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Report on activities in Sweden
for the period 1998-2002
in

International Energy Agency, IEA, Solar Heating and Cooling, SHC, Task 24

"ACTIVE SOLAR PROCUREMENT"

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Preface

During the 90s the solar heating market developed rapidly in Europe but stagnated in Sweden. Many reasons have been given for this, including low energy prices, the poor continuity of State grants and Swedish industrial players being underfunded for the necessary marketing. Another reason, or perhaps a consequence of the above factors, was Swedish industry's inadequate assimilation of research findings.

The Swedish solar heating market, then, was a small one and, moreover, was concentrated on combined space and water heating systems, while the systems gaining ground in the European market were smaller, more cost-effective hot water systems.

At the Council for Building Research (present-day Formas) we believed at the end of the 80s that most of the requisite technical know-how in the solar heating sector had already been amassed through R&D, but that market development incentives were still needed. Meanwhile advances in technology procurement had made it natural to consider a technology competition/technology procurement in the solar heating sector as well.

One of the priority fields of national policy was the development of technology for reducing electricity use. Hot water preheating systems, which had gained a foothold in the European market, would be capable of reducing electricity use in buildings with direct electric heating in an economically acceptable manner, because the system reduced electricity use for water heating and did not require an expensive new heat distribution system. A Swedish market for the hot water preheating system would also provide a jumping board into the European market.

It is with great satisfaction that Formas can declare the competition to have been a success. We are convinced that through it the industry has acquired new knowledge and that it has been instrumental in bringing about the cost reductions occurring in the market. Technology competition/procurement as a method has been further developed in several respects though this project, not least as regards the international aspects.

Formas takes this opportunity of tendering its sincere thanks to the members of the project group for the sustained quality of their work and their high standard of integrity. Much gratitude is also acknowledged to the Swedish solar heat industry, SEAS (the Solar Energy Association of Sweden), Miljöaktion Värmland, the Enköping District Heating Plant and the other financiers, namely the City of Stockholm LIP Office and the Swedish Energy Agency (parts of the project).

Michael Rantil, Formas

Summary

Two activities were conducted within the Swedish part of IEA Solar Heating and Cooling, TASK 24 "ACTIVE SOLAR PROCUREMENT".

- Technology procurement of solar collectors for large systems.

- Technology procurement competition concerning solar-heated domestic hot water systems in detached houses.

The purpose of both activities was to hasten the development of the solar heating market. For decades this technology has been receiving government support for research, development and demonstration, whereas initiatives more specifically concerned with market introduction have been limited. As a result, the cost picture remains too high and the level of interest too low for the technology to achieve a dynamic commercial breakthrough. The market, in principle, being non-existent, production is confined to small volumes with a low level of standardisation and little opportunity for either marketing or cost-cutting. In this perspective technology procurement, as a method, is being used to accelerate market development and so facilitate a more positive movement of costs.

Technology procurement was aimed at co-ordinating orders for large collector modules with a combined area of 10,000 sq.m. The requirement specifications focused on more standardised solutions for more rational assembly and integration of the collectors into hydraulic units. The intended commissioning area of 10,000 sq.m. could not be achieved, and so, regrettably, this activity had to be curtailed, with honourable mentions for 5 tenders meeting the procurement stipulations. Continuing the activity with a combined area of only 2,400 sq.m. would not have been compatible with the aim of the technology procurement.

The technology procurement competition referred to co-ordinated orders for at least 1,000 solar-heated domestic hot water systems in detached houses. The specification of requirements focused on standardised modular solutions capable of replacing conventional electric water heaters. Given that there are today some 500,000 single-family dwellings with direct electric eating which, sooner or later, will have to change their water heaters, this type of solar heating system is judged to have a big potential. Additional information measures led to the formation of an ordering group of about 4,000 house owners who were interested in ordering the system. After a protracted evaluation process a winner could be selected and deliveries began in the spring of 2002.

All in all, the technology procurement competition can be said to have achieved the result intended and a gradual build-up of the solar heating market for single-family dwellings to have been initiated. Moreover, another six solar water heating systems in addition to the winning system are now commercially available in Sweden. The total market potential is probably great enough for one or more companies to achieve the requisite volumes for continuing development.

