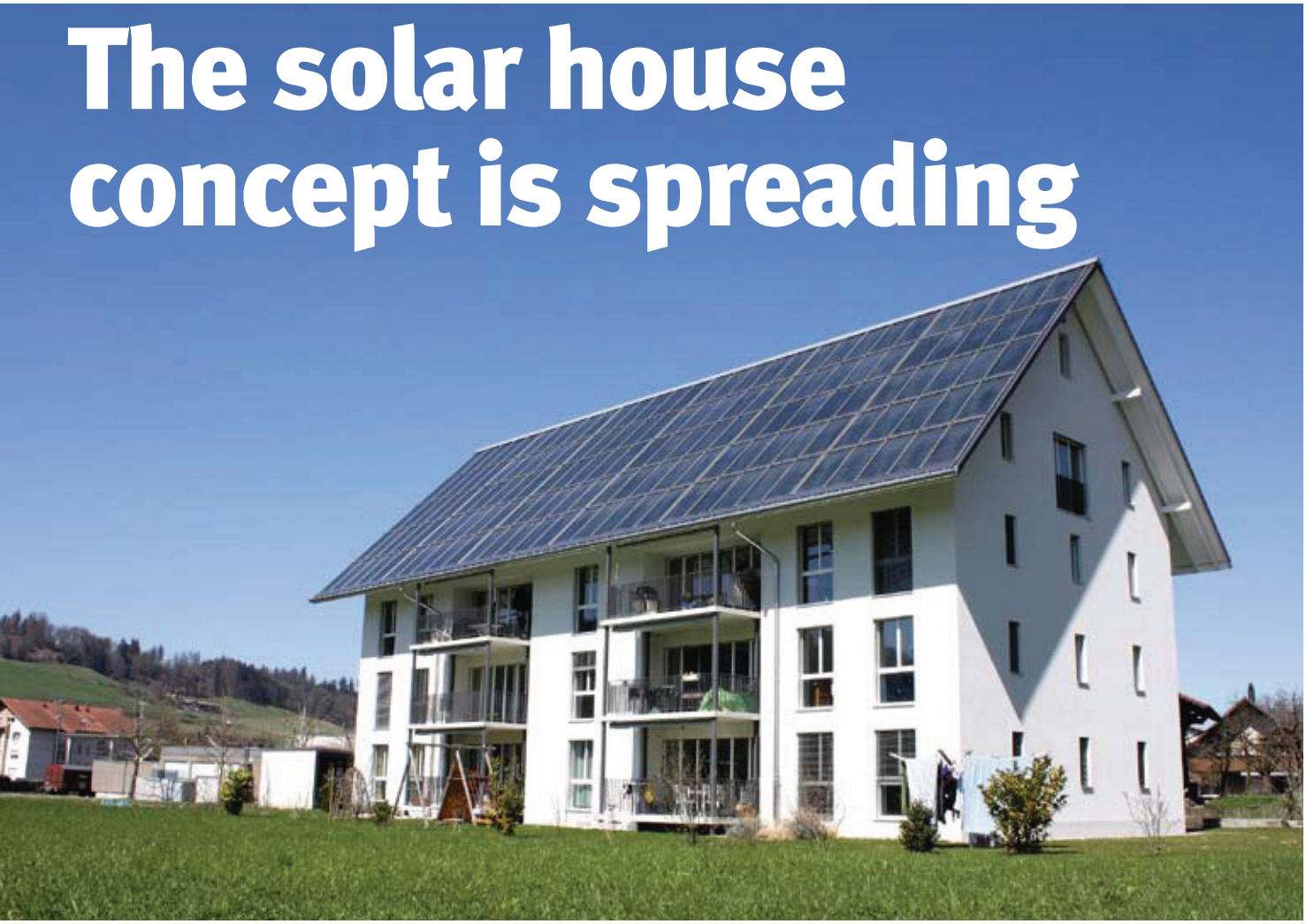
The solar house concept is spreading



In August 2007, the solar house pioneer and building owner Josef Jenni opened this multi-family dwelling with eight apartments, which is heated exclusively by solar energy. Two further buildings based on the same construction and heating concept are set to follow. Their collector areas and storage tank volumes will be 40 % smaller, however. Photo: Jenni Energietechnik

For a long time, houses mainly heated by solar energy were the domain of a few German solar companies. Now, research institutes have begun working on the solar house, and the Austrian brick industry wants to spread knowledge of this house concept in its country.

