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Newsletter of the International Energy Agency Solar Heating and Cooling Programme

SHC INTERNATIONAL ENERGY AGENCY Solar Heating & Cooling Programme

solar heat worldwide

solar thermal continues to heat up

Installed solar thermal capacity grew by 9% around the world in 2007. Solar thermal power output reached 88,845 GWh, resulting in the avoidance of 39.3 million tons of CO2 emissions. These are some of the key stats tracked by the SHC Programme in this year's report, Solar Heat Worldwide: Markets and Contributions to the Energy Supply 2007. To find more detailed analysis on the market penetration of solar thermal technology in the 49 documented countries representing more than 85% of the solar thermal market, go to www.iea-shc.org.

Solar Thermal Capacity in Operation Worldwide

At the end of 2007, the installed solar thermal capacity worldwide equalled 146.8 GWth or 209.7 million square meters . The breakdown by collector type is:

- 120.5 GWth - flat-plate and evacuated tube collectors
- 25.1 GWth - unglazed plastic collectors
- 1.2 GWth - air collectors

Distribution by Application

The use of solar thermal energy varies greatly by country. In China and Taiwan (80.8 GWth), Europe (15.9 GWth) and Japan (4.9 GWth), plants with flat-plate and evacuated tube collectors are mainly used to prepare hot water and to provide space heating while in North America (USA and Canada) swimming pool heating is still the dominant application with an installed capacity of 19.8 GWth of unglazed plastic collectors.

It should be noted that there is a growing unglazed solar air heating market in Canada and the USA aside from pool heating. Unglazed collectors are also used for commercial and industrial building ventilation, air heating and agricultural applications.

Europe has the most sophisticated market for different solar thermal applications. It includes systems for hot water preparation, plants for space heating of

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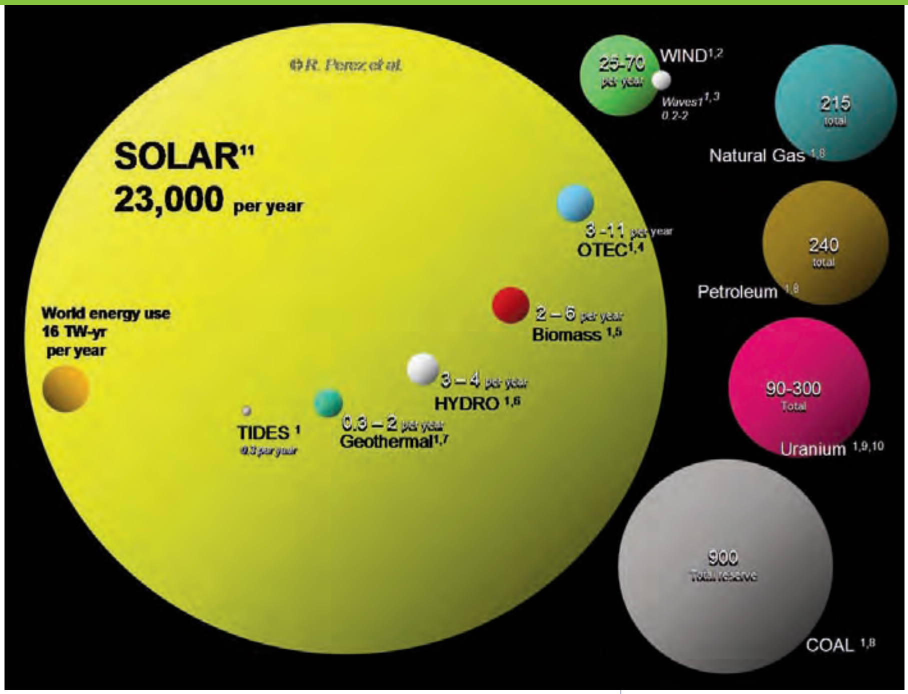
the world's energy reserves

a fundamental look

Global warming, fossil fuel depletion, the growth of large new economies, and the latent risks of terrorism and international conflict are weaving an uncomfortable stranglehold on the world's energy outlook. This is reflected by an extreme volatility in energy commodity prices and associated economic disruptions, superimposed over long-term environmental worries.



Comparing finite and renewable planetary energy reserves (Terawatt-years). Total recoverable reserves are shown for the finite resources. Yearly potential is shown for the renewables.

The International Energy Agency, through its programs such as Solar Heating and Cooling, is actively working to advance the new energy technologies and strategies needed to meet future demand while reducing dependence on the liquid fossil fuels that currently drive the planet's economies.