Introduction and background

The activities within IEA Solar Heating and Cooling, Task 24 "ACTIVE SOLAR PROCUREMENT", were started on Sweden's initiative to support the commercial development of solar heating technology. The initial participants, in addition to Sweden, were Canada, Denmark and the Netherlands, and these countries have since been joined by Switzerland and Belgium.

The common point of departure for the work of Task 24 consists in the fact of the knowledge base for solar heating technology applications being high but poorly distributed among the various players. This knowledge has been acquired during decades of state-subsidised research, development and demonstration of the technology, but the cost picture remains too high and the level of interest too low for the technology to achieve a dynamic commercial breakthrough. The technology is thus trapped in the vicious circle often prevailing where market launches are concerned. Insufficient interest and excessive costs mean little chance of increasing marketing and sales volumes, which in turn is the only possible way of achieving better market prospects and, accordingly, a more dynamic commercial breakthrough.

The overriding aim has been to influence the price-performance relation of solar heating systems in favour of more cost-effective solutions. Parallel and co-ordinated national activities have been conducted in the first phase of international co-operation as a means to this end. The main focus of attention has been on solar-heated domestic hot water systems in detached houses, this being a large market with internationally similar system solutions, added to which, old water heaters require regular replacement (every 15-20 years) and can then be succeeded by new, solar-heated units.

In Sweden's case, the market for solar-heated domestic hot water systems was practically non-existent. Demand for such systems was insufficient and Swedish manufactures were not selling any. Both the majority of potential solar heating customers and the Swedish manufacturers had previously been almost wholly preoccupied with combined space and water heating systems. Historically speaking, the Swedish market has amounted to some 10,000-15,000 sq.m. annually, more than half the units being of the order of < 15 sq.m. Production has been divided between about 10 companies, to most of whom solar heating has been just a sideline.

Swedish organisation and finance

In 1998 the Swedish Council for Building Research (BFR) set up a project group to handle national activities under Task 24. The group comprised the following members:

Jan-Olof Dalenbäck	Expert	Chalmers Installationsteknik
Heimo Zinko	Expert + SubTask B	ZW Energiteknik AB (initially)
Mats Rydehell	Expert	KanEnergi AB (initially)
Hans Isaksson	Expert + SubTask A	K-Konsult Energi Stockholm AB

Other experts and representatives of clients and purchasers were co-opted as the project proceeded.

At the first briefings, attended by procurement representatives, several participants, among them the City of Stockholm, the Swedish District Heating Association and the HSB co-operative housing organisation, also wanted the procurement to include collectors for larger buildings. Two procurement groups were therefore set up and two technology procurements initiated, one for large collector modules and the other for solar-heated domestic hot water systems in detached houses. In each procurement group a chairperson was appointed for the conduct of day-to-day business.

The Swedish activities were financially supported by several organisations, the principal financiers being:

- BFR/Formas, which continuously supported the project administration throughout the programme period.
- The Swedish Energy Agency, which supported the project administration until the end of 2000, when co-operation was discontinued.
- The City of Stockholm, LIP, which supported parts of the project throughout the programme period, mainly with respect to testing and the production and distribution of information material.

In addition, the following participants have above all contributed resources in the form of time, travel and other expenses etc.:

Miljöaktion Värmland (MAV)
Enköpings Värmeverk (the Enköping District Heating Plant)
Eksta Bostads AB
The Swedish District Heating Association
Other industrial organisations
Property companies – private, national, county council and municipal
Individual house owners
Manufacturing companies, through development measures

Solar collector technology procurement for large systems

First of all it should be made clear that the following subdivision of activities according to procurement and purchasing group does not imply any separation. On the contrary, these were parallel and supremely integrated activities.

Procurement:

The technology procurement was constructed in accordance with the Public Procurement Act, LOU, since several purchasers were considered to belong to the public sector. The procurement only included collector modules connectable to a hydraulic units of 200 sq.m. Each buyer taking part was expected to buy at least 200 sq.m., giving a total order of 10,000 sq.m. (*App. 1*, "Invitation to take part, 5th April 2000 …" with attachments). The remaining parts of the system – heat exchangers, accumulators and other components – had to be scaled, procured and ordered by each of the installation proprietors concerned.

