SOLARUPDATE

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Newsletter of the International Energy Agency Solar Heating and Cooling Programme

SHC
INTERNATIONAL ENERGY AGENCY
Solar Heating & Cooling Programme

#SolarHeat
#SolarThermal
#SolarProcessHeat
#SolarCooling
#SolarDistrictHeating

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ORVI Social Housing project wins IEA SHC 2022 Solar Award

▲ **ORVI Social Housing project.**

ORVI's housing project provides a simple, affordable, sustainable solar water heating option for 58 locally built homes. Ms. Helvi Ileka, Centre Head, Renewable Energy and Energy Efficiency of the Namibia Energy Institute, Namibia University of Science and Technology (NUST), and Mr. Leonhard Eins, Managing Director of Solsquare Energy (Pty) Ltd, received the award on behalf of the ORVI Social Housing project during EuroSun 2022, the International Conference on Solar Heating and Cooling for Buildings and Industry of IEA SHC and ISES held this year in Kassel, Germany.

"The 2022 SHC Solar Award celebrates the substantial achievement and measurable impact of a social housing project using solar thermal to reduce energy consumption and costs. The recipient, the ORVI Social Housing project, is a perfect example of affordable housing that improved residents' standard of living, supported a national solar company, and annually saves energy and cuts greenhouse gas emissions – in this case, 120,000 kWh of electricity otherwise produced by old-coal-fired plants thus avoiding the release of 36 tons of CO_2 annually."

TOMAS OLEJNICZAK, *IEA SHC Chairman*

The SHC Solar Award recognizes an individual, company, or private/public institution that has shown outstanding leadership or achievements in solar heating and cooling. With this year's award, the IEA SHC recognizes a social housing project that reduces energy consumption and costs.

◄ **SHC Solar Award recipients - Helvi Ileka, Namibia Energy Institute, Namibia University of Science and Technology (onscreen), and Leonhard Eins, Solsquare, Namibia, are responsible for the installation of solar water heaters on 58 homes.**

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SHC Members

AUSTRALIA
AUSTRIA
BELGIUM
CANADA
CCREEE
CHINA
DENMARK
EACREEE
ECI
ECREEE
EUROPEAN COMMISSION
FRANCE
GERMANY
ISES
ITALY
NETHERLANDS
NORWAY
PORTUGAL
RCREEE
SACREEE
SICREEE
SLOVAKIA
SOUTH AFRICA
SPAIN
SWEDEN
SWITZERLAND
TURKEY
UNITED KINGDOM

▲From left to right: Ken Guthrie, Solar Award Committee Chair & Australian SHC member; Tomas Olejniczak, SHC Chair and Dutch SHC member; Bulent Yesilata, Turkish SHC member; Leonhard Eins, Solsquare, Namibia; Werner Weiss, Austrian SHC member.

"This project is not only a success on the ground but demonstrates how a long-standing, comprehensive training program such as SOLTRAIN can bring together local and international solar industries, research institutions from Europe and Southern Africa, and policymakers to create a framework for the widespread application of thermal solar systems."

HELVI ILEKA, Namibia Energy Institute

Project Impact

Aussenkehr, a settlement in southern Namibia on the north bank of the Orange River, is one of the hottest and driest places in the country. Up to 15,000 permanent and seasonal workers live near the settlement. And most work at grape farms and live in traditional reed huts with no water, sanitary facilities, or electricity. Understanding the need for affordable, energy-efficient homes, ORVI developed a housing project to accommodate its employees. The 58 houses are made of precast concrete bricks and have potable water and electricity. With 40-50% of electricity consumption in low-cost housing projects used for water heating, solar thermosyphon systems for hot water preparation (2.1 m^2 flat plate collector and 160-liter hot water tank) were supplied and installed on every home by Solsquare Energy (Pty) Ltd., a Namibian solar company with support from the Austrian Development Agency-funded SOLTRAIN project. The hot water is used for showers, washing clothes, and cooking.

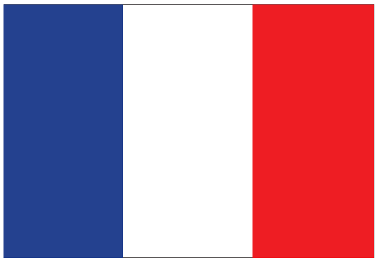
This project has significantly improved farm workers' standard of living. And it demonstrates how simple and affordable houses can be built locally and equipped with sustainable solar technologies. A project that should and can easily be replicated!

Namibia Energy Institute, Namibia Energy Institute, a national research institute at the Namibia University of Science and Technology, established with funding from the Ministry of Mines and Energy, supports the development and dissemination of knowledge, skills and good practices toward a safer, more secure and sustainable energy system in Namibia.

Solsquare had its humble beginnings in 2008 focusing on thermosyphon systems and slowly evolving into on- and off-grid solar PV technology. Today Solsquare is an Engineer Procure & Construct (EPC) company focusing on energy supply concepts, including heat, electric energy and fully off-grid systems.

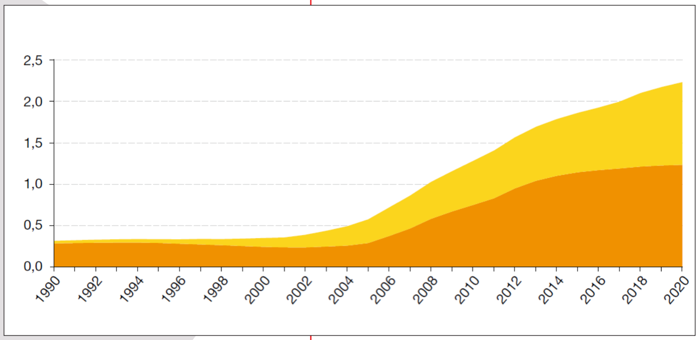
SOLTRAIN is a regional initiative in six southern African countries on capacity building and demonstration of solar thermal systems. The project is managed by AEE INTEC.

France in a Dynamic Solar Thermal Renewal



The planets seem to be aligned once again for solar thermal in France. The solar thermal market is finally on the rise again, with 53,600 m² installed in 2021 compared to 46,130 m² in 2020, an increase of 16% after eight years of decline. Solar thermal technology is benefitting from the upturn in renovations and replacement of old boilers in the residential sector and the rising cost of conventional energy. Solar thermal also has benefited from more appropriate support measures. This is good news for the fight against climate change and the willingness to reduce the dependence on Russian hydrocarbons.

The French market, including its overseas territories, is back on the growth track, rising by 18.9% to reach an installed base of 164,000 m² in 2021. It should be noted that more than half of the French market is in its overseas territories, approximately 90,000 m². In 2020, France's total solar thermal cumulated energy was about 2.2 TWh (+2.8 % compared to 2019).



▲ **Evolution of French solar thermal energy production (in TWh, orange: France and yellow: overseas territories).** Source: SDES, from Observ'ER

The French market also benefitted from the commissioning of four heating networks and Europe's largest industrial solar heating project, Creutzwald, where no such installations were connected in 2020.

The growth outlook for the current year remains positive overall in the European Union and France, in particular, with an expected revival in large-scale installations for heating networks.

