie aus 13 Ländern arbeiten an dem Projekt und analysieren Verfahren und geeignete Methoden zur Qualifizierung guter Kollektoren und Anlagen. Dadurch können die Bemühungen, die einige Unternehmen mit der Installation von PVT-Anlagen vor zehn Jahren begonnen haben, durch Wissenschaft und Zertifizierung unterstützt werden und der PVT-Technologie Marktreife verleihen. Da die Rahmenbedingungen von Subventionsprogrammen einiger Länder in Hinblick auf PVT-Lösungen ungünstig sind, arbeiten die Experten des IEA SHC Task 60 an Verbesserungen.

IEA Forschungskooperation
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SHC
SOLAR HEATING & COOLING PROGRAMME

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Energie, Mobilität,
Innovation und Technologie

Jean-Christophe Hadorn ist Operating Agent des IEA SHC Task 60 „PVT-Systeme". jchadorn@gmail.com

Weiterführende Informationen / Links im E-Paper
Berichte zu IEA SHC Task 60 unter http://task60.iea-shc.org
Webinare zum Thema PVT-Kollektoren https://www.youtube.com/watch?v=CdVFqzbSNP8&feature=youtu.be

"DualSun, seit 2010 als Hersteller von PVT-Kollektorsystemen in Frankreich engagiert, nutzt das Projekt der Internationalen Energieagentur (IEA SHC Task 60) als Gelegenheit, praktische Erfahrungen aus mehr als 1100 weltweit installierten Projekten mit ExpertInnen aus Industrie und Wissenschaft zu teilen, um einen Konsens bezüglich Systemleistungen und Marktmöglichkeiten auszuarbeiten. Die in diesem Thinktank konzentriert vorhandene Expertise ermöglicht es, Entscheidungsträgern Empfehlungen für die Unterstützung von PVT als eine Schlüsseltechnologie zur Begrenzung des Klimawandels zu kommunizieren."

Laetitia Brottier, Head of Innovation, DualSun

3.5 Wikipedia page

Aim: provide uptodate PVT knowledge

An existing page was thoroughly revised and extended by Task 60 experts based on report D5.

https://en.wikipedia.org/wiki/Photovoltaic_thermal_hybrid_solar_collector

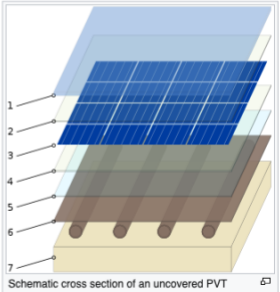
Photovoltaic thermal hybrid solar collector

From Wikipedia, the free encyclopedia

Photovoltaic thermal collectors, typically abbreviated as PVT collectors and also known as hybrid solar collectors, photovoltaic thermal solar collectors, PV/T collectors or solar cogeneration systems, are power generation technologies that convert solar radiation into usable thermal and electrical energy. PVT collectors combine photovoltaic solar cells, which convert sunlight into electricity, with a solar thermal collector, which transfers the otherwise unused waste heat from the PV module to a heat transfer fluid. By combining electricity and heat generation within the same component, these technologies can reach a higher overall efficiency than solar photovoltaic (PV) or solar thermal (T) alone.[1]

Significant research has gone into developing a diverse range of PVT technologies since the 1970s.[2] The different PVT collector technologies differ substantially in their collector design and heat transfer fluid and address different applications ranging from low temperature heat below ambient up to high temperature heat above 100 °C.[3]

Contents [hide]



Schematic cross section of an uncovered PVT collector with sheet-and-tube type heat exchanger and rear insulation:
1 - Anti-reflective glass
2 - Encapsulant (e.g. EVA)
3 - Solar PV cells
4 - Encapsulant (e.g. EVA)
5 - Backsheet (e.g. PVF)
6 - Heat exchanger (e.g. aluminum, copper or polymers)
7 - Thermal insulation (e.g. mineral wool, polyurethane)

PVT markets [edit]

PVT collectors generate solar heat and electricity basically free of direct CO2 emissions and are therefore regarded[*by whom?*] as a promising green technology to supply renewable electricity and heat to buildings and industrial processes.[*citation needed*]