Thus the procurement was made to focus on an integrated order volume of collector modules corresponding to one year's output in the Swedish market. In addition to technical specifications, cost requirements etc., the invitation to take part also included requirements concerning the presentation of rational assembly solutions and times. The requirements were divided into obligatory requirements and desirable requirements.

The invitation to take part was distributed in April 2000 to Swedish and other European manufacturers. At the same time the procurement was advertised in the EU Official Journal. By the expiry of the tendering period, 11 tenders had been received, 4 of them from other countries.

The cost requirement stated in the tendering documentation was SEK 200/MWh. An introductory evaluation showed 6 tenders for tested collectors to be relatively complete while the other tenders for collectors, submitted before or during testing, were incomplete.

The purchasing group:

Björn Johansson, Enköpings Värmeverk, was appointed to chair the technology procurement and represent the buyers. Several activities proceeded between 1999 and 2001, aimed at building up the purchasing group. They included, for example, representations and information activities, via business organisations and trade journals, on the subject of technology procurement, and the production and distribution of brochures. In addition, all municipal housing utilities in Stockholm were contacted and informed of the procurement process. The Swedish District Heating Association contacted all members believed to be in a position to supplement their energy mix with solar. Buyers who were interested were able, using a form which, for example, could be downloaded and submitted through the home page (*App. 2*, "Letter to buyers, 13th June 2000…" inc. order form), to enter the solar heating projects they wanted to include in the technology procurement. The form was constructed as a declaration of intent to order a given area of collectors from the supplier judged most advantageous when the tenders received were evaluated.

During the spring of 2004 a total of 40 solar heat projects were registered, comprising some 8,000 sq.m. collectors altogether. The supporting documentation for the reports, however, was incomplete in some cases, which made it very uncertain whether all the projects were realistic. To remedy the uncertainty, all project leaders were contacted and, in certain cases, expert consultants engaged for basic pilot studies. Several of the projects, unfortunately, proved to have been insufficiently thought through and were therefore deleted. A number of others were eliminated because the procurement timetable was extended and the procurement outcome could not be awaited.

By the end of 2000, the total area included in the procurement was found to have declined to a mere 2,400 sq.m. This remaining area was divided between a handful of carefully worked-out, realistic

projects. Even so, the feasibility of the procurement was in doubt, the procurement target and the "bait" for the company or companies to deliver the collectors having been set to 10,000 sq.m. It had already been made clear in the invitation to take part that the procurement could be cancelled if the total area fell short of 4,000 sq.m. In addition there was a price clause regulating the price in linear proportion to the total area ultimately included in the procurement. At the cut-off point of 4,000 sq.m., this price corresponded to what a buyer was expected to obtain when purchasing separately.

Faced with this situation, the procurement jury decided to cancel the procurement. The jury formulated and, by way of conclusion, published a pronouncement in which 5 tenders were mentioned as being more or less equal with respect to the technical and economic stipulations for the procurement (*App. 3,* "Jury pronouncement, 15th September 2001, for solar collector technology procurement").

Technology procurement competition for solar-heated domestic hot water systems in detached houses, "Småsol"

The Småsol technology procurement competition and the activities in the pertinent buyer groups were conducted parallel to the procurement of collectors for larger systems.

The competition:

The procurement was organised in competition form because the prospective purchasers were individual house owners unaffected by the Public Procurement Act, LOU, but the structure of LOU was used as an implement for organising and documenting the activities.

The competition concerned a complete solar-heated domestic hot water system for a detached house. The water heater was to be a 60x60 cm module, corrosion resistant and capable of replacing conventional heaters on the market. In addition, the "package" was to include all other parts: collectors, drive package, installation devices etc. The requirements were divided into obligatory requirements and desirable requirements. All data to be given referred to a particular standardised house. Another prerequisite was for the system, by means of a standardised calculation model, to derive energy coverage from the collectors equalling at least half the annual requirement. The companies taking part in the competition were to indicate two price levels for the system, one referring to 1,000 deliveries and another to 2,000. One obligatory requirement was that the total cost, installation excluded, was not to exceed SEK 16,000 inclusive of VAT. The cost was worked out in relation to the additional cost of installing a conventional water heater. Installation time and cost were judged on the basis of data supplied and subsequently also from test installations of prototypes submitted.

