In 2030, many homes will be heated using only solar thermal

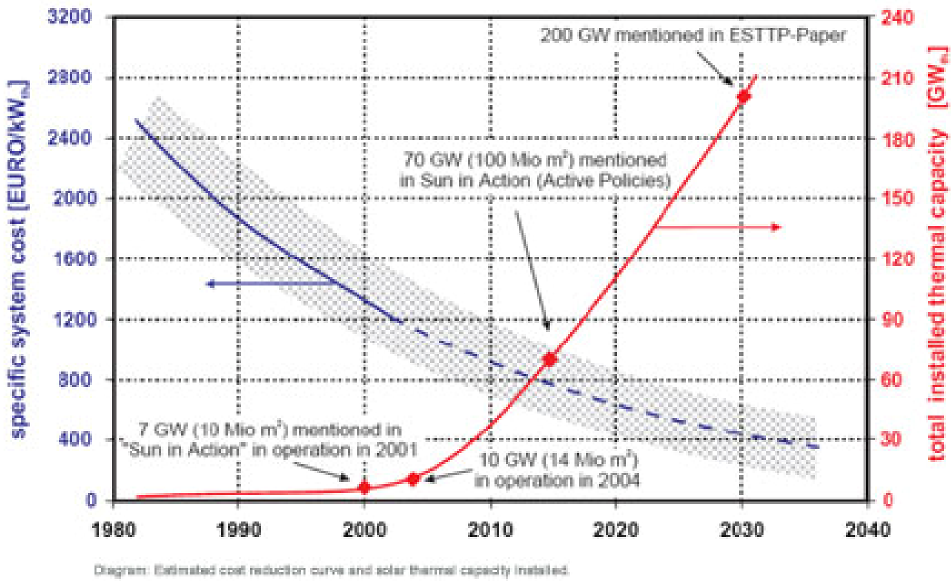
At 49%, heating comprises almost half of the European energy demand. In comparison, only 20% is used for electrictrical gerneration and 31% in transportation. Due to the increasing dependence on imports and the exploding prices for heating oil and natural gas, politicians and consumers are becoming more aware of the importance of our heat supply. More and more home owners are concerned about how they can heat their homes in the future in a reliable, affordable and environmentally responsible manner. This presents an intriguing question: What roll will solar thermal play in the future of our heating supply? The newly founded European Solar Thermal Technology Platform, ESTTP, is adamantly pursuing this question. Experts at ESTTP are convinced that solar thermal is capable of covering over 50% of heating demands up to 250°C in Europe over the long term and call for the intensification of technological development and acceleration in the expansion of solar thermal use.

Technology platforms are a strategy used by the European Commission to systematically promote the development of trendsetting technologies, to preserve the European technological advantage in research and industry and to strengthen innovation. At such platforms, industry, research and policy work together. The goal is to formulate a mutual vision for these technologies and thereby compile a research and development strategy for the next few years. This cooperation will drive the efficient, goal-oriented application of public and industry research funds. As of now, there are 30 official European technology platforms; examples are nanomedicine, sustainable chemistry, road transportation, nanoelectronics, forestry, civil engineering, and photovoltaics. A platform for wind energy is being developed and the solar thermal technology platform is in the process of being official recognized (see http://cordis.europa.eu/technology-platforms/home_en.html).

Until now, solar heating has only been used for domestic water and to supplement space heating in private homes. This reduces energy demands, helps limit the rising costs of heat and is therefore a logical first step. Additionally, a typical combination system in Germany would cover 25 to 30% of the total heating needs of a home insulated according to the Heat Insulation Ordinance. Gas, oil and more and more frequently wood pellets are used to cover the rest of a home's heating demand. If solar thermal remains limited to these uses, it could contribute to only a modest percentage of the heating supply. Therein is the danger that interest from industry and consumers will be turned to strengthening other technologies like heat pumps and fuel cells.