Heat is the largest energy end-use. In 2015, the provision of heating for use in buildings, industrial purposes and other applications accounted for around 52 % (205 EJ) of the total energy consumed. Of this, over half was used in the industry and around 46 % in the building sector. While 72 % of the heat was provided by the direct combustion of fossil fuels, only 7 % was from modern renewables such as solar thermal, biofuel or geothermal energy.[4] The low-grade heat market up to 150 °C is estimated to be 26.8 % of the worldwide final energy demand, which is currently serviced by fossil fuels (gas, oil, and coal), electricity and renewable heat. This is the sum of industry demand 7.1 % (25.5 EJ)[5] and building demand 19.7 % (49.0 EJ residential and 13.6 EJ commercial)[6].

The electricity demand in buildings and industry is expected to grow further due to ongoing electrification and sector coupling.[7] For a significant reduction of greenhouse gas emissions, it is essential that the major share of electricity is sourced from renewable energy sources, such as wind power, solar energy, biomass and water power.

The market for renewable heat and electricity is therefore vast, illustrating the market potential of PVT collectors.

The report "Solar Heat Worldwide"[8] assessed the global market of PVT collectors in 2019. According to the authors, the total area of installed collectors amounted to 1.16 million square meters. Uncovered water collectors had the largest market share (55 %), followed by air collectors (43 %) and covered water collectors (2 %). The country with the largest installed capacity was France (42 %), followed by South Korea (24 %), China (11 %) and Germany (10 %).

PVT collector technology [edit]

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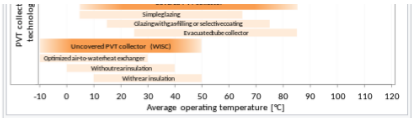
Low temperature applications include heat pump systems and heating swimming pools or spas up to 50 °C. PVT collectors in heat pump systems act either as low temperature source for the heat pump evaporator or on the load side to supply medium temperature heat to a storage tank. Moreover, regeneration of boreholes and ground source heat exchangers is possible.[1] Uncovered PVT collectors with enhanced air-to-water heat exchange can even be the only source of a heat pump system. In combination with a system architecture allowing to store cold produced with WISC or air collectors also air conditioning is possible.



Map of PVT collector technologies and PVT applications per operating temperature

Low and medium temperature applications for space heating and water heating are found in buildings, with temperatures from 20 °C to 80 °C. The temperatures of the specific system depend on the requirements of the heat supply system for domestic hot water (e.g. freshwater station, temperature requirements for legionella prevention) and for space heating (e.g. underfloor heating, radiators). Moreover, the PVT collector array can be dimensioned to cover only smaller fractions of the heat demand (e.g. hot water pre-heating), thus reducing operating temperatures of the PVT collector.

Solar process heat includes a diverse range of industrial applications with low to high temperature requirements (e.g. solar water desalination, solar cooling, or power generation with concentrating PVT collectors).

Depending on the type of heat transfer fluid, PVT collector technologies are suited for several applications:[16]

- PVT air collector: space heating systems, agricultural processes (e.g. drying crops);
- PVT liquid collector: Space heating (domestic, industrial), water heating systems, water desalination, space cooling, food processing systems.

PVT technologies can bring a valuable contribution to the world's energy mix and can be considered as an option for applications delivering renewable electricity, heat or cold.

See also [edit]

- Solar air conditioning
- Photovoltaic system

Renewable energy portal
Energy portal

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4 Webinars

2020

https://www.youtube.com/watch?v=CdVFqzbSNP8

1

Why consider PVT systems ?

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Abstract:
Over the past few years, PVT systems that combine solar thermal technology and solar PV have gained more attention. IEA SHC started in 2018 the Task 60 called “PVT systems” to better understand the applications of the technology. PVT solutions can be used in several ways Task 60 is currently investigating. Heating or cooling for residential, commercial, administrative or industrial buildings is the main application. We will introduce the current status of PVT technologies, show examples of systems, analyze the markets and trends, talk about the key findings of Task 60 and open new horizons.