The competition document (*App. 4*, "Competition document, 21st January 2000, for solar-heated domestic hot water systems", inc. attachments), was distributed in January 2000 to Swedish and other European manufacturers. At the same time the procurement was advertised in the EU Official Journal. By the expiry of the tendering period, 14 tenders had been received, 3 of them from other countries. After the first evaluation it was established that at least 7 tenders, including 1 from another country, met the requirements in such a way that they should be further evaluated by system testing at the Swedish National Testing and Research Institute, Borås. As SP was only able to test 6 systems at once, the test had to be conducted with 9 systems in two rounds, which affected the timetable. Testing conformed to the new European standard SS EN 12976 for system tests. In addition, all companies which had submitted prototypes for testing were offered a free review (1/2 day) and comments from SP on the results obtained (*App. 5*, "SP Report, 26th September 2000, on system testing of prototypes").

When prototype testing was complete, it was noted that two systems had amply satisfied all the technical requirements of the competition. Thee were followed by 7 systems which met all the obligatory requirements apart from falling short of the performance requirement of 50% energy coverage from solar heat. Discussions were then opened with the two companies scoring highest on the evaluation list, concerning capacity and prerequisites for completing deliveries to at least 1,000 private house owners.

It fairly soon became clear that the first company did not wish to adhere to the price level indicated in its competition entry and was only prepared to deliver the full number of systems to one place and on one and the same occasion. Thee were two considerable departures from the terms of the competition. The other company also made completion of deliveries conditional on a change of price level. There was also uncertainty as to whether this second company was strong enough financially, which was considered a fundamental prerequisite for meeting a major delivery commitment. The company was given repeated opportunities for clarifying its financial position, but was unable to furnish satisfactory day. Once the above matters became clear, the question arose whether there were any formal

impediments to continued discussions with other suppliers who had not met the obligatory requirement of 50% coverage.

The legal examination showed that there were no formal impediments, because the buyers were private persons and the competition had not been announced as procurement under LOU. It was further established that the solar heat coverage values obtained for several prototypes would in all probability improve once the manufacturers had taken into account the supplementary information supplied by SP to each entrance after the test. In this situation a revised performance requirement was judged more attractive to the buyer group than a revised price requirement. The competition organisers therefore resolved to open price and delivery discussions with additional firms on the evaluation list.

Eventually one supplier crystallised out who both met the technical requirements and was ready to offer favourable delivery commitments to the buyers who had registered their interest in the competition. A framework and delivery agreement was signed in March 2001 with the manufacturer Uponor AB of Fristad (*App. 6*, "Contract, 9th March 2001, for delivery of solar-heated domestic hot water systems", inc. attachments, *App. 7*, "Jury pronouncement, 15th March 2001, concerning solar-heated domestic hot water systems", *App. 8*, "Memorandum, 22nd March 2001, concerning evaluation of competition entries"): At the same time work began on quality certification (P-labelling) of the collector in the winning system. P-labelling of the winning collector, if it was not P-labelled already, had been stipulation from the very beginning of the competition.

During the summer of the same year, test installations were fitted in five houses, in order to check the installation procedure in field condition and identify any deficiencies of the system which laboratory testing had, for one reason or another, failed to detect. Under the agreement signed with Uponor, deliveries to the buyer group were not to begin until the solar heating installations in the test buildings had been inspected and approved by SP.

In connection with a severe and prolonged heat wave, reports were received of some of the test houses having developed collector leaks. At the same time, testing by SP revealed a weakness in the collector's absorber. This had not been apparent during the original collector testing, which conformed to the Swedish P-labelling standard, but was first revealed by the pressure testing under stagnation which was not carried out in compliance with the newly introduced European standard SS EN 12975 for collector testing. By the late summer, following analyses, proposals existed from Uponor for requisite reinforcement measures and the competition jury then decided to expand the requirements so that P-labelling of the collector was to be completed before deliveries could start. It was further decided that a test system was to be installed at SP and that the collectors in the four remaining pilot systems were to be replaced, after which the systems would have to be inspected and approved before deliveries could begin. to allow sufficient time for material testing and outdoor exposure in connection with P-labelling, 31st March 2002 was set as the deadline for meeting these requirements.