Some day, Erwin Jenni from Oberburg in the Swiss Canton of Bern may well find himself living in a historic, listed building, since Jenni lives in the "Oberburger Sonnenhaus" (Oberburg Solar House). This is the very house with which his brother, the storage tank manufacturer Josef Jenni, made headlines throughout Europe in 1989. Although there had previously been a few projects from research institutes and private persons, this was the first attempt at implementing the concept of a house that is mainly heated by solar energy on a commercial basis. Occasionally, Josef Jenni still has to listen to mockery regarding the big water tank, but generally his house concept receives more appreciation today than ever before. Energy-saving building concepts are in great demand. In 2020, almost-zero-energy houses will be compulsory. Due to this development, the solar house has become established as one of the diverse energy-saving building concepts now in use. The great breakthrough has yet to happen, but at least the solar heating concept has now left the eco-niche and is being evaluated on a scientific basis.

At least 50 % solar

According to Jenni's definition, at least half of a solar house's heating energy requirement for hot water generation and room heating should be covered by solar energy. A standard solar house with 150 m^2 of living space and a solar fraction of about 70 % has a collector area of 40 m^2 on the south-facing roof and a water tank with a volume of 8 m^3. In the ideal case, the inhabitants use pellets or wood logs for the additional heating. In this way, it is possible to meet a primary energy demand of around 15 kWh per m^2 and year for hot water generation and room heating. It is the goal of the solar house pioneers around Jenni to have the lowest primary energy demand of all the low-energy houses.

"Switzerland has caught up", says Josef Jenni with regard to the dissemination of his house concept. "Even in this country, the concept is now spreading quickly." But he does not specify any concrete figures for projects in Switzerland. So far, most solar houses have been built in Germany, Jenni continues.

Martin Leitl, the Managing Director of the company Bauhütte Leitl-Werke GmbH in Eferding, Austria, started his commitment to solar houses in Austria with this "Vital-Sonnenhaus". The multi-purpose building generates more energy than it consumes. On the south façade, 108 m² of solar collectors are installed. Inside the building, there is a 27,000 litre buffer storage tank. Photo : Bauhütte Leitl-Werke

As one of just a few manufacturers of large-scale storage tanks, he owes this progress primarily to the "Sonnenhaus-Institut" (solar house institute).

Germany is leading

The Sonnenhaus-Institut was founded in 2004 by the South-German solar companies Hartmann Energietechnik, Soleg and Solar-Partner-Süd as well as the architect Georg Dasch from the town of Straubing, and now has 250 members, including collector manufacturers, installation companies, architects and an increasing number of building contractors. According to the institute's manager Peter Rubeck, about 750 projects have been realized so far. The statistics include new buildings as well as renovations, and private homes as well as commercial buildings.

The members of the Sonnenhaus-Institut have often been confronted with criticism that the concept was primarily suitable for new buildings and single-family homes, but in the meantime there are dozens of examples of solar renovations of old buildings. The institute defines these as existing buildings that have been retrofitted sufficiently to reach a solar fraction of over 50 %. There is now also a selection of commercially used solar buildings.

One example is the "Vital-Sonnenhaus" belonging to the company Bauhütte Leitl-Werke GmbH in Eferding, Austria. The office building with an event and exhibition area gains more solar energy than it needs to cover its annual requirement for heating energy and warm water. For this purpose, 108 m² of solar collectors are installed on the south-facing façade. Inside the building, there is a buffer storage tank with a volume of 27,000 litres. The brickwork walls, 50 cm thick and made from the "Vital-Ziegel" bricks developed by the company Leitl, ensure a high level of heat insulation. The calculated annual solar yield is 30,000 kWh, which is twice as much as the entire energy needed by the building with its 660 m² of useable floor space. Leitl supplies the excess energy to the neighbouring building, which is connected via a district heating system.

Now also multi-family houses

Recently, the first companies have proved that the concept is also suitable for houses for several families. Once again, solar house pioneer Josef Jenni was the initiator. In 2006/2007 he built what he claims to be the first multi-family dwelling in Europe that is heated exclusively by solar energy. Like the "Oberburger Sonnenhaus", it was erected in the immediate vicinity of the company headquarters.

The building has eight apartments and a collector area of 276 m². The storage tank holds 205 m³ of water. The building application for the next two houses following the same pattern has been submitted, but Jenni already knows what he is going to change in these houses. "The system in the first multi-family dwelling is overdimensioned by a factor of two", he says. He is still aiming at a solar fraction of 100 %, but the collector area and the storage tanks of the new buildings will be 40 % smaller.