Bio
Mr. Hadorn is an engineer and a manager from Switzerland. He developed activities in engineering in different companies and in management consulting. He has a long experience in solar thermal energy and heat storage since 1979 and in solar PV since 2005 and was involved in several IEA SHC Tasks. He is CEO of Solar energies and strategies a consulting company in Switzerland and he is the Operating Agent of IEA SHC Task 60 “PVT Systems 2018-2020” on behalf the Swiss Federal Office of Energy.

Duration : 15 min

2

Overview of the PVT industry and perspectives

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Abstract:
PVT industry has emerged since a few years with innovative products and systems on the market, especially in France and all over Europe. Innovative solutions will be presented and experience on field will be reported by the founder of one of the most active player on the PVT market, also a member of Task 60 of the IEA Solar Heating and Cooling Programme.

Bio

After a double degree of engineering and entrepreneurship at the Ecole Centrale Paris engineering school and a PhD in energetics at the Paris Saclay Ecole Normale Supérieure University, Laetitia Brottier was at the origin of the DualSun hybrid concept and in 2010 co-founded the company to develop, industrialize and commercialize the technology. At the end of 2013, the DualSun was the first module in the world to pass the PVT IEC certifications. In 2020 DualSun launches its 4th certified version, ever more powerful and competitive. Today, as Head of Innovation and Research at DualSun, she is responsible for keeping DualSun as a technological leader on the PVT market.

Duration : 15 min

3

PVT systems figure of merits and KPIs

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Abstract:
PVT collectors and systems are quite a new technology. KPIs (Key performance Indicators) have been worked out within the Task 60 "PVT systems" of the IEA SHC Programme so that systems can be reported consistently over the world in the future.
Some figure of merits of PVT solutions will be discussed helping to better understand what the PVT technologies can bring to the energy supply.

Bio
Daniel Zenhäusern is a researcher at the main solar research institute of Switzerland and head of Subtask D of Task 60 of the IEA SHC programme.
Nar M

Duration : 15 min

2019

https://www.youtube.com/watch?v=N8YlgODkbpA

In this webinar, moderator Andreas Häberle (SHC Task 60 Subtask D) welcomes Andreas Bohren (Solar Keymark), Laetitia Brottier (DualSun), Shawn Martin (SRCC) and Michael Intrieri (SunDrum) to share and discuss lessons learnt when certifying PVT products.

The webinar includes a Q&A section with questions submitted by the audience at the end of the recording.

2018

https://www.youtube.com/watch?v=n1JA-xcclN8&t=3049s

Solar Heating and Cooling Market and Industry Trends 2017

Tuesday 12 June 2018, 13:00 - 14:30 GMT

This webinar will highlight the key data and findings of the two most recent SHC market reports: *Solar Heat Worldwide. Global Market Development and Trends in 2017* from IEA Solar Heating and Cooling Programme (IEA SHC) and *Renewables 2018. Global Status Report* from REN21.

35 GWth of new solar thermal capacity was commissioned in 2017, increasing total global capacity by 4% to around 472 GWth. 2017 was a record year for new solar heat for industrial processes installations driven by economic competitiveness, a strong supply chain and policies to reduce air pollution. Concentrating collector technologies played an increasing role in providing heat for district heating and industrial applications. For the first time since the peak years 2011-2012, new manufacturing capacity was constructed for flat plate and concentrating collectors.

The webinar is organised by the Solar Academy of the IEA SHC Programme and hosted by ISES, the International Solar Energy Society.

Three experts will speak during the 1.5 hours webinar. Recording will be available online afterwards.

Werner Weiss, Director of the Austrian Institute AEE INTEC and co-author of the study *Solar Heat Worldwide*, shares key data on added capacity, prospering applications, jobs and the contribution to emission reduction.

Bärbel Epp, News Editor of solarthermalworld.org and author of the GSR section Solar Heating and Cooling Market and Industry, presents recent developments in industry and policy.

Jean-Christophe Hadorn, Manager of Swiss firm Base Consultants and Operating Agent of the IEA SHC task *Application of PVT Collectors,* explores market and industry development of PV-Thermal technologies.

The webinar will be moderated by **Pedro Dias**, Secretary General of Solar Heat Europe, Belgium.

Werner Weiss is founding member and director of the Austrian research institute AEE – Institute for Sustainable Technologies (AEE INTEC) in Gleisdorf and is working in national and international solar thermal and energy efficiency projects since the beginning of the 1980ies.