In the opinion of ESTTP experts, the potential for solar thermal and its development have long been grossly under appreciated. Solar thermal will play an important roll in concert with sustainable heat generators, when its technological potential is successfully developed. Then the advantages of solar heating will be clear: the solar supply is stable and dependable, available everywhere in large portions and its use does not result in harm to our climate or dependence on imports. It is clear that solar thermal technology must be further developed.

European solar thermal experts have compiled a preliminary solar heating vision for the start of the ESTTP: New buildings will be 100% heating through solar as a standard by 2030. For existing homes, solar renovations resulting in well over 50% solar coverage will become a cost effective refurnishing option for both single and double family homes as well as in multiple family residences. In addition to this, solar thermal will be applied where heating up to 250° is needed; in hotels and hospitals, in industry and production hereby delivering not only heat, but also cooling by powering cooling units.



The use of solar thermal is expected to increase rapidly if costs continue to decrease. (Image: BSW)

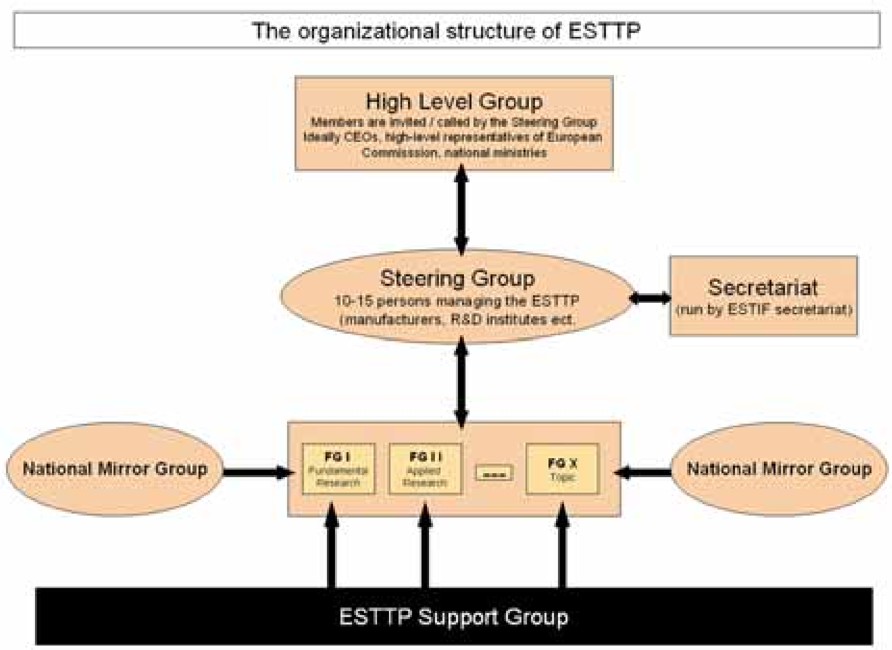
Founding of the Solar Thermal Technology Platform with Energy Commissioner Andres Piebalgs

Work began on the European platform in May 2005 at a workshop in Freiburg, Germany, where researchers and industry agreed on a cornerstone vision for Solar Thermal 2030. The result was the development and refinement of this concept by a team of European authors and then in December, this plan was brought to discussion in front of a group of European experts. The final version of the solar thermal vision for 2030 has been available since May 2006 and clearly states how diversely solar thermal can be applied in the future and it illustrates the expanse of upcoming research and development work. Of the 49% of the EU energy demand used for heating, about 80% of this underneath 250°C and can, in principle, be met through solar thermal systems. Important issues are therefore centred around solar water heating, solar space heating, local solar heating, solar cooling and the availability of solar process heat.