In 2021, France was the most active country in the European Union, with four new heating networks commissioned incorporating solar energy (Creutzwald, Narbonne, Pons, and Cadaujac) for a cumulative surface area of 11,219 m², and ahead of Denmark.

The largest plant is Creutzwald (5,621 m² collector area, 4.3 MWth) operated by La Française de l'Énergie (LFDE). The Narbonne plant has a 2,996 m² solar thermal collector field that will replace 2,410 MWh of heat previously supplied by a gas-fired boiler. This plant is owned by Newheat, an ESCO energy service company that owns the equipment and markets the solar heat. The third French solar heat network completed in 2021 was that of the city of Pons (1,661 m², 1.2 MWth), also owned by Newheat and built by Savosolar. The solar thermal collectors on this site have the distinction of being positioned on solar trackers. This innovation was done to optimize the annual solar production using a limited surface area. The plant, operated by Dalkia, will deliver solar heat (about 1,000 MWh each year) into the network of the city of Pons.

◀ **Panoramic view of the Pons solar thermal system.** Source: Newheat

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▲ **Panoramic view of the Kyotherm solar thermal plant at Malterie Franco Suisse (Issoudun).** Source: Kyotherm

The smallest heating network is in Cadaujac, in southwest France, with a collector surface of 941 m^2. (720 kW). This is a turnkey solar power plant built by Savosolar to meet the heating needs of an eco-responsible residential area and produces 510 MWh per year. The solar production is linked to inter-seasonal geothermal storage, allowing this new district to cover 100% of its heating and domestic hot water needs with renewable energy.

Another growing market segment is solar thermal systems for industrial processes. This sector is becoming increasingly structured with the arrival of more and more ambitious projects in fields as varied as the food industry, paper mills, and greenhouse heating. The largest industrial project to be commissioned in 2021 is the Issoudun plant in France. With an area of 13,243 m^2 (consisting of 893 Savosolar Savo 15 SG-M collectors), it is the largest solar heating system in France and the largest solar thermal system producing industrial heat in Europe. The plant owner is Kyotherm, a company specializing in financing renewable heat projects by third parties. The solar unit will supply heat to a malt drying plant operated by the Franco-Swiss Maltsters.

Another project for which a contract was signed in early February 2021 is expected to be completed in 2022. What should become the largest solar thermal power plant in France will be built by Newheat to supply heat to the Lactalis group. The unit will have a collector surface of nearly 15,000 m^2 for a maximum power of about 13 MWth (for the production of approximately 8,000 MWh). This project, located in Fromeréville-les-Vallons, near Verdun, will provide solar heat to preheat the air in a new whey drying tower (from 15°C to 80°C) and will enable the site to reduce its gas consumption by 11% and its CO_2 emissions by 2,000 tons per year.

▲**Schematic view of the Dualsun PVT concept.** Source: Dualsun

As for innovation, the government is providing public support mechanisms, and private companies are stepping up, such as Newheat in large-scale solar thermal systems and DualSun with its particular PVT technology. These two companies are not only innovators but also active participants in several Tasks of the Solar Heating and Cooling Programme.

Finally, ADEME, the French agency for energy transition, is likely to publish a call for projects by the end of 2022 that will support innovation in the following areas: lower investment and operating costs, development of innovative system management solutions, and optimized integration of storage for solar thermal systems. Undoubtedly, the planets' alignment will continue to mean a bright 2023 for solar thermal in France.

This article was contributed by the French IEA SHC Executive Committee members Daniel Mugnier of Planair and Paul Kaaijk of ADEME.

Solar Geysers Beat the Limescale Blues in Limpopo

Families and members at Airforce Base Makhado in Limpopo are reaping the benefits of yet another energy efficiency project – this time, solar geysers designed to reduce the damage of limescale buildup and the amount of electricity used to heat water in domestic housing. Piloted as one of the projects implemented through a five-year partnership between the South African National Energy Development Institute (SANEDI) and the military (SANDF), this installation is part of ongoing research to ensure sustainable energy as well as quantify energy, cost, and emissions savings through energy efficient and renewable energy interventions.

Certain parts of South Africa are more prone than others to severe limescale buildup in their water heating systems, and many consumers are unaware that this raises the costs of heating (electricity) and significantly reduces energy efficiency as well as the lifetime of the hardware. Parts of Limpopo's natural environment contribute to this issue where hard water containing high mineral content builds up in geyser and piping hardware, requiring more electricity to heat the water. In addition to affecting a geyser's efficiency, the buildup eventually damages the geyser and heating element reducing their lifespan.

"What you find is that a geyser that should last for five years is now only lasting 18 months or less. The SANDF is helping us build a business case for this technology in high limescale water areas," says Dr. Karen Surridge, Acting General Manager of Energy Efficiency at SANEDI.

The project kicked off with the installation of 50 indirect high-pressure solar water heating systems and the training of seven artisan soldiers to install and maintain these systems. Dr. Surridge says the high-pressure indirect system specifically deals with limescale risks to household water heating systems. These indirect high-pressure solar heating systems will be compared to other heating technologies, such as instantaneous water heating and heat pumps. All these technologies are considered energy efficient over the traditional electrical geyser.

"If you put in a "normal" direct solar water heating system, it will simply calcify with limescale just like the electrical heating. Indirect systems work by heating a water-glycol mix (similar to anti-freeze in your car) which runs alongside the normal water and heats it for use. In hot climates like Limpopo, solar water heaters can reach much higher temperatures than what the thermostat of a conventional geyser will allow, meaning that less hot water is needed for use," says Surridge.

SANEDI previously quantified the energy cost savings from a similar project at a different military base in Limpopo, albeit at a larger scale. The "real-life" data indicate a return on investment in under three years accompanied by significant cost, electricity, and emissions savings. Over the next five years, this, and other technologies implemented in South Africa, will drive sector development. These vital pilot projects will inform business cases to encourage the public and businesses to take advantage of these benefits.

"It is the first time the technology is being tested at a domestic scale in Limpopo where hard water is so severe. We are looking forward to seeing the results. Proving sustainable and efficient energy technologies fit for purpose is vital in the energy constrained environment in which South Africa finds itself at present. Solar water heating will contribute positively towards reducing electricity demand on the grid, electricity costs to the consumer, and emissions acting on climate change," Dr. Surridge added.

This article was contributed by Karen Surridge of SANEDI and the South African Executive Committee member, www.sanedi.org.za.

NEW WORK

2023 Kicks Off With Two New Projects

Two new Tasks were approved at the December SHC Executive Committee Meeting. Both Tasks, one on lighting and the other on life cycle and cost assessment, highlight the breadth of work undertaken by the IEA SHC Programme.

Low Carbon, High Comfort Integrated Lighting

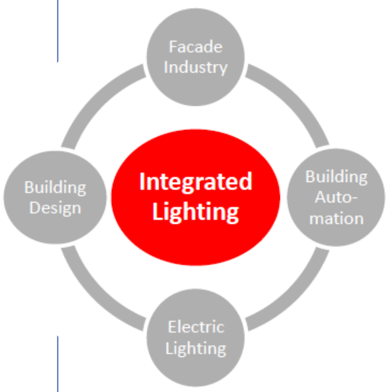
The overall objective of this new SHC Task is to identify and support implementing lighting (electric, façade: daylighting and passive solar) in the decarbonization on a global perspective while aligning the new integrative understanding of humans' light needs with digitized lighting on a building and a building related urban scale. Jan de Boer of Fraunhofer IBP in Germany will lead the Task.