Often cited alternatives include clean coal, nuclear, and an array of renewable options: hydropower, biomass/biofuels, geothermal, ocean thermal energy conversion, waves, tides, wind, solar, etc. In the eyes of leaders and decision makers, developing such a mix of alternatives is a reasonable approach to bring about the desired stable energy future -- akin to putting future energy eggs in different baskets. However this view presupposes that all alternatives have a comparable capability. Hence the purpose of this brief note: to step back and take a fundamental look at their respective potential.

The three-dimensional rendering in Figure 1 compares the current annual energy consumption of the world to (1) the known reserves of the finite fossil and nuclear resources and (2) to the yearly potential of the renewable alternatives. The volume of each sphere represents the total amount of energy recoverable from the finite reserves and the energy recoverable per year from renewable sources.

This direct side-by-side view shows that:

- The renewable sources are not all equivalent by far. The solar resource is orders of magnitude larger than all the others combined. Wind energy could probably supply all of the planet's energy requirements if pushed to a considerable portion of its exploitable potential. However, none of the others – most of which are first and second order byproducts of the solar resource -- could, alone, meet the demand. Biomass in particular could not replace the current fossil base – the rise in food cost paralleling the recent rise in oil prices and the resulting increase in the demand for biofuels is symptomatic of this underlying reality. On the other hand, exploiting only a very small fraction of the earth's solar potential could meet the demand with considerable room for growth.

- While coal reserves are vast, they are not infinite and would last at most a few generations if this became the predominant fuel, notwithstanding the environmental impact that would result from such exploitation if now elusive clean coal technologies do not fully materialize.

- Nuclear energy is not the global warming silver bullet. Reserves of uranium are large, but they are far from limitless. Putting aside the environmental and proliferation unknowns associated with this resource, there would simply not be enough nuclear fuel to take over the role of fossil fuels -- the rise in the cost of uranium that paralleled and even exceeded that of oil from 1997 to 2007 is symptomatic of this reality. Of course this statement would have to be revisited if an acceptable breeder technology or nuclear fusion became deployable. Nevertheless, short of fusion itself, even with the most speculative uranium reserves scenario and assuming deployment of advanced fast reactors and fuel recycling10, the total finite nuclear potential would remain well below the one-year solar energy potential.

In conclusion logic alone would indicate that the planetary energy future will be solar-based. There will of course be challenges, managing this locally variable -- but globally stable and predictable -- resource, in particular developing the necessary storage technologies and infrastructures. However, solar energy – as embodied by dispersed PV and CSP -- is the only quasi-ready-to-deploy resource that is both large enough and acceptable enough to carry the planet for the long haul.

This article was contributed by Richard Perez of the University of Albany, NY, USA, perez@asrc.cestm.albany.edu and Marc Perez of AltPOWER Inc., New York, NY, USA, marc@altpower.com. Richard Perez is an expert of SHC Task 36 Solar Resource Knowledge Management. This Task, led by David Renné, addresses the solar resource availability directly, and will provide a significant source of information regarding the true availability of solar resources that can be tapped into worldwide.

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Austrian ExCo Member Receives National Honor

PROF. GERHARD FANINGER, *our Austrian Executive Committee member, received Austria's Grand Decoration of Honor for Services to the Republic of Austria. This medal is presented to individuals who have served the public in an outstanding way and have a distinguished service record.*

As a pioneer of solar research in Austria, Prof. Faninger can be credited with formulating Austria's energy research platform. His work in this field began over 30 years ago when the Austrian government asked him to leave his industrial research job in Germany and return to Vienna with the directive to develop an energy research concept that could serve as a basis for future Austrian energy policy. As a result, Austria has a strong and viable renewables sector.

Since 1977, Prof. Faninger has worked in the area of renewables with a focus on solar thermal at universities and research institutes as well as in the industrial sector. As part of this work, he has represented Austria in the IEA's Renewable Energy Working Party and the Solar Heating and Cooling (SHC) Programme since it was established in 1977. As an active member of the SHC Programme, Prof. Faninger has initiated numerous international research projects.

One aspect of his work has been the market analysis of solar thermal technologies. Starting in 1977 Prof. Faninger began collecting and analyzing annual solar data from Austrian solar collector manufacturers. The value of this work is demonstrated by the SHC Programme taking the recommendation from Prof. Faninger to collect and analyze annual solar data from countries throughout the world. The SHC's 2009 edition of *Solar Heat Worldwide* includes data from 49 countries representing 85-90% of the world's solar thermal market.

solar heat & energy statistics

defining & calculating

How Does Solar Heat Contribute to the International Energy Balance?

Solar heating systems contribute to our energy needs, but how much is often not visible in international energy statistics. The reason for this is twofold, the contribution of solar heat is not metered and the definition of renewable heat is not well established.