One year later, the official founding of the European Solar Thermal Technology Platform, ESTTP, took place in Brussels on May 30th. The significance of the platform was reinforced by the presence of and a presentation from EU Energy Commissioner Andres Piebalgs. He praised the creation of the platform and emphasized that solar thermal will be an important contributor towards a sustainable and competitive energy policy in Europe. He is convinced that the Solar Thermal Technology Platform will be a significant boost for the solar sector, which has ample potential for further development. As of now, the installed area of solar thermal collectors in Europe is 15.5 Mio m², well under the goal envisioned by the EU in the 1997 White Book of 100 Mio m² by 2010. Appropriate actions must therefore be intensified. The current EU percentage of the global market for collector production is only 10%. Increasing this percentage and maintaining European technological leadership have to be given high priority. The EU must develop a high number of innovative products, for example a new generation of collectors, storage devices, and new heating and cooling systems for domestic, commercial and industrial use. The platform will be an important driver for the development of solar thermal and the EU Commission, together with the solar sector, will successfully create a position for solar thermal to which it is are entitled to.

In the next two years, the ESTTP will further solidify their solar vision and expand the requisite research and development steps. The work of the

ESTTP is divided into three focus groups with the themes "Solar Thermal in Buildings", "Solar Thermal in Industrial Uses", and "Market Development and Market Implementation Strategies." These groups will then be divided into work groups to focus on more detailed questions.



The organizational structure of ESTTP. (Image: BSW)

Once a year, a meeting of all members of the ESTTP support groups will take place. All persons interested in the development of solar thermal can become members. Over 100 businesses, researchers and experts are registered members. ESTTP membership is free and can be obtained at www.esttp.org. The first full meeting of members will take place in Brussels on December 6th, at which the focus groups will discuss their technological vision and work groups will be created. They will establish concrete focus points for research and devise strategies for implementation. After two years, a detailed vision for solar thermal in 2030 and a corresponding research strategy should be on hand.

Activities will be directed by a steering committee comprised of experts throughout Europe from industry, research and policy. The office will be co-jointly administrated by the European Solar Thermal Industry Federation, (ESTIF) and the association of research institutions, European Renewable Energy Centres Agency (EUREC). National mirror groups play an important roll by discussing suggestions from the platform in individual countries and carrying out the legwork for the EU level and in doing so contribute to the coordination of national level research policy to that of the European level.

Germany Sees Big Opportunities with the Platform

At the November 2005 coalition convention, it was already clear that the federal government would pay special attention to heat derived from renewable energies in the future. So it was there agreed upon, among other things, that the market potential for renewable energies in the heating sector should be opened for further developed. The Environmental Ministry (BMU) therefore openly supports the ESTTP and the supervising departmental leader for research at the BMU, Joachim Nick-Leptin is a member of the platform steering committee. As a first step, the BMU has already begun to markedly increase funding for solar thermal research this year. It is planned to increase the current research funding for renewable energies from 83 million Euros by 5 million Euros per year until 2009. German solar industry and research also attributes significant meaning the ESTTP. The German Solar Industry Association (BSW) and several research institutions were initiators of the ESTTP.

A Variety of Research Issues

In the „Solar Thermal Vision 2030", future sectors for application and research agendas were broadly outlined. The fundamental points will be described in the following. A fundamental task for every sector is to lower the price of solar thermal, to be achieved through technological development and mass production. The price per kW of solar heating capacity in central Europe could have already been reduced from about 1.800 Euro to nearly 1.100 Euro in the last 15 years. By 2030, a further reduction to almost 400 Euro per kW of thermal capacity is expected. At least 200 gigawatts of solar thermal capacity should be installed in Europe by 2030, 20 times more than the current 10 GW, which corresponds to 14 million m² of collector area.