Appropriate energy efficient and sustainable lighting is driven and orchestrated by architecture and building design practice and employs technologies from three relevant industry sectors: façade, electric lighting, and building automation.

The Task work is divided into four subtasks:

- Subtask A: Low Carbon Lighting and Passive Solar: Scenarios, Strategies, Roadmaps
- Subtask B: Visual and Non-visual User Requirements
- Subtask C: Digitized Lighting Solutions (Technology & Design Tools/Process)
- Subtask D: Application and Case Studies

Interested in learning more or would like to join this Task, contact Jan de Boer at jan.deboer@ibp.fraunhofer.de.



Efficient lighting driven by building design and technologies from three industry sectors: façade, electric lighting, and building automation

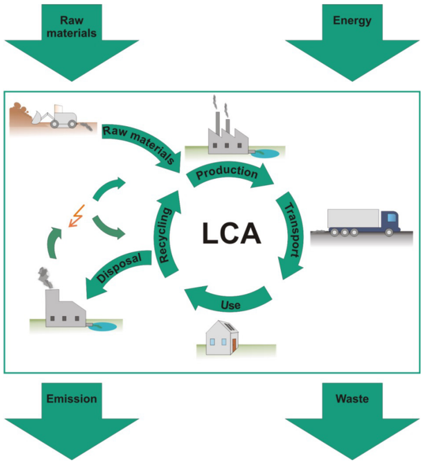
Life Cycle and Cost Assessment for Solar Heating and Cooling Technologies

This cross-sectoral research Task on life cycle assessment (LCA) and Levelized Cost of Heat (LCOH) aims to develop methodology guidelines and define the parameters for location and system-specific ecological and economic evaluation assessment. Karl-Anders Weiss of Fraunhofer ISE in Germany will lead the Task.

Because life cycle assessment is cross-sectoral by nature, the Task will collaborate with other heating and cooling-related projects within the IEA Technology Collaboration Programme. For example,

the results of Task 12 within the IEA Photovoltaic Power Systems Programme are particularly relevant as they include methodology guidelines on LCA of photovoltaics and life cycle inventories.

And another relevant project that just ended is IEA Energy in Buildings and Communities Programme's Annex 72: Assessing Life-cycle-related Environmental Impacts Caused by Buildings and its work on methods for developing specific environmental benchmarks for different types of buildings.



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Inaugural ISES & IEA SHC EuroSun

▲ **Tomas Olejniczak, IEA SHC Chair, and Prof. Klaus Vajen, ISES President, celebrate the success of the first ISES and IEA SHC jointly organized EuroSun.**

See you in 2024 in the Hague in the Netherlands!

At the first jointly organized EuroSun between ISES and IEA SHC, having over 480 solar experts from more than 50 countries gather in Kassel, Germany, was a welcome post-pandemic sight. And the silver lining was having Kassel University, the conference host, provide the perfect backdrop for drawing together new and experienced solar experts.

Prof. Klaus Vajen, ISES President and conference co-chair, emphasized the relevance of the conference location, "Kassel is the centre of the German renewable energy sector with a high number of renewable energy companies, research institutes, and educational facilities located in and around the city. The region is also home to young renewable energy experts and hosts more than 100 Ph.D. students working on various renewable energy research topics in internationally recognized institutes, most of which are connected with the University of Kassel."

Since the first EuroSun in 1996, it can still claim to be one of the main events on solar energy for buildings and industry. The conference's focus on heat supply, especially for buildings and industry, could not be timelier as the impact of climate change is being felt more than ever throughout Europe and the world. And solar researchers and the solar industry are being asked to demonstrate the enormous potential of solar in combating climate change and transforming the world into one powered by renewable and sustainable energy.

Tomas Olejniczak, IEA SHC Chair and conference co-chair, explained, "This new collaboration is exciting because it strengthens the cooperation between our two organizations and underscores how vital solar energy technologies are for achieving climate-change goals."

Over five days leading international scientists shared their work and their knowledge in a range of formats – 16 speakers from leading European and international institutions, 147 oral presentations, 144 poster presentations, 10 high-level keynote speeches, 5 plenary sessions, 5 topic-specific workshops, and 2 technical tours to solar industries and research institutions.

Research results, trends, and technological developments from the fields of components and applications, as well as topics of general importance, such as solar radiation and economic efficiency, were covered. Three focal points were thermal storage systems, digitalization, and artificial intelligence. The many events for young researchers underlined the conference's goal of supporting the next generation of solar experts. With over 30% of the conference participants being students, the solar future is on a bright trajectory.

New Work *from page 6*

The Task work is divided into five subtasks:

- Subtask A: Cooperation with ongoing or upcoming SHC Tasks and related Tasks from other programs
- Subtask B: Methodology adaption
- Subtask C: Data of different technologies and components (Identify, compile, and analyze existing inventories and other input data for Life Cycle Assessment and costing for SHC technologies and components)
- Subtask D: Reference systems and their requirements, scenarios, and optimization
- Subtask E: Dissemination, networking, and policy involvement

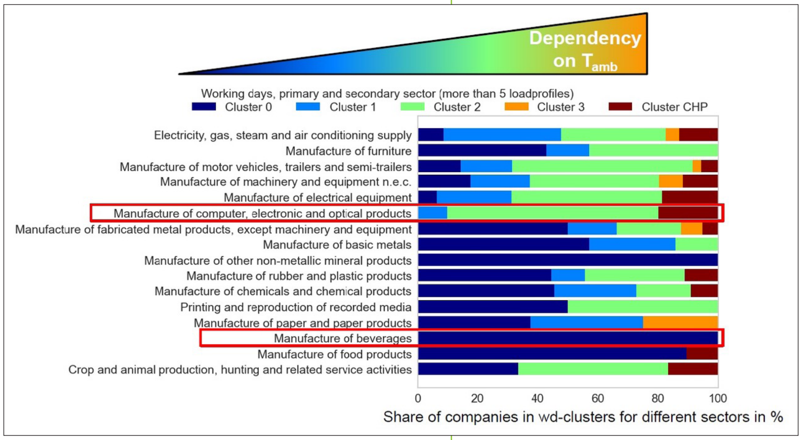
Interested in learning more or would like to join this Task, contact Karl-Anders Weiss at karl-anders.weiss@ise.fraunhofer.de.

Task 64

Tips and Tricks to Contract and Design a SHIP Project

It can be a big challenge to contract and design a SHIP (Solar Heat for Industrial Processes) project. SHC Task 64 on Solar Process Heat is working to support planners and investors as they consider such a project. During the recent SHC Solar Academy webinar, three SHC Task 64 experts shared tips and tricks on designing a SHIP project and the success factors to consider. The webinar recording, including the Q&A session, is available at https://www.iea-shc.org/solar-academy/webinar/solar-process-heat.