In recent years, a standard 0.7 kW/m^2 factor has been used by the IEA SHC Programme and other organizations and trade associations for calculating the installed collector area to installed capacity. However, the way energy production of solar heat is calculated varies greatly. This is not only the case for solar heat, but is true for all renewable heat. Every technology has its own calculation method and its own definitions.

Now that renewable heat is considered in the energy balance and contributes towards the renewable energy goals of the European Union, it is important to come to a broadly accepted definition and calculation method for renewable heat. This was the aim of the ThERRA project that was funded by the Intelligent Energy Europe-program. The SHC Programme contributed to the solar part of this project.

The Current Monitoring Situation for Solar Thermal Energy

Eurostat and the IEA define solar thermal heat as a renewable energy. Their definition of renewable energy is *"energy that is derived from natural processes that are replenished constantly."* There are various forms of renewable energy derived directly or indirectly from the sun or from the heat generated deep within the earth. Renewables include energy generated from solar, wind, biomass, geothermal, ambient heat, hydropower and ocean resources, solid biomass, biogas, liquid biofuels and biogenic fraction of wastes and other similar commodities.

Heat is the result of a conversion of an energy source into heat. If the source is renewable, the heat output is renewable heat (see Figure 1).

Renewable heat can be defined on the input side or on the output side. The input definition is in line with the Eurostat energy balances. The output is called "useful heat output." Eurostat counts all renewable energy on the input side. Solar thermal heat according to the input method from Eurostat is defined as *"the heat available to the heat transfer medium minus the optical and collector heat losses."*

In general, solar thermal experts give figures on the output of solar thermal systems or energy saved by the solar thermal systems. Some countries use the substitution method (for example, the Netherlands, Germany and France). This method calculates the fossil energy that is saved by the use of a renewable source. The ThERRA proposal for a calculation method does not include the use of such a substitution method since this method would be too complicated for energy statistics on a European scale. The new Renewable Energy directive of the EU defines final energy use as the energy delivered to the end users. For solar heating in a home this would mean that the input definition would be used because the transformation into heat is done by the end user.

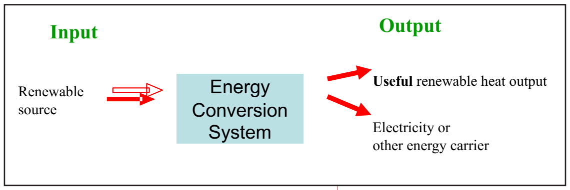


Figure 1: Definition of Input and Output

Monitoring of Installed Area

The output of solar thermal systems is typically not measured, but calculated using the installed capacity. Only for very large systems is the output measured. To assess the installed capacity, a questionnaire is typically completed by industry on the total collector area sold. In a similar way, the area of non-covered collectors is assessed. This method provides reasonable accuracy. The main differences occur in the life-time that is assumed for the solar systems. Some countries have a methodology to assess the life-time and therefore they can calculate the total collector area in use. If this is not done by the countries themselves, it should be done before international comparisons are made.

The IEA SHC Programme assumes a life-time of 25 years. A proposed international CEN standard exists that provides the life-time for many technologies. For solar heating systems, CEN proposes a life-time of 19 years. Additional data on the actual life-time of solar thermal systems would be useful, but in a fast growing market the impact of a somewhat shorter life-time on the installed base is very small.

Surveys conducted on the installed collector area in international markets include:

- IEA SHC Programme: an overview of the world based on the best data that the experts from the Programme can find. The report includes a division between different collector types and a calculation of the produced heat.
- Eurostat: the official statistics.
- IEA statistics office: same data as Eurostat.
- ESTIF: the data focuses on market development, and includes expected market development
- EurObserv'ER: follows the official statistics of EuroStat, but publishes the available data sooner.

In general, the data have acceptable accuracy. The data are not as good as for example the electricity produced by wind power, but more accurate than the energy produced by wood stoves or the renewable heat produced by heat pumps.

Monitoring of the Solar Thermal Production

Total thermal production is calculated from the installed collector area. Most countries use a simple figure of per square meter of collector. The IEA SHC Programme uses a more sophisticated method that includes the simulation of a typical solar system for each country (this data is included in the annual SHC report, *Solar Heat Worldwide*). Eurostat relies on the statistic offices in the EU-countries and on the collector input as defined in their input-method, that is, the energy falling on the collector minus the collector losses. Most countries use national figures, which can range from 64 to 903 kWh/m^2, and have no relation with the insolation of the country.

The ThERRA project is proposing a fixed method for calculating the collector production that is based on measured data. If no measured data are available then a default value would be used.

Proposed ThERRA Project Method

To establish figures independent of the insolation, a formula was proposed by Jan Erik Nielsen of ESTIF.

$$E = C * A\,[m^2] * G\,[GJ/m^2]$$

C = a coefficient dependant on the application.
A = average installed collector area in the monitoring year.
G = the global radiation for the optimal collector orientation for the monitoring year.