He headed numerous national and international projects – especially in the framework of EU, IEA and UNIDO programmes.

Since 2009 he is board member of the European Technology and Innovation Platform on Renewable Heating and Cooling and since 2010 the Austrian representative in the Executive Committee of the Solar Heating and Cooling Programme of the International Energy Agency (IEA). From 2010 to 2014 he acted as chairman of this IEA programme.

Since 2007 he is lecturer at Vienna University of Technology and the University of Applied Sciences - Technikum Wien.

Bärbel Epp is the founder and managing director of the agency solrico – solar market research & international communication, a network of solar thermal professionals worldwide. She is responsible for the international newsletter on the web portal www.solarthermalworld.org, which has been dedicated exclusively to the solar heating and cooling sector. solrico has published the first *World Map of Solar Process Heat Specialists* at the beginning of 2017 and is partner in the international project Solar Payback that aims at increasing the deployment of SHIP (Solar Heat for Industrial Processes) in four partner countries: India, South Africa, Brazil and Mexico. She graduated in physics and looks back at more than 20 years of journalism in the field of solar thermal energy (www.solrico.com).

Jean-Christophe Hadorn is an engineer and a manager. He developed activities in engineering in different companies and in management consulting. He has long experiences in solar thermal energy since 1979 and in solar PV since 2005 as chairman of a listed company.

Hadorn has lead several international groups within IEA Solar Heating and Cooling Programme and written three books in this context since 1988. Currently he leads the new IEA SHC Task about PVT systems (2018 to 2020) with the goal to enhance the awareness of this promising technology and to consolidate the knowledge on the PVT systems for the solar and HVAC industry.

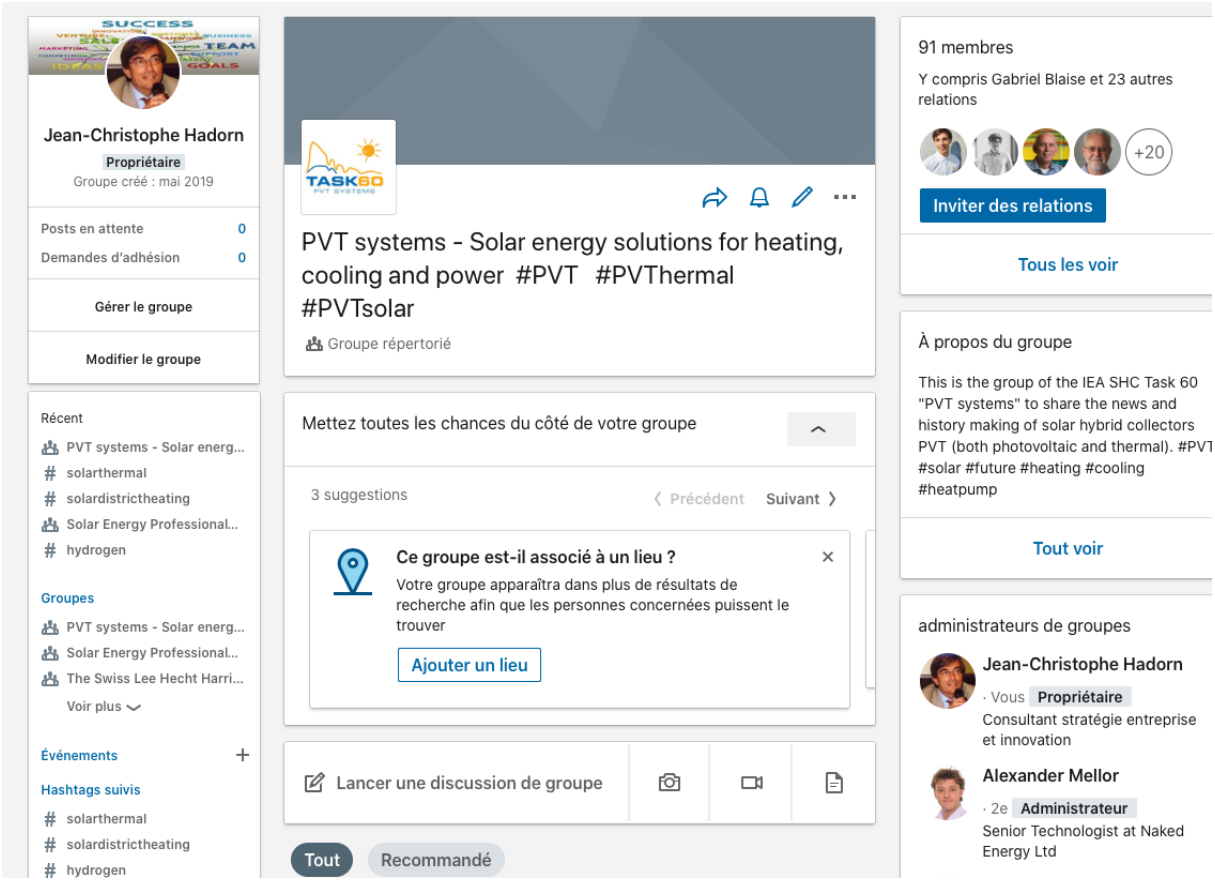
Hadorn was manager of the Swiss research program Solar heat and heat Storage for several years.