Felix Pag from the University of Kassel, Germany, started the webinar with a presentation on the role of solar in future industrial hybrid energy systems. Based on the analysis of measured heat profiles from several hundred industrial companies in Germany, he showed the sectors with a strong dependency of the heat load profile on the ambient temperature. In Figure 1, for example, a beverage manufacturer is placed into the cluster with no dependence on the ambient temperature, whereas manufacturers of computer, electronic and optical products have more processes that are related to the ambient temperature. "It is very important to consider the seasonal behavior of the heat load during the design phase," Felix Pag recommended. The good news for SHIP – almost all companies have summer heat demand that can be covered with solar collectors.



▲ **Figure 1. Proportions of companies with a certain load profile during working days within a particular industry segment. For example, 100% of beverage manufacturers are in cluster 0, whereas in other sectors, there is a bigger range.** Source: University of Kassel.

Cost Assessment of Hybrid Renewable Industrial Heat Systems

"At the beginning of SHC Task 64, we noticed that everybody was talking about the combination of solar and heat pumps, but there is no really established common system design methodology, and each planner has their own strategy based on individual experience", said Felix Pag. So, the researchers from the University of Kassel investigated three different system designs. They wanted to find out which parameters influence the levelized cost of heat of such hybrid systems. They first compared a parallel configuration where the heat pump and the solar field provide the required temperature together in parallel, then a variant where solar pre-heats the water, and finally, a configuration where the heat pump is the pre-heater.

Researchers found that the location, the hydraulic concept, and the load profile type have very little impact on the economics of the system (top part of Figure 2), whereas the other three parameters at the bottom of Figure 2 really make a difference to the levelized cost of heat (LCOH). Among them are the daily load profile and the temperature of the heat pump's heat source.

In Figure 2, you can also see that the heat pump capacity ratio, which is defined as the heat pump capacity divided by the maximum heat load of the factory, influences the economics significantly. "Our calculations have shown that a strong under-dimensioning of the heat pump results in lower LCOH, but the smaller the heat pump, the lower the renewable proportion you achieve over the year," said Felix Pag. He concluded that the heat pump capacity factor should be around 0.5 to find a good trade-off between lower LCOH and a reasonably high renewable energy fraction. In this variant, the capacity of *the heat pump is half of the total peak heat load of the factory.*

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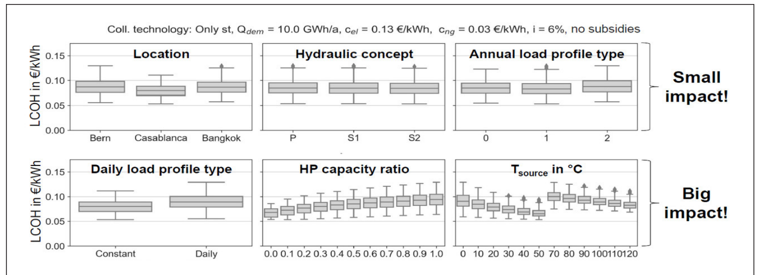
More details about the results of the LCOH assessment will be published in a paper titled Hybrid Solar Thermal and Heat Pump Systems in Industry: Model-Based Development of Globally Applicable Design Guidelines, which is currently under review at Solar Energy Advances.



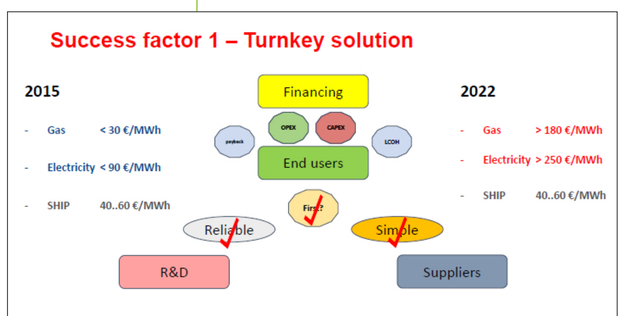
▲ **Figure 2. Parameters impacting the levelized cost of heat of hybrid SHIP systems calculated over 20 years (6% discount rate) based on fixed energy costs with a level from before the energy crises.** Source: University of Kassel.

Three Success Factors for SHIP

Wolfgang Gruber-Glatzl from AEE INTEC, Austria, introduced some of the success factors for SHIP based on the project database http://www.ship-plants.info, which includes more than 400 plants worldwide. He looked at the perspective of the end user. Investors want to know if SHIP is a reliable solution, whether it is a simple solution, and if they will be the first ones to implement it or if it has been done before. "Once we have convinced the end user that SHIP is reliable and that there are experts with a lot of experience, the next important selling point is the constant and low heat prices," he said.

Success Factor 1: Turnkey solutions

Wolfgang Gruber-Glatzl noted that we try to avoid looking at payback times because they do not show the true value of solar industrial heat. While it is better to change the perspective towards the levelized cost of heat to illustrate the long-term energy security providing heat at reasonable costs. Hence the first success factor is a business model that establishes customer confidence by delivering solar heat instead of selling the collector field. An example of a successful ESCO (Energy Service Company) is the 10 MW solar thermal plant at the Boormalt malting factory in Issoudun in southern France that started operation in the first half of 2021.



Success Factor 2: Innovation

A high number of SHIP plants use flat-plate collectors, but there is a growing trend toward SHIP systems using evacuated flat-plate collectors or parabolic trough collectors to provide higher temperatures above 100 °C. The big advantage of these collector fields is that they can be integrated into the supply line on the utility side of the industrial plant. In these cases, you work with the facility manager instead of the production manager. It also means that a larger proportion of the heat demand can be covered, thus achieving economies of scale. The next area of innovation is expected to be hybrid solutions with heat pumps and seasonal storage and combined with sources of excess heat.

▲ **Solar process heat system for Martini & Rossi, with a capacity of 0.42 MWth, is equipped with high-vacuum flat plate collectors, Turin, Italy.** Photo: TVP Solar, Switzerland.

Success Factor 3: Multiplication, Standardization

For the last success factor, Wolfgang Gruber-Glatzl looked to Mexico – the largest SHIP market in terms of the number of installed systems worldwide, where two dominating technology suppliers have optimized their selling points. Standardization has reduced planning costs. And high replicability makes their solutions competitive. It will be important that other SHIP providers reach this tipping point to accelerate their business and expand the SHIP market globally.

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SHIP Plant Simulations

Alan Pino from the University of Seville spoke about the ongoing work on simulation and monitoring tools for assessing the potential benefits of SHIP plants. One area of work is a comparative study of different simulation tools to assess the plants' yield. In the first quarter of 2023, SHC Task 64 will publish the report, Guideline for Yield Assessment in SHIP Plants: Uncertainties derived from the simulation approaches. Solarthermalworld.org will post a news article once the report is published.

This article was contributed by Bärbel Epp, editor-in-chief of solarthermalworld.org.