For the input method, a coefficient would be around 0.50, which is the average collector efficiency.
For the output method, the coefficient would be calculated from monitoring data. Monitoring projects in the ThERRA project range from 0.14 to 0.30.

There is a large difference in system performance. In particular, large systems for households show a lower performance (but a higher solar fraction). Before an average default value can determined, additional monitoring data needs to be analyzed.

Input or Output Method?

Whether to use the input or the output method depends on the application of the data. Eurostat creates energy balances, and therefore, the energy input of a conversion process is seen as the energy production. This is in line with the method used for biomass or coal calculations. The output method is used to determine the amount of useful heat that is used. The final energy, as used in the EU Renewable Energy Directive, can use the input method if the solar system is located at the end user or the output method if the solar system is delivering the heat to other users (as in a district heating network).

Conclusions

- The quality of the statistics for collector areas is reasonable, but the average life-time for solar systems should always be included.
- The energy production of the solar systems is still uncertain. The data from Eurostat shows a difference in production per square meter of collector that is not acceptable.
- The method to include solar heating systems in official statistics should be harmonized so that the energy production from solar heat can be compared.
- For the output method, the simple formula is an easy way to calculate the average output, however, the data still will vary significantly between countries.

Outstanding Issues

The coefficients for the simple formula should be determined. The method described in SHC Programme's report, *Solar Heating World Wide*, is a sound option. This will be discussed with the solar thermal industry at a joint meeting with IEA SHC Programme and solar thermal trade associations on May 29th in Munich, Germany.

This article was contributed by Lex Bosselaar of SenterNOVEM, Executive Member from the Netherlands.

thermal energy storage materials

task kick-off great success

This new joint Task of the Solar Heating and Cooling Programme and the Energy Conservation through Energy Storage (ECES) Programme will combine for the first time research on materials and research on heat storage applications.

In a snow-covered Bad Tölz, south of Munich, Germany, 67 experts from 17 countries gathered in February to share the state-of-the-art of their research and to discuss the first steps to take in the Task. To facilitate the work, the participants agreed to structure the work into two Subtasks with working groups on materials research, storage applications and cross-cutting areas.

The Materials Development Subtask has four working groups – materials engineering and processing, testing and characterization, numerical modeling and apparatus integration. The Applications Subtask has three working groups – cooling applications, heating and domestic hot water applications, and higher temperature applications. The cross cutting fields are theoretical limits and system integration.

The Task's main goal is to move the development of technologies for compact thermal energy storage forward by improving the materials in combination with the storage applications. Compact thermal storage materials can be divided into three classes –phase change materials (PCM), sorption materials, and thermochemical materials (TCM).

During the kick-off meeting presentations provided a better understanding of the state-of-the-art and outlined the R&D steps needed in the different material classes.

Phase change materials tend to receive the most attention. PCMs are developed for indoor comfort improvement, especially for overheating prevention. At this time, the key areas of work are:

- Optimization of the material and on the system performance.
- Basic research on the synthesis of better performing fatty acids, on improving the solidification process by adding nucleation agents, and on the development of very accurate numerical models to optimize the melting and solidification process for different PCM container geometries.
- General problem of low thermal conductivity of PCMs
- High temperature applications, for example in concentrated solar power plants, compound materials to increase the charging and discharging power.

Work on sorption materials is currently focused on a system scale to optimize liquid sorption systems for seasonal storage and better performing solid sorption materials, which is often conducted in conjunction with material development for adsorption heat pumps. The wide range of applications considered in the Task is shown by two special cases for sorption storage in dishwashers and in truck cabin cooling.

Participants in the SHC Task 42/ECES Task 24 Kick-off Meeting in Germany

The field that is furthest from practical application is that of thermochemical storage of heat. Current work is focused on salt hydrates and on sodium hydroxide.

In the numerical modeling field, a new frontier is about to be crossed. By combining the calculation techniques on atomic scale and molecular dynamics with Monte Carlo numerical techniques on a higher scale, it will become possible to couple processes on these different scales. This ultimately will give us tools that use the fundamental TCM properties to determine the optimal geometry of thermochemical reactors.

At the kick-off meeting, a blueprint was sketched of the activities in the various working groups for the activities in the first period of this 4-year project. The first results will be presented and discussed at the second Task Experts Meeting on September 23-25, 2009 in Spain.

This Task has attracted a large group of enthusiastic scientists and developers. And, a relatively large number of the participants are dedicating their PhD study to the Task's work. These two factors have created a very good basis for fruitful collaboration.

The number of participants, however, is never too large as the long-term goal of the Task is far-reaching and complicated. The contribution of new experts, especially from the materials research field, is welcomed.