Vision 1: New Buildings Exclusively Heated from the Sun

Home owners desire environmentally friendly heating without a dramatic increase in price and without a dependence on imported energy from unstable areas in the world. Solar energy is the ideal energy source; it is available everywhere for everyone, inexhaustible and free. In the run of a year of course, yet unfortunately, not during the dark, cold winter months does the sun have enough strength to heat our homes directly. Therefore, it is necessary for a nearly or completely solar heated house to have a heat storage device that can store solar heat over the course of many months. Single family homes with so called seasonal water storage have been around since the beginning of the 1990s. In modern buildings these storage devices are between 10 and 30 m³ large. In the past they were significantly larger with collector surfaces over 50 m^2 and able to account for between 70 and 100% of total heating demand. Since storage devices cost money and space it is only logical to install a solar heating system requiring a large surface area into a well insulated house. Quite a few homes have been built that prove the functionality of this concept (see www.sonnenhaus-institut.de (only available in German).

The goal of the solar branch is this: An "active solar house", heated up to 100% by the sun, will become a standard in the construction of new buildings. The aim to this end, is therefore to reduce the volume of the solar storage device. Experts at the ESTTP believe it is possible to increase the capacity of a storage device by a factor of eight through the use of alternative heat storage materials such as phase changing mediums or thermochemical storage devices. With the application of highly efficient heat insulators for the storage device, vacuum insulation for example and the optimizing of system technology, the net volume of the storage device can be further reduced. In the long run, a 1.000 liter storage device should allow a single family house to be completely solar heated.

Experts from the technology platform also believe that it is possible to use conventional building structures, such as roofs or walls, as storage mediums. Along these lines, a facade design is being conceptualized, for example, that would absorb solar energy through an outer collector, transfer the heat to a storage medium in the wall and then emit heat to the inside of the room as is needed.

Vision 2: The Challenge of Building Modernization

The big challenge in the next decade in respect to the declining birth rate is not the construction of new buildings, but rather the renovation of existing structures. With out a doubt, the number of existing buildings in its entirety must be thermally insulated in order to begin to reduce the dramatically high heating demands. This presents an opportunity to tap into the synergetic effect of (passive) insulation combined with the active use of solar energy. The ESTTP vision is that through the renovation of the roofs and facades of existing buildings, auxiliary modules can be fixed to a building that will act simultaneously as both heat insulator and solar medium. This option will be significantly more affordable than separate elements. These modules can be used as a heating source for water through air or water collectors and also as an electricity source through photovoltaic modules. Standardized connections will allow modules to be combined as desired. With this system, roofs and facades will be transformed into solar receivers and thereby into energy sources.

The complete solar heating of a building requires an architectural design that, for example, incorporates large, south-facing windows to facilitate the use of passive solar heating. Since this condition is not often at hand in most buildings and because many homes are partially shaded, a completely solar heating building will not always be possible. None the less, the goal is to account for the remaining heating demand by more than 50% through solar thermal.

Vision 3: Solar Thermal to 250°C in the Commercial Sector

Today, over 90% of solar thermal is installed in single and multiple family homes. In the future, the use of solar heating can be applied in other, non-private applications in which low temperature heating is needed: in small, multiple family houses with a few dwelling units, to large apartment complexes, in hospitals and rest homes, in hotels and guest houses and in office buildings as well as in commercial and industrial operations. Many of these buildings are located in dense residential and commercial areas where the available roof and facade surfaces do not capture enough sunlight to allow for a desirable degree heating demands to be met with solar thermal. Everywhere – except for where they are already available- proximal and remote district heating grids will be built, into which solar heating can be fed. There are currently ten solar thermal district heating grids in Germany that have a large, integrated seasonal heat storage of up to 20.000 m^2 of water allowing them to stockpile solar heat produced in the summer for the winter. Solar proximal heating grids and seasonal storage are necessary to provide a high proportion of solar heating, near 30%, and to supply more of the net heating demand.

Furthermore, there are high hopes for solar cooling. Through this, solar heating will be applied to power absorption or evaporative cooling units. Over 50 solar cooling systems are already on-line on Europe, one example being the Federal Public Relations Office in Berlin. Unfortunately, there are only cooling units designed for large-scale use and costs are still significantly higher than conventional technologies.