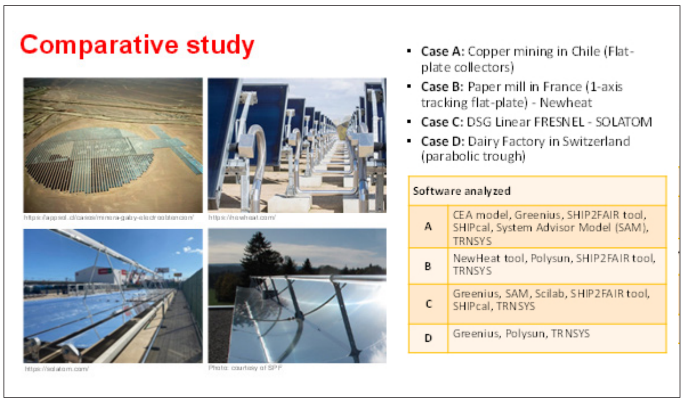

Photo: Inventive Power SAPI de CV

Photo: Módulo Solar, SA de CV

Solar Thermal Partners

Heat Changers

Heat Changers and the IEA SHC Programme understand the significance of Solar Heat in the push to reach a carbon-neutral world. With our new partnership, we look forward to demonstrating why Solar Heat is pivotal for our changing energy sectors.

Did you know there is a short and entertaining podcast about **Solar Heat?** Every month, the Heat Changers release a **15-minute episode**. The podcast is produced and conducted by marketing, communication, and solar thermal professionals, led by Marisol Oropeza from matters. Several members of the solar thermal industry in Mexico and other countries in Latin America have participated in the 10 episodes available in **Spanish** so far. The Spanish series have been listened to in over **25 countries** on three continents.

On November 3, the **first episode in English** was released! This new English series is supported by Intersolar, which will expand the audience globally. Plus, each episode will include a policy brief from Alexandra Sutu, Communications Officer from Solar Heat Europe.

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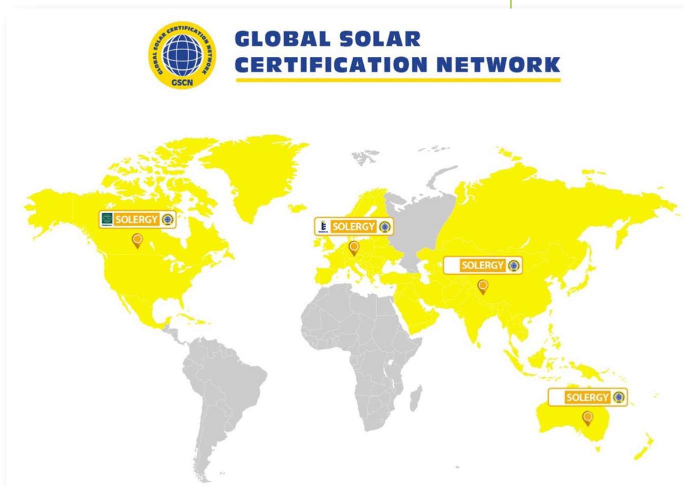
The podcast is free for listeners and is available on the Heat Changers website and the most popular podcasting platforms, such as Spotify, Apple Podcast, Google Podcast, and Amazon Music.

Global Solar Certification Network - GSCN

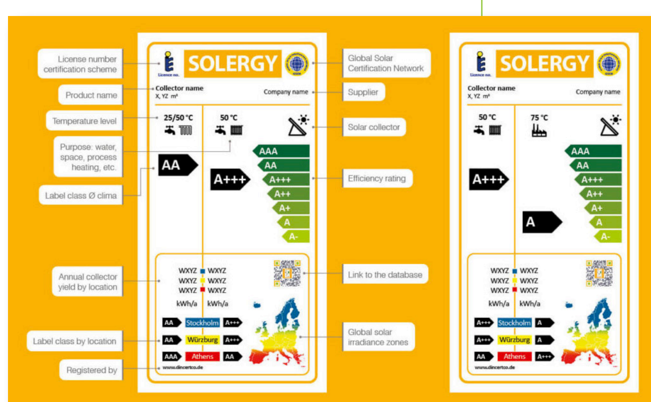


GSCN and the IEA SHC Programme partnership goes back to 2014 with the start of GSCN. With a newly energized partnership, we look forward to supporting the growth of solar thermal technologies through this testing and certification platform.

The GSCN is a worldwide cooperation between solar thermal industry representatives, certification bodies, test laboratories, and inspection bodies. It was established based on the work of IEA SHC Task 43: Solar Rating and Certification and IEA SHC Task 57: Solar Standards and Certification.

The GSCN aims to facilitate worldwide cross-border trading for manufacturers of solar thermal quality products and avoid re-testing products and re-inspecting production lines when entering new markets. This leads to increased product quality, lower costs, access to more markets, and better business opportunities. “Being a member of the GSCN makes it possible to define the required collector tests from the beginning in such a way that the requirements of the certification scheme from different countries are covered. This means that the tests on collectors do not have to be carried out twice. The number of required test specimens is reduced. Also, the recurring factory visits can be carried out with much less travel and significantly reduced costs for the industry “, states the Austrian collector manufacturing company GREENoneTEC.

The GSCN takes harmonized existing certification schemes as a basis and grants mutual recognition of test and inspection reports if they fulfill the requirements specified in the GSCN Working Rules and are done by test labs and inspectors recognized by the GSCN. Its vast expertise in solar thermal collector certification schemes makes it an internationally valuable information hub for the industry. Besides, the GSCN provides guidance and suggestions for implementing certification programs for solar thermal collectors in different countries and regions all over the globe.



The alliance with the Solar Heating Initiative, SOLERGY Label, a voluntary label for solar thermal collectors launched in Europe in 2016 by the Solar Heating Initiative, is a natural match. “A key issue of the SOLERGY Label is to show how well a solar collector uses solar irradiation at different temperatures and locations. This is relevant for collector manufacturers that export to multiple countries and target clients from various segments (swimming pool heating, water heating, process heat, among others),” remarks Marisol Oropeza from the Solar Heating Initiative. Several communication activities, including webinars and digital campaigns, are jointly implemented to raise more awareness about the GSCN and the SOLERGY Label.

Highly recognized companies from around the world belong to the GSCN. Currently, it has 30 members, including seven from the solar thermal industry, seven certification bodies, eight test labs, and two inspection bodies. Applications from six more organizations are being processed.

Task 65

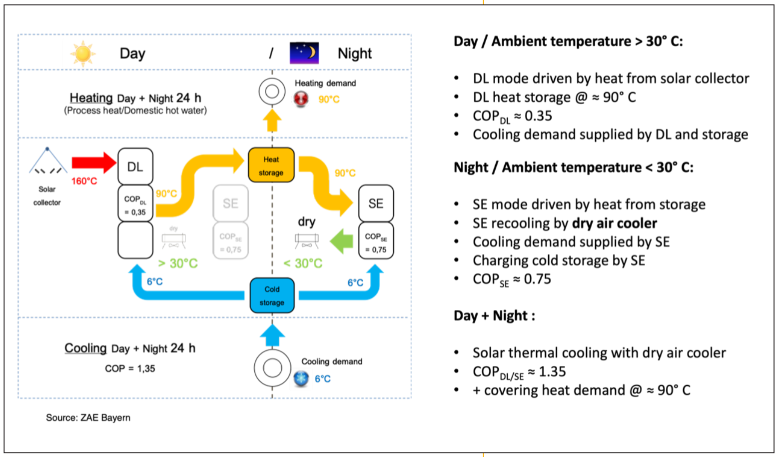
Future Potential of Solar Cooling

The energy demand for air-conditioning is growing faster than any other energy consumption in buildings. The main share of the projected growth for space cooling comes from emerging economies and will more than triple by 2050 to 6,000 TWh/a globally. What could be the contribution of PV and solar thermal cooling to meet this increasing demand in the next decade? This was the key question that Dr. Uli Jakob, Task Manager of SHC Task 65 on Solar Cooling for the Sunbelt Region, elaborated on in his keynote presentation, The Future of Solar Cooling, at EuroSun 2022.