This article was contributed by the SHC Operating Agent, Wim van Helden of the Energy Research Centre of the Netherlands (ECN), vanhelden@ecn.nl, and the ECES Operating Agent, Andreas Hauer of ZAE Bayern, Germany hauer@muc.zae-bayern.de. For more information, visit our website at www.iea-sch.org/task42.

country spotlight

solar heating in norway

This June Norway will host the SHC Executive Committee meeting in Stavanger. The meeting will conclude with a technical tour of three Norwegian wood projects -- Preikestolen Mountain Lodge, Egens Park apartment buildings and Marilunden low energy homes.

Norway has many state-of-the-art energy efficient buildings that include solar technologies despite the fact that solar heating and cooling is not a government priority. At this time, a national program dedicated to solar heating and cooling does not exist and only a few research projects are funded through the Clean Energy System for the Future (RENERGI) program. However, in 2008 the public enterprise Enova launched a new program for heating systems. The aim of this program is to reach the Government target of 4 TWh environmentally friendly wataer-based heating by 2010. To help meet this target, Enova has set aside a budget of NOK 100 million (€11 million) to support environmentally friendly heating solutions in households. This new program includes a subsidy (up to NOK 10,000 or €1,100) for homeowners purchasing solar collectors.

The market for solar heating systems has been limited, and less than 1,000 m^2 of collectors were installed in 2007 and produced an estimated 9 MWth in 2006. An increase is expected in the market due to the Enova incentive program, but compared to the neighboring countries (Sweden 209 MWth installed and Denmark 287 MWth installed) Norway's market is still small.

Despite this low commercial activity, Norwegian researchers have been working on new plastic materials for solar collectors for many years, and two manufacturing companies have been established, Solarnor in 1995 and Aventa in 2005. Both of these companies have their origin from researchers at the Institute of Physics at the University of Oslo (UiO). One the present RENERGI funded research projects is in fact focused on "Sustainable Polymers for Solar Collector Applications," and the work is based at UiO. The goal of this project is to summarize the market status and to disseminate information about new international developments in the field. New and inexpensive solar collectors will be developed using polymeric materials to increase the cost effectiveness of solar systems. Researchers in this project are also participating in *SHC Task 39, Polymeric Materials for Solar Thermal Applications*.

Solar At Work

Oslo Apartment Building

Solar energy and gas cover the heat demand in an 8-apartment building in Oslo. The solar application is 95 m^2 of polymer collectors from Solarnor. The collectors cover 20-25% of the total heat demand for hot water and space heating. The expected annual outcome of the collectors is 250 kWh/m^2 and the calculated solar energy cost is about 0.60 NOK/kWh (7.3 €cent/kWh).

Preikestolen Mountain Lodge, Architect: Helen and Hart AS
(photo: Emile Ashley)

Løvåshagen Apartment Building

The Løvåshagen project near Bergen has 80 apartments of which 28 were built using the passive house standard and 52 were built using the low energy standard. The passive houses have a simplified water heating system where one central located radiator covers the entire apartment. Each apartment has a combined solar heating system for domestic hot water and space heating. The systems with evacuated tubular collectors will cover 50% of the DHW and 15-20% of the space heating demand. To evaluate the two standards, the energy use and the output of the collectors will be measured.

Løvåshagen apartments, ABO Architects/MIR

Marilunden low energy homes in Stavanger, Architect: Eder Biesel Architects AS

Energy Efficient Housing Renovation

The Norwegian Research Council, Enova and the State Housing Bank are funding the EKSBO-project on energy efficient housing renovation. This is a collaborative activity between researchers and about fifteen Norwegian industry companies. The project is focused on how to renovate houses to a very high energy standard and will develop strategies that support market penetration of these renovations in market segments with high renovation and opportunities for replication. This work is part of *SHC Task 37 Advanced Housing Renovation* with Solar and Conservation with Norway as the project leader and EKSBO as the Norwegian participant.

This article was contributed by the Operating Agent of SHC Task 37, Fritjof Salvesen, fs@kanenergi.no and the Norwegian Executive Committee Member, Anne G. Lien, anne.g.lien@ENOVA.NO.

single- and multi-family houses and hotels, large-scale plants for district heating as well as a growing number of systems for air conditioning, cooling and industrial applications.

In Austria, Germany, Switzerland and the Netherlands the share of applications other than hot water preparation in single-family houses is 20% and higher than in other European countries. There are about 130 large-scale plants (≥ 500 m^2; 350 kWth) in operation in Europe with a total installed capacity of 140 MWth. The biggest plants for solar assisted district heating are located in Denmark with 13 MWth (18,300 m^2) and Sweden with 7 MWth (10,000 m^2). The biggest reported solar thermal system for providing industrial process heat was installed in 2007 in China. This 9 MWth (13,000 m^2) plant produces heat for a textile company.