On the basis of the enquiries that he gets, he observes that more multi-family houses are being built or at least being thought about. "The demand for large storage tanks is very high", says Jenni. "If all these projects are actually realized, we will have a problem." Therefore, he is glad that his new production hall is currently under construction. Last year, he delivered a large tank for a multi-family house about every two months. But the projects still require a lot of advice and persuasion, Jenni notes with a little regret.

In Germany, two multi-family houses that are heated only by the sun were built in Upper Bavaria last year. The project was initiated by the building cooperative "Selbsthilfe Salzachkreis Baugenossenschaft Laufen", which is managed by Alexander Stockhammer. Twelve rented flats with a total living space of 1,400 m² were built. On the roofs of the highly insulated buildings, 270 m² of solar collectors are installed, with another 62 m² on the façade. Each of the two buildings holds a

Night view: "Vital-Sonnenhaus" Photo: Sonnenhaus-Institut e.V.

77 m³ storage tank (14 m high, diameter 2.7 m). The solar installation is connected to an existing district heating system. This allows the two multi-family houses to supply their neighbours with the surplus heat that is produced on sunny days.

The first so-called "energy self-sufficient house" also emerged from the sphere of the Sonnenhaus-Institut. It is located in the show house area of the construction company Helma Eigenheimbau AG in Lehrte, Germany, and is a joint project of Helma, Timo Leukefeld and Sunstrom GmbH, Dresden. They presented the house to the public at the beginning of May.

The emphasis of the project is on energy self-sufficiency. It aims at providing the inhabitants with electricity and heat independently of the public grid. 46 m² of solar collectors ensure a solar fraction of 65 %. For additional heating, the project partners have included in their plans 2 m³ of wood per year. Electricity is supplied by 58 m² of photovoltaic modules (8.2 kW), which are installed on the same roof below the collectors. The power they generate is consumed directly by the residents or stored in an accumulator for later use.

Helma Eigenheimbau has been offering turnkey solar houses according to the Jenni concept for quite some time already. Now, the company, which is active Germany-wide, wants to raise interest in the energy self-sufficient house among a broader public. Dasch and Jenni have noticed a development that should be helpful in achieving this goal. "It is no longer just a topic for the greenies", Dasch says with satisfaction. "It is increasingly Mr. Average who is interested in a solar house."

Scientific evaluation is planned

The first independent advocate from the solar industry that the Sonnenhaus Institut found is probably Gerhard Stryi-Hipp. As the manager of the German Solar Industry Association, he spoke up via this solar thermal technology platform for the vision of a house that is heated completely by the sun. He initiated the special exhibition Solarhaus 50+, which presented the concept of heating with a high solar fraction for the first time at the Intersolar 2009 and 2010. In 2009, Stryi-Hipp

This is module 2 of the Montessori Campus in Marchegg, Lower Austria, which was planned by the architect Martin Rührnschopf from Vienna. The module is designed as an active solar house with a solar fraction of 85 %. Rührnschopf wants to compare it with module 1, which is built as a passive house and heated using a heat pump. Photo: Martin Rührnschopf

changed jobs and went to the Fraunhofer Institute for Solar Energy Systems (ISE), where he is now the head of the research group "Thermal Collectors and Applications". In his new position, he developed the research project HeizSolar, which is supported by the German Federal Ministry for the Environment. The project partners also include the SWT Stuttgart, which is affiliated to the University of Stuttgart, as well as Ilmenau University of Technology and the Sonnenhaus-Institut.

The research institutions are going to collect data from nine buildings with solar fractions of between 50 and 100 % in various regions of Germany and develop a simulation model for solar houses. "On the basis of the measured data, we will find out how well heating with high solar fractions works in practice. The measurements will also serve the purpose of testing our simulation model, which we are going to use to look systematically for the existing optimization potential in the solar houses. In this way, we will create the basis for a serious scientific assessment of this heating concept", says project manager Stryi-Hipp. To date, the market is based on the experience of planners and engineers, but a sound scientific examination of the heating concept is still needed in order to achieve a breakthrough.

"Another goal of the project HeizSolar is the classification of solar heating within the range of the other future-oriented house concepts with a low primary energy demand and low CO_2 emissions, such as extremely low energy houses, passive houses or plus-energy houses", he continues. The methods that are needed for a fair assessment will be developed in the project. "Furthermore, we want to hold workshops together with the industry in order to discuss the knowledge about solar heating that we acquire in the project and to spread this knowledge by providing information material", Stryi-Hipp goes on. His scientists are currently preparing for the measurements together with the installers and the homeowners. The monitoring will begin before the onset of the coming heating period.