The challenge faced by many solar thermal cooling systems in the sunbelt region is the need for recooling the heat-transfer medium. In areas with high ambient temperatures above 30 °C wet cooling towers are necessary, which causes costs and water requirements. In the SunBeltChiller project, scientists have developed a new system configuration for a solar thermal cooling system that works without a wet recooler so it can be operated in dry and water-poor areas.

There are three special features of this concept, which are shown in Figure 1:

- Double lift (DL): Uses concentrating collectors as the heat source of around 160 °C for a high-temperature heat pump.
- Single effect (SE): The waste heat from the double lift process at around 90 °C is stored and used in a single-effect absorption chiller at night.
- Cooling storage is connected to the single-effect chiller to make the cold produced at night available during the day.

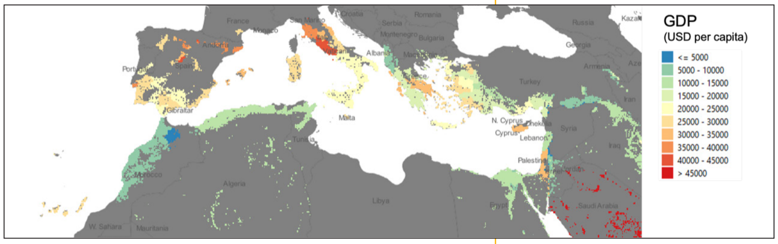


▲ **Figure 1. The SunBeltChiller system combines the double-lift (DL) operation of a high-temperature heat pump with a single-effect absorption chiller to avoid a wet recooler.** Source: ZAE Bayern

"The big advantage of the SunBeltChiller concept is that only the single-effect cooling process needs recooling. This is done at moderate temperatures during the night because of the storage, which allows the use of dry recoolers," explains Richard Gurtner, Head of the SunBeltChiller project and researcher at the German ZAE Bayern research institute.

A newly developed tool within the German project SunBeltChiller allows the assessment of the future

► **Figure 2. Potential customers for SunBeltChiller systems around the Mediterranean. Inhabitants live in areas with a DNI higher than 1,500 kWh/a and water scarcity. The colors show the GDP, with green representing low-income groups and red indicating well-off population groups.** Source: ZAE



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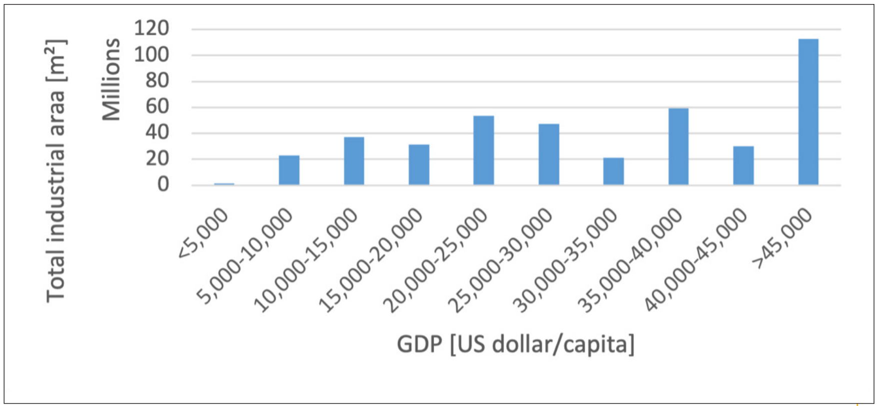


Figure 3. The global potential for SunBeltChiller systems for industrial cooling. How to read this chart: The tool identified industrial areas totaling 110 million m2 across the globe where the GDP is above USD 45,000 (column on the right). Photo: ZAE

potential of solar cooling based on specific geographical data on irradiation, population density, industrial areas, and water availability. To determine which areas of the sunbelt region have the potential for this concept, the team defined a DNI of at least 1,500 kWh/m^2 annually as the necessary condition for the concentrating collectors. They also wanted to find arid regions where the dry cooling advantage of the SunBeltChiller concept has a unique advantage.

ZAE used geographical information system software (QGIS). They also collected data from publicly available sources, such as climate zones, irradiation potential, gross domestic product, population density, industrial areas, and water availability. They then adapted it to a uniform grid structure. The tool covers the whole world with a grid of one square kilometer fields. The tool can check the available data in all these squares and aggregate the results if a set filter is met.

Two filters are crucial as key indicators for market size. The GDP level is an indication of the market volume for building air conditioning because homeowners need a certain income to buy solar cooling systems. Industrial areas, on the other hand, are the indicator for the market size of industrial cooling demand. The result can then be displayed graphically (see Figure 2) or as a chart (Figure 3).

Currently, the QGIS tool is being used on a global level only. But Gurtner and his team want to identify potential demand for solar cooling systems in buildings and industry at the country level.

This article was contributed by Bärbel Epp, editor-in-chief of solarthermalworld.org.

"The QGIS-based software is a great tool to identify potential solar thermal cooling demand," summarized Uli Jakob. "It is all about how to use the solar resource on-site for particular applications."

SHC Publications

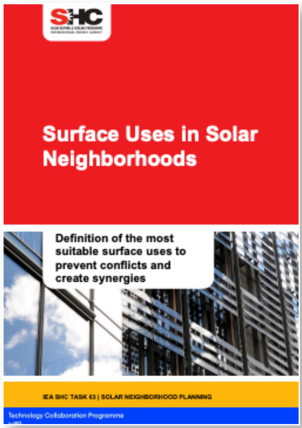
New Publications Online!

You won't want to miss the new reports highlighted below. You can read them online or download them for free. Our complete library of publications – online tools, databases, and more – dating back to the start of the SHC Programme can be found on the IEA SHC website under the tab "Publications" or under a specific Task.

SOLAR NEIGHBORHOOD PLANNING

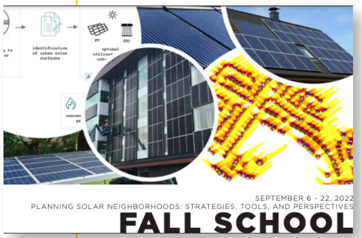
Surface Uses in Solar Neighborhoods

The experts of SHC Task 63: Solar Neighborhood Planning developed a collection of solutions suitable for the application in solar neighborhoods, starting with active and passive solar energy systems and then expanding to several other sectors. The results are graphically presented in this report, using the urban surfaces as a basic element for describing the spatial structure of neighborhoods and identifying the areas in which the different solutions might be applied.



Fall School: Planning Solar Neighborhoods: Strategies, Tools, and Perspectives

This booklet includes presentations from the September 2022 Fall School. Participants were introduced to and discussed solar strategies and methods to assess and evaluate these solar strategies and concepts from various perspectives and standpoints. Presentations and discussions highlighted multiple perspectives to consider when selecting solar strategies (passive and active) for neighborhood application. These perspectives include life cycle analysis, solar technologies integration, techno-economic aspects, simulations, multi-objective solutions, impact on energy goals and sustainable developments, and other practical, social, and technical aspects.