Leading Countries

Flat-plate and evacuated tube collectors

Based on the total capacity of flat-plate and evacuated tube collectors in operation at the end of the year 2007, the leading countries are:

- China (79.9 GWth), Turkey (7.1 GWth), Germany (6.1 GWth), Japan (4.9 GWth) and Israel (3.5 GWth)

Followed by:

- Brazil (2.51 GWth), Greece (2.50 GWth), Austria (2.1 GWth), the USA (1.7 GWth) and India (1.5 GWth)

As can be seen China is by far the largest market, representing 66% of the world market of flat-plate and evacuated tube collectors. Here it should also be mentioned that China again increased its market share by 2% in 2007.

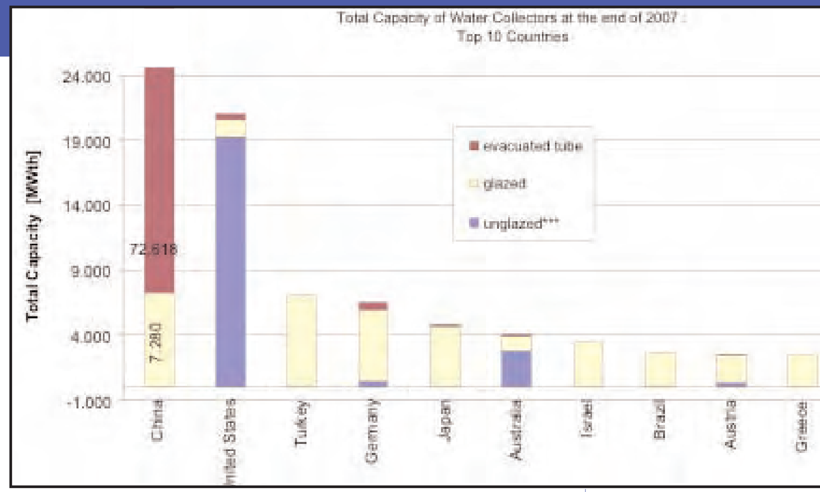
Based on the market penetration – total capacity in operation per 1,000 inhabitants – the leading countries are:

- Cyprus (651 kWth), Israel (499 kWth), Austria (252 kWth), Greece (224 kWth) and Barbados (197 kWth).

Followed by:

- Jordan (100 kWth), Turkey (95 kWth), Germany (73 kWtth), China (60 kWth) and Australia (57 kWth).

Europe: EU-27, Albania, Macedonia, Norway, Overseas Departments of France, Switzerland;
Others: Barbados, Brazil, India, Israel, Jordan, Mexico, Namibia, South Africa, Tunisia and Turkey



Total capacity in operation of water collectors of the 10 leading countries at the end of 2007

Unglazed plastic collectors

For the heating of swimming pools using unglazed plastic collectors, the USA leads with a total capacity of 19.3 GWth in operation ahead of Australia with 2.8 GWth, Germany and Canada with 0.5 GWth each, and Austria and South Africa with 0.4 GWth.

The market penetration – total capacity in operation per 1,000 inhabitants – gives a slightly different picture. The lead countries are:

- Australia leads with 137 kWth ahead of the USA with 63 kWth and Austria with 51 kWth per 1,000 inhabitants.

Followed by:

- Switzerland, the Netherlands and Canada with an installed capacity between 20 and 14 kWth per 1,000 inhabitants.

Installed Capacity in 2007

In the year 2007, a new capacity of 19.9 GWth corresponding to 28.4 million square meters of solar collectors was installed worldwide. The number of new installations increased 8.7% compared to 2006. This represents a decrease of the growth rate compared to 2005/2006 when the market grew 22%. The main reasons for this were the market slumps of unglazed plastic collectors in the USA and of flat plate and evacuated tube collectors in Germany.

It is remarkable that the global market of evacuated tube collectors grew 23.4% compared to the year 2006, whereas the markets of flat plate collectors and unglazed collectors decreased 18.3% and 7.2% respectively.

Europe: EU-27, Albania, Macedonia, Norway, Overseas Departments of France, Switzerland.
Others: Barbados, Brazil, India, Israel, Jordan, Mexico,

What all these numbers mean for the environment is:
A solar thermal power output of 88,845 GWh (319.841 TJ) means an oil equivalent of 12.09 million tons and the avoidance of 39.3 million tons of CO_2.

Namibia, South Africa, Thailand, Tunisia and Turkey. The most dynamic markets for water collectors (unglazed, flat-plate and evacuated tube collectors) in Europe with growth rates near and above 100% compared to the capacity installed in 2006 were:

- Hungary 700%, Ireland 293%, Slovak Republic 200%, UK 93% and Portugal 80%.