A solar cooling machine. (Photo: Phönix)

However, much work is being done on developing small, compact units that can be installed into office buildings and also into single and two family homes in the future. The goal is to create compact units that use solar energy to cool in the summer and heat in the winter. In light of increasing warmer summers, a comparatively large market is expected in Germany.

For applications requiring higher temperatures up to 250°C, high temperature collectors will be developed, consequently opening up a new application sector for trade and industry.

Research and Development Tasks – Collectors

In order to realize the described applications and to lower costs significantly, solar thermal components and system technology must be considerably further developed. Examples are mentioned below.

High temperature collectors that can generate up to 250 °C are still a challenge for R&D. (Photo: Langrock)

The room for the improvement of solar collectors, in terms of their power capacity is already well beyond exhausted. Significant improvements were achieved in the past with the help absorption coatings and collector glassing techniques. Highly selective sputtering absorption laminates and antireflection coated glass surfaces increased the efficiency of solar collectors by more than 10%. An important detail of collector technology is the absorption material and connection technology between absorbers and absorber tubes that contain the thermal transporting medium. Until recently, copper was the primary absorption material, but due to a heavy increase in the price of copper, the prevalence of aluminium absorbers has recently increased. The bases for this are new laser welding techniques that permanently and reliably bind different materials – aluminium for the absorption plate and copper for the absorption tubes. The trend towards laser welding processes continues, because it is through improved absorbers and collectors that higher and higher cut-off temperatures are able to be achieved.

Cost reduction should result from the further automation of collector production and above all, through the application of new materials. In the construction of flat collectors for example, work is being done on roof-integrated wood framed and composite plastic collectors. In various businesses and institutions the application of plastics are being investigated that, until now, have failed to show the proper mechanical, electrical and optical characteristics. The application of ceramic insulation materials or metallic foams in solar thermal systems has been research only recently. Products of nanotechnology research that could further increase collector efficiency by making the glass surface grime repellent are also in the test phase.

The development of high temperature collectors able to reach 250°C, which could be used to cooling and other industrial processes, present a new challenge. The first pilot systems of flat collectors with more anti-reflection glass plates or small parabolic collectors are currently being built. Aside from flat collectors, various new vacuum tube collectors are also being developed.

A substantial challenge for the development of collectors is, above all, the long-lasting and architecturally attractive integration of collectors into roofs and facades. Synergy effects, which can be achieved through the combination of thermal insulation with other elements in the building envelope such as skylights or photovoltaic modules, for example, are therefore desirable. Presumably, a set standardization of collector dimensions and interconnections will be available, making it easier to combine products.

Storage Technology and Thermal Regulation

Thermal storage is the key component to the strong, target-oriented spread of solar thermal use. New materials and concepts are being tested, but even more intensive research efforts are needed before storage devices with an even higher storage capacity are available. Until then, water-based thermal storage devices will continue to dominate the market. With respect to the many advantages of water-based thermal storage, this is not an issue. Water is cheap, non toxic and possesses a comparatively high heat capacity.

How great the end contribution of solar thermal systems will be to heating supply depends largely on the regulation of heat between the solar thermal system and conventional heating system. In non-optimized systems, a large portion of the solar catch can be lost due to the insufficient uptake and discharge of the storage device caused by circulation losses and through poor regulation between of the solar system and the central boiler. With smaller systems, the greater part of the thermal regulation occurs within a potable water or combination storage device. This is how the solar branch brought about innovative concepts over the past 15 years, for example, stratified storage devices with injection pipes, with internal and external heat exchange or with tank in tank storage. Some manufacturers have also integrated the storage device into the burner. These concepts will be further developed and optimized in the future to ensure greater efficiency, higher capacity and more reliable operation.