GRP storage tanks

Ilmenau University of Technology in Thuringia, Germany, has already discovered an area of potential optimization, starting from a point of criticism of the Jenni concept that has frequently been put forward. This relates to the unique feature of Jenni's concept, the large-volume steel tank for water storage. According to many critics, the steel tank takes up too much space in the building. This is also the opinion of Jürgen Bühl, the head of the research group "Regenerative Energy, Application and Environmental Technology" at Ilmenau University of Technology. Together with partners, he started as early as 1995 to develop a storage tank made of glass fibre reinforced plastic (GRP).

The current model of pressure-resistant heat storage tank has a volume of 2 to 4 m^3. "The GRP pressurized heat storage tank costs the same as a comparable steel tank at present, but it has advantages in use", says Bühl and starts listing them. "The materials of the inner wall are approved for drinking water without any need for enamelling." In addition, the tank has a very low weight. The current version of the unpressurized heat storage tank with a volume of 300 m^3, for example, has a gross weight of 6.5 tons. The maximum weight of the individual components is 370 kg. "Welding is not necessary, since the individual parts are laminated together. On top of that, the tank can be recycled." And that is not all: "There are more possibilities regarding the geometric design. Apart from the common cylindrical shape, for example, angular storage tanks are also possible, which can easily be integrated into existing rooms", says Bühl.

No GRP storage tanks based on this model have been installed in solar houses yet, but the group around Bühl is considering storage tanks with volumes ranging from 2 to 35 m^3 for houses largely heated by solar energy. At the company Verbundwerkstoff- und Kunststoffanwendungstechnik (VKA) GmbH in Schönbrunn, the investments are just being made, reports Jürgen Bühl. "In the autumn, fully automated production will start. The series that will be available from October onwards is designed for 1 to 35 m^3 of storage volume."

He does not believe that new storage technologies will replace the water storage tanks in the solar houses soon: "In the short term, there is no way around hot water storage tanks. Other technologies still need more time."

Initiative in Austria

Meanwhile, the Austrians still rely on the classical Jenni concept. So far, the country has been known as a stronghold of passive houses. A group of people around Martin Leitl, the Managing Director of the company Bauhütte Leitl-Werke GmbH in Eferding, a provider of bricks and other building materials, wants to change that.

Leitl and his partners got to know the solar house through the German Sonnenhaus-Institut. They recognized it as an opportunity to sell their bricks

together with an energy-saving building concept. The foundation of the "Initiative Solar House Austria" is currently under way.

"As a neutral and independent association, we want to promote the concept of the solar house in Austria", says the initiative's manager Peter Stockreiter. "We want to raise awareness of this concept among the end customers." The association seems not to be totally independent, however. Just as the supporters of the passive house concept include many companies from the insulation industry, the Austrian brick industry seems to have created a platform for itself here. The ten founding members include the companies Wienerberger Ziegelindustrie GmbH, Bauhütte Leitl-Werke GmbH and various other brick manufacturers. The programme comprises information events, training sessions for installers, studies and information exchange. When asked how his association differs from the German Sonnenhaus-Institut, Stockreiter said: "We want to place emphasis on informing the end customers."

A solar house and a passive house in one

A project that was realized by the architect Martin Rührnschopf from Vienna should be interesting for the advocates of the solar house and the passive house alike. For two private customers, Rührnschopf designed the "Montessori Campus" in Marchegg, Lower Austria. The private school was erected in 2009 and 2010 in several steps and from several modules. The core modules are insulated according to the passive house standard. Beyond that, the first two modules differ in the ways in which they are heated.

Module 1 was built in 2009 as a wooden lightweight construction. The building is heated using an air-water heat pump. The second building (module 2) was set up in the following year. It has brick walls and 40 m^2 of solar collectors on the roof. The collectors feed the solar heat to a massive ground plate (solar concrete core activation). This in turn stores the heat and gradually releases it to the rooms via the walls and the floor. The remaining heating energy demand is covered using a pellet-burning stove inside the building with a capacity of 6 kW. The heated floor space in this module is 200 m^2, and the solar fraction is 85 % according to the architect.

"Module 1 is a classical passive house with a heat pump, module 2 is an active solar house", says Rührnschopf and adds: "We want to compare and scrutinize the concepts". Therefore, he is going to collect data from both modules, which function independently of each other. Of course he knows about the dispute between the Austrian passive house faction and the solar house faction. "I couldn't care less about it", comments Rührnschopf. "There is no such thing as the 'only' true concept." Nevertheless, Josef Jenni will be pleased if more solar companies, architects and planners follow his ideas.

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