Outside of Europe, large market growth rates were seen in:

- Namibia 74.5%, Mexico 60% and Brazil 32%

In China, the world's largest market, the number of new installations increased in 2007 by 17.4% compared to 2006.

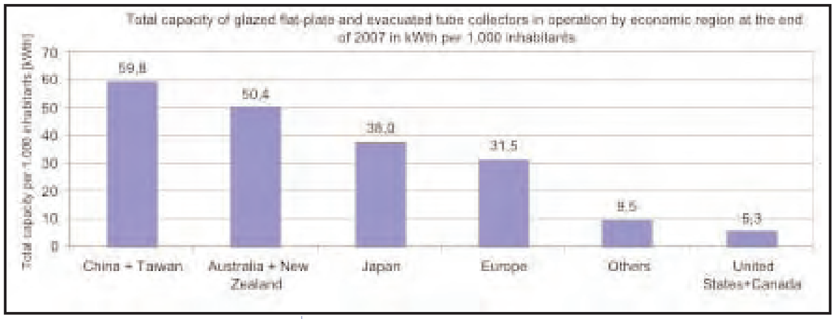
Market Development

The main markets for flat-plate and evacuated tube collectors worldwide are in China and Europe as well as in Australia and New Zealand. The average annual growth rate between 1999 and 2007 was 23.6% in China, 20% in Europe, 26% in Canada and the USA and 16% in Australia and New Zealand. Although the installed capacity of flat-plate and evacuated tube collectors in the USA is very low compared to other countries, especially with regard to USA's large population, the market for new installed glazed collectors has been significantly growing in the recent years.

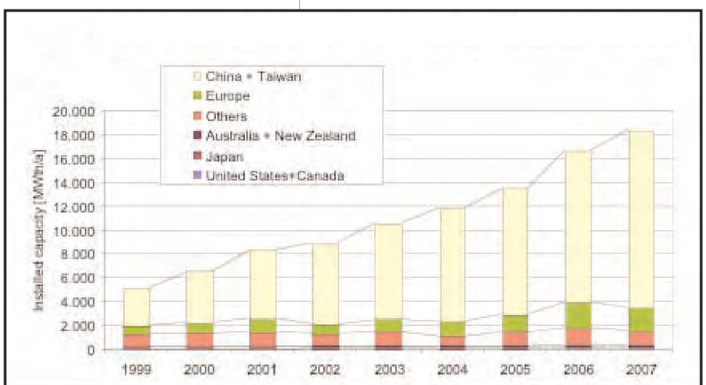
Europe: EU-27, Albania, Macedonia, Norway, Overseas Departments of France, Switzerland;
Others: Barbados, Brazil, India, Israel, Jordan, Mexico, Namibia, South Africa, Thailand, Tunisia and Turkey

The worldwide market of unglazed collectors for swimming pool heating recorded an increase between 1999 and 2002 and a slight decrease in 2003. After a slight increase from 2004 to 2006, the installed capacity rate declined again in 2007. The main markets for unglazed collectors can mainly be found in the USA (0.79 GWth) and Australia (0.4 GWth). South Africa, Canada, Germany, Mexico, The Netherlands, Sweden, Switzerland, Belgium and Austria also have notable markets, but all with values below 0.1 GWth of new installed unglazed collectors in 2007.

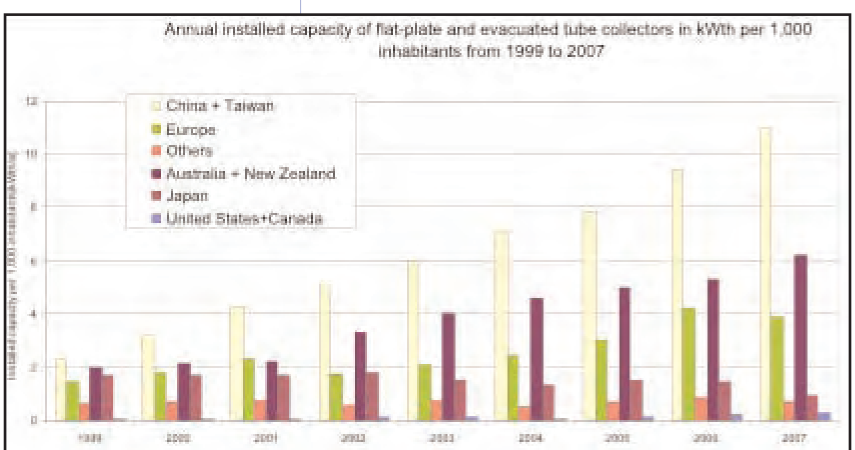
The 2009 edition of Solar Heat Worldwide will be available on the SHC web site this May.