SOLAR PROCESS HEAT

Integration schemes and BOPs more commonly used in commercial SHIP applications

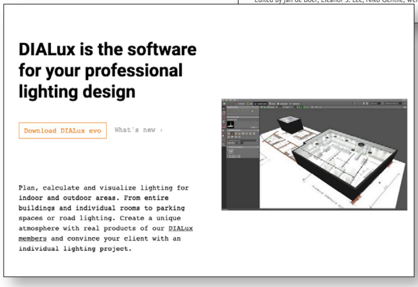
This report highlights a new strategy for identifying future SHIP projects – an analysis of BOP options depending on the fluid required in the industrial process and the working fluid used in the solar field. Once these fluids were identified, the industrial partners performed an integration analysis of those combinations that were part of their business portfolio. Section 4 of this report covers the contributions received to date. As Task Manager Andreas Häberle notes, "For solar process heat projects, the interface between the collector field (the heat source) and the industrial process (the heat sink) is called the balance of plant (BoP). Especially for high temperature processes, with heat transfer media like steam, thermal oil or hot air, we expect cost benefits for the BoP by standardizing its configuration and components."

DAYLIGHTING & ELECTRIC LIGHTING

Two new resources supported by SHC Task 61/EBC Annex 77: Integrated Solutions for Daylighting and Electric Lighting

Special Issue of Energy and Buildings, Integrated Solutions for Daylighting and Electric Lighting, November 2022

DIALux is a free and open planning tool with all the functions for professional lighting design.



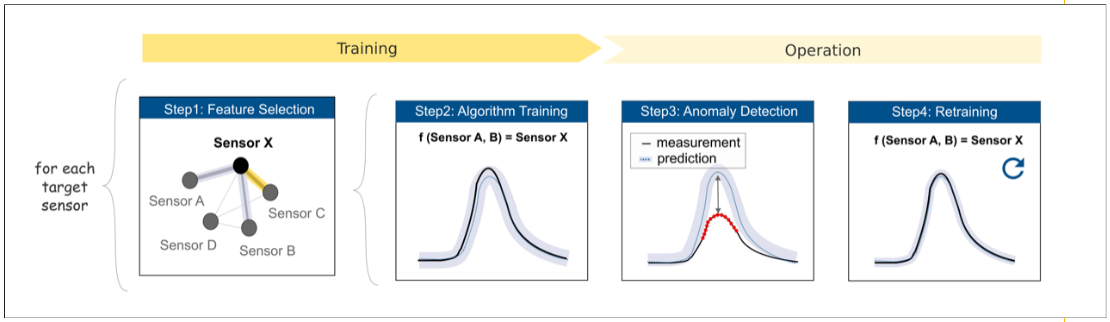
Task 68

Fault-Detective – Fault Detection Based on Artificial Intelligence

Good monitoring is essential to ensure the performance of solar thermal systems. Only then can solar thermal systems live up to their full potential and provide as much renewable energy as possible.

To support monitoring personnel with their work, researchers from SOLID Solar Energy Systems, Best Bioenergy and Sustainable Technologies, and Links Foundation developed a new Fault Detection algorithm, called Fault-Detective. Using machine-learning, it allows to spot any abnormal system behavior. The main advantage over other algorithms is that Fault-Detective can be applied very easily. As the algorithm is purely data-driven, it can be applied to any solar thermal system and only requires some monitoring data. All other information is automatically extracted based on the measurements.

How It Works



Four-step approach of Fault-Detective.

The algorithm uses a four-step approach.

1. Find correlations

In the first step, a small portion of the historical data (~1 week) is analyzed to identify correlations between sensor measurements. In principle, this step allows the Fault-Detective to understand the system's structure.

2. Create models

In the second step, machine learning is used to model the correlation between sensors. After this, predictions about sensor values can be made using the data of its related sensors. Put in another way, Fault-Detective models the relations between the parts of the system.

3. Detect anomalies

In the third step, these models are used to detect abnormal system behavior during the system's operation. As soon as new data from the system is available, predictions for the sensor values can be generated. If the predictions (trained fault-free system behavior) and measurements (actual system behavior) differ too much, this indicates that a problem occurred in the system.

4. Retraining

Finally, one last step is needed to keep the models of the system up to date. This step is required as normal system operation might change over time - for example, if operating conditions are changed seasonally or if parts of the system are replaced or added. Hence, models are updated frequently.

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Fault-Detective *from page 15*

Test Results

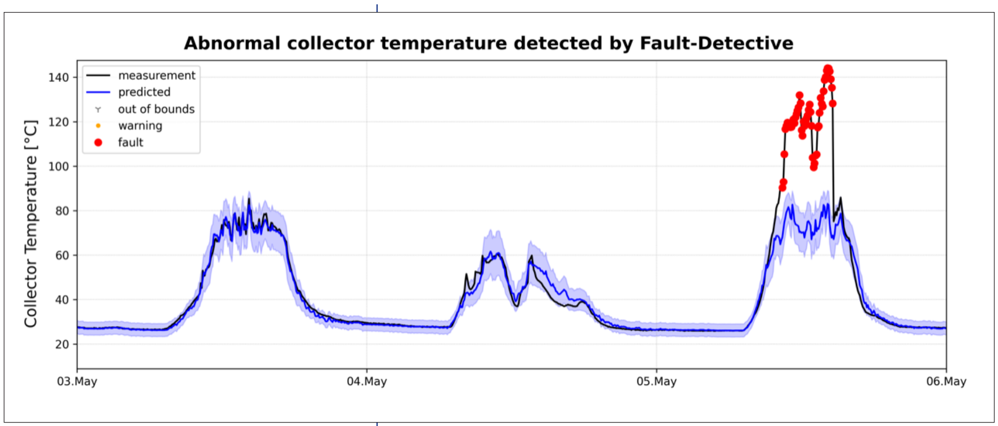
This approach was tested using the data of three different solar thermal systems – targeting three different types of sensors. The results show that the Fault-Detective can successfully model the behavior of the sensors and detect faults well. All faults spotted by the monitoring personnel were also found by the Fault-Detective. Moreover, the algorithm even identified some faults that the domain experts missed.

One limiting factor is that anomalies due to rare operating conditions cannot be distinguished from anomalies due to faults. As a result, alarms are sometimes raised even though the anomaly has less or no impact on future system behavior.

These results are based on the H2020 Project Ship2Fair. The algorithm and similar topics in the context of fault detection of solar thermal systems will be further discussed and pursued in the SHC Task 68: Efficient Solar District Heating Systems.

In addition, a publication on the Fault-Detective algorithm is currently under review for the open-access journal Solar Energy Advances.

This article was contributed by Viktor Unterberger of BEST and SHC Task Manager of Task 68: Efficient Solar District Heating Systems, viktor.unterberger@best-research.eu, Lukas Feierl of SOLID, l.feierl@solid.at and Sabine Putz of SOLID, s.putz@solid.at.