2020 in french

- **Mieux connaître la technologie et la performance des systèmes hybrides PVT**
  Intervenants : Laëtitia Brottier, Dualsun - Jean-Christophe Hadorn, IEA SHC - Edwige Porcheyre, Enerplan - Daniel Zenhäusern, SPF
  28 avril 2020 | 14h30 | Durée : 1h30

5 Linkedin PVT group

https://www.linkedin.com/groups/12245439/



6 Website

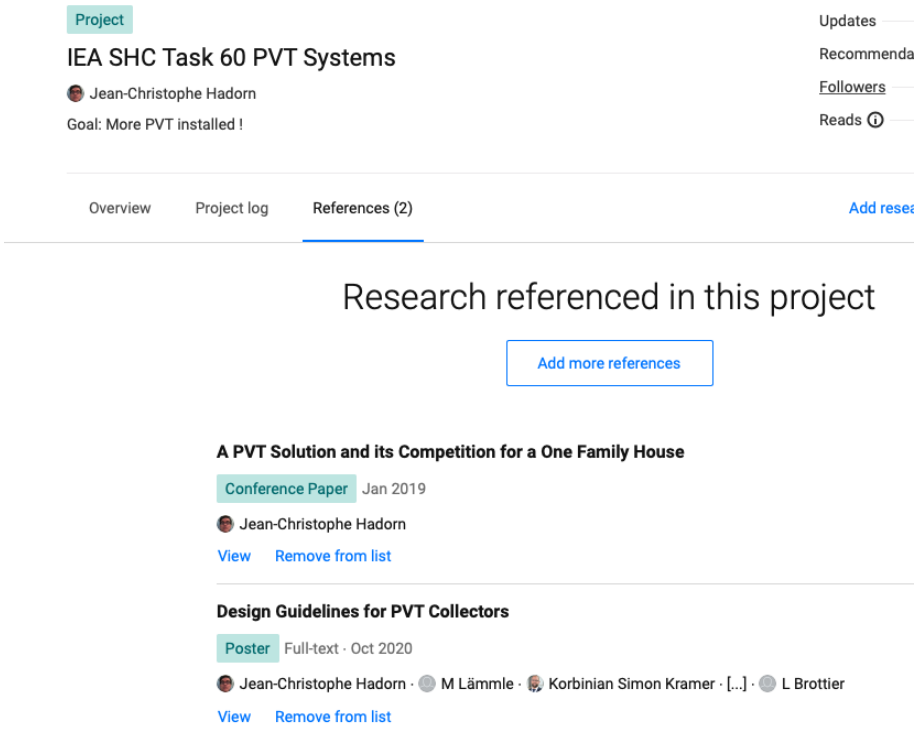
https://task60.iea-shc.org

7 ResearchGate

This extension of the diffusion of Task 60 reports is new and was tested with some of the reports only but will be extended if SHC EXCO approves this way of promoting Task reports.

The reports must appear in a project linked to the profile of a researcher. We chose the OA for this trial.

https://www.researchgate.net/project/IEA-SHC-Task-60-PVT-Systems



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