Total capacity of glazed flat-plate and evacuated tube collectors in operation by economic region at the end of 2007 in kWth per 1,000 inhabitants



Annual installed capacity of flat-plate and evacuated tube collectors from 1999 to 2007



Annual installed capacity of flat-plate and evacuated tube collectors in kWth per 1,000 inhabitants from 1999 to 2007

new work

solar energy AND architecture

Existing buildings account for over 40% of the world's total primary energy use and 24% of greenhouse gas emissions. A combination of making buildings more energy-efficient and using a larger fraction of renewable energy is key to reducing non-renewable energy use and greenhouse gas emissions.

A large portion of the potential for energy efficiency in buildings and the potential use of solar energy remain unused. It is clear that solar energy use can be an important part of the building design and the building's energy balance to a much higher extent than it is today. Cleverly used, active and passive solar energy can both contribute to the energy supply and to a higher quality of the architecture.

Why Aren't Solar Energy Systems A Standard Building Component?

Despite all the available solar technologies and the opportunity to reduce the energy demand, solar energy systems are not a standard option considered in new and renovated buildings. The key reasons for this are:

- Economics - investment costs and maintenance costs
- Technical knowledge - lack of knowledge among decision makers and architects as well as a general reluctance to "new" technologies.
- Architecture (aesthetics) - solar technologies impact a building's design and look.

This new three-year Task will focus on the third reason noted above, architecture.

Why Is This Task Focusing On Architectural Aspects?

Important bottlenecks are architects as well as the architectural quality and flexibility of solar components and systems. Architects are key actors at an early design stage; establishing the principal design concepts when communicating with the client. If architects have more knowledge about the possibilities of integrating solar systems and better tools supporting the design phase of their work, they could both be convinced themselves and have arguments to convince e.g. the clients and city planners. Also, to achieve high architectural quality of the building integration of solar systems, the architect needs to take this into account very early in the design process. This task is therefore important as it focuses on the architect's need and to initiate product development for increased architectural quality.

The Task

As the Task's title *Task 41, Solar Energy and Architecture*, indicates, the focus of the work will be on both high architectural quality and high energy performance. It would be counterproductive to show the use of solar applications in buildings where the energy performance is poor or even worse than without solar applications. The Task also will focus on a new way of approaching the use of active solar energy in buildings that sees architects composing their architecture with solar components conceived as building elements.

Sunny Woods is a new Swiss residential building that integrates evacuated tubes collectors in the balconies on the building's south façade. The collector modules are constructed as multifunctional elements for energy production and balcony fence by Schweizer energie AG – SWISSPIPE

The objectives of the Task are to help achieve high quality architecture for buildings integrating solar energy systems, as well as improving the qualifications of the architects, their communications and interactions with engineers, manufactures and clients. It is understood that by increasing user acceptance of solar designs and technologies the market penetration will accelerate.

To achieve these objectives, the work is divided into three Subtasks:

- Architectural quality criteria; guidelines for architects and product developers by technology and applica-

tion for new products development.
- Tool development for early stage evaluations and balancing of various solar technologies integration.
- Integration concepts and examples, and derived guidelines for architects.

A key component of this work will be hosting seminars with architects, manufacturers and other key actors. The seminars will be carried out nationally and regionally based on a common format developed within the Task. In addition, special seminars will be held in connection with Task meetings. These seminars will provide a forum for Task experts and local practitioners and manufacturers to come together and discuss barriers and solutions. Also, an international survey will be carried out on architects needs and on identifying barriers. Existing buildings will be used for analyzing components and systems and developing innovative design solutions.

Expected Results

Task results will be targeted to architects, manufacturers of components and systems, clients, building engineers, municipalities, etc. Specific results will include:
- Document for architects that describes important architectural integration criteria for different categories of solar systems, with good examples.
- Document for product and system developers that describes important architectural integration design criteria for different categories of solar systems, with good examples.
- Improved or new methods and tools for architects for the early design stage. Tools to support communication activities.
- Working method for urban planning illustrated through selected examples of energy-efficient and sustainable urban planning. This includes illustrating the potential for solar energy to cover the energy needed for buildings, including different potentials for roof integration and façade integration in an urban context.
- Presentation of exemplary buildings including architectural design, systems, technologies, energy performance and costs.
- Communication guidelines on concepts, principles, potentials and exemplary buildings.

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The Centre d' exploitation des Routes Nationales (CeRN) is a maintenance building of the Swiss motorways. The building is an excellent example of solar thermal collectors integrated into a building façade by adapting an Energie Solaire solar roof system.

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 42 R&D projects (known as Tasks) to advance solar technologies for buildings. The overall Programme is managed by an Executive Committee while the individual Tasks are led by Operating Agents.

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