After reviewing the results presented, the competition jury was able to establish that all requirements had been met. Uponor undertook to complete delivery of the Uposun HW 300 system to 1,000 buyers over a one-year period, in keeping with the framework and delivery agreement drawn up previously. Deliveries began in May 2002 and are being continuously reported to the competition organisers.

The purchaser group:

Matti Nordenström, Miljöaktion Värmland (MAV), was appointed to chair the technology procurement competition. During the project he was also Webmaster in charge of the Swedish home page. The target group for the technology procurement competition, being individual house owners, discussions were initially held concerning the most effective way of reaching them.

The target group for the competition mainly comprised the 500,000 or so houses in Sweden with direct electric heating, but also many other houses in which installation of a separate water heater is feasible. Several strategies were employed to reach this large target group. Brochure material was compiled as a basis for various channels of distribution. Municipal energy advisers, nearly 300 nationwide, were

kept regularly informed by e-mail as the competition proceeded. They were probably an effective channel of distribution. It was directly apparent from the numbers of incoming interest notifications that certain regions had been especially active in conveying the message to their municipal residents. In other cases municipalities addressed direct mail to owners of houses with electric heating. In Stockholm, for example, some 18,000 house owners were contacted in this way.

Notifications of interest were continuously recorded by MAV via the Internet. Soon after the winner of the technology procurement competition had been declared in mid-March 2001, the total number of notifications stood at roughly 4,000. These notifications are divided between persons expressing interest in buying the hot water system specified and those only interested in solar collectors complete with drive package. The latter probably already have an accumulator tank, e.g. for wood-firing, with solar providing both space and water heating – a combined system, in other words. Both possibilities of expressing interest were included in the terms of the competition. To encourage early registration, the buyers were also informed that deliveries would be made on a first come, first served basis, by registration date.

Experiences worth noting

Marketing and information

The list of marketing activities could be extended, but there was no budget to finance advertising. In addition to local distribution of brochures, marketing consisted of information in the form of copy which news media were free to use for articles of their own. Reference to the home page for further information made this a fairly effective method. Articles or spots, for example, were published by nationwide Svenska Dagbladet and Dagens Nyheter, but also by several regional and local papers as well as trade journals. Several items about solar heating were telecast. In addition, Formas organised a press conference and press releases when the winner of the technology procurement competition was announced.

Other events which can be said to have marginally contributed included the "Solklart solvärme" campaign mounted by the Swedish Energy Agency, the National Board of Housing, Building and Planning and SEAS during 2001. Aimed as it was at marketing national investment support for solar heating, this campaign can only have influenced matters through general information about solar heating, added to which, it began late in relation to the procurement.

The pilot installation leakages in the summer of 2001 attracted massive press coverage. Often the deficiencies were mentioned without any mention of the pilot installation systems having been failed. Approved installations were a precondition for the commencement of mass deliveries. It has since emerged that it was other manufacturers who obligingly informed the press, at the same time as the industry deplored the undermining of public confidence in solar heating technology by these adverse reports. One positive effect of the press coverage was a number of new registrations of interest addressed to Uponor direct.

Experience of using the Internet for information and notifications of interest

The question of the most rational way of handling the flow of information and the administration of purchaser groups was discussed at an early stage. The internet and the construction of a separate home page, http://solupphandling.formas.se were a natural choice. (*App. 9,* "Registrations of interest via the Internet"). The home page was intended to function dynamically throughout the process as a channel of information to both manufactures and purchasers. During the introductory phase of procurement, for example, prospective manufacturers wishing to take part in the procurement process could access information on rules, timetables etc and download the invitation to take part and competition documents in both Swedish and English. This was probably the first innovation project in the energy sector where it was planned from the very outset to supply all tender invitation documents in an international language (English) as well as the national one and, moreover, to make them easy to download from the home page. In both competitions a number of tenders were received from companies outside Sweden. There are several important lessons here which can also be applied to other product fields. Subsequently everything of current interest – activities of various kinds, timetables, decisions etc. – was presented as "news". Moreover, all subsequent documents were uploaded as write-protected Word or PDF files.

Good results by this method were conditional on the project being continuously monitored by an active webmaster.