In larger solar thermal systems pumps regulate the thermal medium and the uptake and discharge of heat. Theoretically, this allows for the process to be better controlled, however experience from a number of systems shows that the complexity of the hydrological processes is grossly underestimated and that many well-intended regulation strategies fail to function because of unanticipated side effects. Therefore, system engineering is a central topic for research and development in the coming years. This includes optimized hydraulics, optimised regulation strategies and above all the interplay between solar thermal systems and conventional boilers. The more complete the hydraulics are upon delivery to the site and the more completely they are integrated into the system, the greater the probability that the system functions optimally. Today, the first ready-made hydraulic units are offered under the name “Solarenergiezentrale” (Solar Energy Central), or “SolvisZentro“. The continued development of this approach– in combination with further the optimization of solar storage devises – is a key challenge for the future.

Development of additional Components

In previous years, the optimization of single components within a solar thermal system that have up until now received far less attention, enjoyed a much greater focus. For example, substantial advances are being made in pump technology. Previously, heat pumps designed for high flow rate under low pressures were used. In solar thermal systems however, low flow rates and high pressures are needed. Thus, the optimized solar pumps of today require 20% less electrical energy compared to earlier pumps that had been used. Well-designed pumps can automatically adjust the delivery rate to differences in pressure or temperature.

New solar pumps require up to 80% less energy. (Photo: Wilo)

To transport solar heat from the collector to the storage device, easy to install and well insulated solar conductors were developed from either copper or stainless steal tubes. In the future, more affordable and ever easier to install connection materials will be applied. Ionic fluids as heat transfer mediums are under investigation. Work is being done to create tubes, fixtures and safety devices with special attention to the continuously rising temperatures within the solar loop.

ESTTP expedites Development

The number of tasks mentioned clearly illustrates that an intensification of research and development activities in the area of solar thermal is absolutely necessary to achieve these ambitious objectives. Through the European Solar Thermal Technology Platform (ESTTP) a framework to systematically identify development potential will be created. The ESTTP will significantly contribute to the intensification and coordination of research and development activities and to networking between researcher, industry and policy. The involvement of all solar thermal experts at the European level is possible through a support group or in one of the work groups. Over the next two years, national watch groups will promote discussion in Germany and call for experts to convene more often. From this basis, it is expected that solar thermal, whose promise and potential has been under appreciated for many years, will experience a marked increase in its rate of development and thereby the technological foundation for a strong expansion in the use of solar thermal will be created.

Quick Reference

The European Solar Thermal Technology Platform (ESTTP) was founded in Brussels on May 30th, 2006. Its purpose is the creation of a vision for the application of solar thermal in the year 2030, the development of a research strategy to meet this vision and to facilitate the realization of this research strategy.

At the founding of the ESTTP, the "Solar Thermal Vision for 2030" was released. This vision includes potential applications for solar thermal and describes fields for research and development. The document will be solidified over the next two years and individual tasks for development will be described in further detail. The Solar Thermal Vision is available to download at www.esttp.org.

Persons involved in the solar thermal industry and research are invited to take part in the work of the ESTTP as a member of the support group or as a participant in any of the work groups. Membership is free of charge and can be established at www.esttp.org.

The introductory meeting of the ESTTP will take place in Brussels on December 6th, 2006, at which work groups will be formed. All members of the support group are invited.

The founding of a national watch group in Germany is planned to take place soon. Here, preparations for the ESTTP on the national level will be discussed and solutions from the German level will be addressed. These solutions will then be presented as suggestions to further the purpose of the ESTTP. Also planned is the calling together of solar thermal experts and the creation of work groups. Activities will be co-jointly organized by the German Solar Industry Association

(BSW) and the Solar Thermal Research Institution and funded by the Federal Environmental Industry.

More detailed information about the ESTTP at www.esttp.org or from BSW, Jan Knaack, Tel: 030 2977788 37, email: knaack@bsw-solar.de .

Author

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A German version of this article was published in the German magazine SBZ on 2 October 2006.

(http://service.gentnerverlag.de/download/pdf/sbz/viele_haeuser.pdf)