▲ **Exemplary results of Fault-Detective showing how it successfully detects abnormally high collector temperatures.**

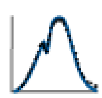
What makes this Fault Detection algorithm different from others?

Flexible

Some algorithms require very specific measurement devices, measurement conditions or system layouts. Instead, our algorithm can be used at any system due to its flexible training mechanism.

Easy to Configure

Often, a considerable amount of time needs to be spend to configure algorithms, set parameters and adapt to special system layouts. In contrast, our method uses Machine-Learning to do so automatically.



Accurate

Sensor data of solar thermal systems is not always easy to interpret. Many correlations between measurements have to be kept in mind when analysing the data. In contrast, our algorithm is able to mimic the multi-dimensional, time-dependend and non-linear data very well.

Solar Thermal 2023 TRENDS

As 2022 comes to an end and 2023 begins, our team of SHC Task Managers wants to share trends they see coming in their fields of expertise. We hope that by taking the time to stop and think about where solar thermal is headed, we can stay one step ahead of the technological advances and market changes.

TECHNOLOGY

Solar Cooling

The energy demand for air-conditioning is growing faster than any other energy use in buildings. The main share of the projected growth for space cooling comes from emerging economies – more than tripling by 2050 to 6,000 TWh per year globally. One of the main trends for 2023 will be the emergence of more and more **hybrid cooling system solutions** (combinations of absorption or adsorption chillers with compression chillers using natural refrigerants). Even in the small to the medium cooling capacity range, they simultaneously offer high CO_2 savings with sound economics.

In the field of **medium-temperature systems** (solar collector temperatures around 160-180 °C) and commercial double-effect and new SE/DL absorption chillers (e.g., SunBeltChiller concept), there will be solutions with better efficiency and economy using smaller solar fields and with heat dissipation capacities to achieve an **investment advantage of up to 40% over traditional solar cooling systems.**

A newly developed **GIS tool** within the German project SunBeltChiller shows excellent potential to identify new markets for solar cooling based on specific geographic data on solar irradiation, population density, GDP, industrial areas, or water availability. Two filters are crucial here. The level of GDP is a measure of the market volume of building air conditioning because homeowners need a certain income to buy solar cooling systems. On the other hand, industrial areas indicate the market size of industrial cooling demand.

Solar Water Heating

Natural gas and oil prices will continue to be volatile in 2023. In fact, the gas supply will be limited or restricted in several parts of the world into 2023, accelerating the roll-out of solar-driven heating and cooling technologies. For Solar Water Heating, this means:

- Gas water heaters will start to be phased out in some regions. Despite a gradual decline in new solar thermal hot water collector installations (on a year-on-year basis), the **overall share of solar energy supplied to hot water systems is set to GROW by diverting solar electricity (from photovoltaics) to water heating applications.**
- Low-income economies will choose to 'skip' expensive centralized fossil fuel infrastructure with volatile fuel prices (e.g., gas water heaters) in favor of **distributed energy systems such as PV2Heat hot water systems and thermosyphon water heaters.**
- High-income economies will see a rapid increase in the number of **heat pumps used for space and water heating** in the market, **powered increasingly by local rooftop solar** and a higher share of solar electricity at the grid level. The design and control of these heat pumps to operate with local PV will be key for energy savings and maintaining grid power quality.
- With rising energy prices, many new products will come to market in 2023 to help residential and business consumers manage their energy bills by scheduling energy consumption and storing energy as thermal energy (e.g., in hot water tanks and by pre-heating/cooling spaces). These emerging **'smart' products** have the potential to provide a triple win by creating value for manufacturers, consumers, and grid operators.

Compact Thermal Energy Storage (CTES)

With the sharp increase in energy costs, the distance to market for a number of compact thermal energy

continued on page 18

storage applications has significantly shortened. We will see this for **industrial applications of Phase Change Materials (PCM)** at medium temperatures and **heat storage and transportation using sorption materials.**

In the coming year, there will be more CTES technology **demonstration projects** and probably the birth of more **start-up companies** in this field. However, policymakers must enable this development by creating the proper **R&D and market introduction measures.**

BUILT ENVIRONMENT

Solar Neighborhoods

Due to security aspects and pressure on energy supplies, high on national agendas is how to plan for increasing the local energy supply together with energy-efficiency measures to reduce the energy need. The growth of PV installations on buildings and in urban areas combined with more large-scale solar fields outside cities due to the demand for local and secure energy supply – the push will be even greater to develop **supportive planning methods and tools, identify business models**, and suggest **strategies for how to increase solar access** and use not just active solar energy, but passive solar energy and daylight.

INDUSTRY

Solar District Heating

Five trends in the coming year stand out. The first is that **large-scale solar thermal systems** using the economy of scale will be competitive with gas and oil prices. Second, new **innovative solar thermal technologies and collectors** will more efficiently provide solar heat, even at higher temperatures. Third, **long-term seasonal storages** used for solar thermal and other technologies will significantly contribute to the efficient operation of different sector coupling technologies, for example, Combined Heat and Power (CHP) systems, since they allow for maximizing the heat use and, in turn, overall performance. Fourth, the **combination of technologies, solar thermal with other technologies** (e.g., heat pumps), will increase the efficiency of both. And lastly, the push to reach the next step regarding **digitalization** will allow for the application of new algorithms and methods, resulting in a more efficient, robust, and cost-reduced operation.

Nexus Water-Energy-Industry

In addition to solar thermal energy for supplying wastewater treatment technologies, **direct UV radiation** in solar water decontamination and disinfection systems is becoming increasingly important. **New industrial applications** are needed in combination with overcoming the technical, economic, and political barriers to new decontamination and disinfection systems to increase the number of installations. Another trend is the development of new solar reactors that aim to process wastewater efficiently into **hydrogen (H2) through photocatalytic or photo-electrochemical processes** by directly utilizing solar radiation. Using a multidisciplinary approach, disciplines from solar collector development, efficient reactor systems, photo-electrochemical materials research, wastewater chemistry, and the innovative production of alternative fuels, such as H2, will need to be combined.

Solar Process Heat

We will see more **large-scale solar thermal plants** for district heating and industrial process heat. Financing mechanisms by ESCOs are well-known in other technology fields. And as solar thermal technologies increasingly become attractive investments, we will see more projects financed by third parties based on **contracting models**. Especially in combination with large thermal storages, solar thermal plants can reliably deliver a substantial share of industrial heat demand and thus help to hedge energy costs and CO^2 emissions. Therefore, we will see more projects with **large storages** and a **combination of solar thermal with other renewable technologies** (heat pumps, biomass) to aim at a 100% CO^2-free heat supply.

We will see more large-scale solar thermal plants for district heating and industrial process heat.

IEA SHC programme

The International Energy Agency was formed in 1974 within the framework of the Organization for Economic Cooperation and Development (OECD) to implement a program of international energy cooperation among its member countries, including collaborative research, development and demonstration projects in new energy technologies. The members of the IEA Solar Heating and Cooling Agreement have initiated a total of 68 R&D projects (known as Tasks) to advance solar technologies for buildings and industry. The overall Programme is managed by an Executive Committee while the individual Tasks are led by Task Managers.

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SOLARUPDATE

The Newsletter of the IEA Solar Heating and Cooling Programme

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