There can be no doubt that a database was essential for coping with purchaser groups of the magnitude involved in this project. A server was connected to the home page, through which more than 2,000 parties either registered interest or enrolled as prospective purchasers. The database made possible sorting operations with reference, for example, to enrolment times, geographic distribution, types of technology choice etc. Functions for address labelling and automatic e-mailing streamlined the flow of

information to the enrollees, energy advisers, county administrative boards, the National Board of Housing, Building and Planning and the funding authorities.

A powerful statistical function was linked to the home page. In this way it could be ascertained from which countries the page had been visited, how long the session had lasted and which parts of the home page had the highest visitor frequency. Hits were also counted (roughly 10,000 per week), but these, being momentary, have not been reported hitherto. Between May 2000 and September 20022 some 50,000 sessions were registered, more than 30 per cent of them emanating from abroad. Session durations ranged from on minute to over an hour, though the average was 2 or 3 minutes.

Experience of collector technology procurement for large systems:

First of all, we may note that the decision to procure collector modules only was prompted above all by resource constraints. The intention was for the buyers themselves to take charge of scaling the remaining parts of a complete system. Subsequent experience indicates that many buyers devoted insufficient resources to preplanning and even to pilot studies. Whether this was due to lack of competent and/or lack of interest is hard to say, but as a consequence the actual purchasing volume and the number of feasible projects included turned out to be too small and, accordingly, less interested as a basis of co-ordinated procurement.

The prospective volume of deliveries was set at 10,000 sq.m., equalling one year's output in the Swedish market. The aim was for this volume to provide additional impetus and elicit more rational production by the manufacturers or other changes in the choice of materials, mode of installation etc., which would alter the cost of the solar collector in a project. As a next step, in addition to the Swedish procurement, Stage 2 of the international co-operation was also expected, which could involve far greater procurement volumes. A review of the tenders received showed, however, that there had not been any breakthrough where technical solutions were concerned, as regards either manufacturing or installation methods. All the firms taking part were previously known as manufacturers or suppliers of solar heating equipment.

The question is what could have been done better or differently:

- How can better, more realistic projects be canvassed?

Probably more competence and resources have to be committed in order to arrive at realistic projects. It should also be mentioned that we made reference to suitable expert consultants who could be engaged for pilot studies at fixed rates, and also that we funded expert consultants, via the project budget, to examine incoming project proposals, but by then it was too late. Perhaps it is more fruitful to give the buyers' own staff basic training in solar heating technology (pilot study and planning) than to try to persuade them to outsource competence.

- How can buyers be induced to act more dynamically?

Successful technology procurement calls for greater buyer power. Offering buyers a cut and dried solution is clearly not enough. Perhaps an "icon" – a leading ambassador of the industry – or several trade organisations could take charge of procurement? In this way perhaps greater pressure could be brought to bear in favour of devising realistic projects and making a firmer commitment to share in the common responsibility which co-operative procurement implies. It should be mentioned in this connection that practically all the relevant major industrial organisations and property companies in Sweden were contacted and invited to take part in the technology procurement. A chairperson who could have been principally task with technology procurement for a period of time might possibly have resulted in a larger volume of co-operative purchasing, provided the funding of the chairperson's input could have been guaranteed.

- How does one go about choosing the system limit, the whole system or just collector components?

The problem here is that systems are so different in terms of size and number of components such as accumulator tanks etc. This also affects assembly and the cost of installation, which is a significant part of the total cost. Possibly a handful of standard sizes could be selected and properties then canvassed for which they would be suitable.

As regards the invitation to take part, one may ask whether the specification of requirements could have been better and more clearly framed. For example, the particulars furnished concerning installation times and costs were hard to evaluate. They showed a considerable spread and, after several rounds of supplementation, still had to be normalised by the jury in order for comparisons to be possible. Perhaps too there were suppliers who were undercutting. This last point, however, was impossible to refute or verify, because procurement was cancelled before any delivery agreements had come up for discussion.

Experience from the solar-heated domestic hot water systems technology procurement competition

In the technology procurement competition, a standardised hot water system was opted for, the advantage being that the whole process of technical design and scaling has been completed and only minor adjustments of pipe lengths etc. are needed for the local building.

A complete system makes heavier demands on evaluation than would be the case with a single component. In return, there is a great intrinsic advantage in being able to offer buyers a complete solution, and many pitfalls are avoided in this way. Commitment to a comprehensive system test of the competition entries in accordance with the new European standard SS EN 12976 paid generous dividends, in that several shortcomings of the systems were revealed and improvements could be suggested in all cases. In its final report on the tests, SP presented a number of suggested improvements to most of the systems taking part – improvements which the participants regarded with honourable mentions pledged themselves to introduce before marketing their systems. The improvements primarily involved simple but effective alterations such as moving a temperature transducer or adjusting a thermostat setting. The companies were also able, free of charge, to consult SP experts when making the improvements.

Subsequently the system test used in the competition was reiterated in the tests carried out by the National Consumer Agency in the summer of 2001. This has clearly raised the standard of knowledge among the manufacturers, and the quality of all marketed systems has gradually improved. Manufactures have been continuously supplied with SP's assessments of the improvements made to their systems.

The delivery volume anticipated in the competition document was defined on two levels, namely 1,000 and 2,000 systems. This again, it was hoped, would be sufficient basis for eliciting more rational solutions. One thousand systems corresponds to a collector area of 5,000-8,000 sq.m., which ought to be an interesting delivery volume.

The evaluation of tenders could have been simplified by greater flexibility in the requirements formulated for an innovation project like this, such as fewer obligatory requirements and more desirable requirements.

The great majority of competition entries came from established collector manufacturers, with the exception of Uponor. Uponor presented a collector design based partly on recycled plastic. The fact of the collector being made of recycled plastic did not in itself sway the evaluation, but the fact of the weight of material being considerably less than with a conventional collector enhanced the installation side of things. No mechanised lifting was required, for example: roof installation could be managed by two persons unaided.

In the case of Uponor the competition had induced a player to venture into a new market. The capacity for innovative thinking is also worth noting. Conventional development has moved in favour of collectors with progressively greater yield per unit of area, but this has been accompanied by a concomitant increase in the cost per unit of area. Uponor chose a cheaper design, which however required a larger total area in order to match the yield of a conventional collector. But if the total cost is lower, this is exactly what the competition was aimed at achieving.

One also finds that Uponor demonstrated an industrial mentality. From the very first presentation of the competition entry, the intention was for production to take place in a manufacturing process involving relatively few manual operations. In addition, the company has development resources for further developing the system and also for developing the collectors for other applications in the solar heat sector.

The delivery commitment in the competition was more or less identified as a manufacturer-to-house owner delivery (the Consumer Purchases Act). This delimitation was made because it was not judged feasible to induce a manufacturer or supplier to offer a house owner delivery inclusive of installation (the Consumer Services Act). The latter is desirable from the consumer's point of view, because warranty commitments etc. are then appreciably clearer (cf. Nutek's heat pump procurement, which included an end price with installation on the customer's premises). In this connection it was felt that direct delivery would yield the best dividend in the competition. So far, indeed, this has worked well on the whole, but we may also note that in several instances the installation firms approached have not been interested in helping house owners with the installation. There are several reasons for this. For example, the technique is unfamiliar (a conservative industry), the installation firm has not been given a discount on the product, because it has already been purchased by and delivered to the house owner, the installation firm has to quote a price for its service which does not include installation discount, there is uncertainty regarding the installation firm's warranty commitment (cf. above, the Consumer Purchases Act and the Consumer Services Act), and in an overheated installation market the above factors generate additional inertia.

Thus delivery conditions in the competition, together with any bottlenecks, were not unknown but if anything were bargained for. Here again, a good solution seems to have been arrived at. Uponor's work in the energy sector includes industrial co-operation with about 1,000 installation firms, among others. This co-operation is already in place, for example, at heat pump installations, where the installation personnel are trained and "certificated" for different products. This is course means a from of quality assurance and the end customer being assured of functional efficiency. The same interface is also to be used for the impending solar heating installations. Training of installation technicians in West Sweden began in the spring of 2002, and a list of qualified installation firms is being published this autumn on Uponor's home page. Later on, after the competition deliveries have been completed, the installation firms will probably order the collector equipment from the supplier, Uponor, direct for installation on the customer's premises. In this way the above mentioned delivery situation as per the Consumer Services Act will be attained as envisaged.

At the time of writing, information has been received that Uponor has quoted a list price of about SEK 22,000, VAT included, for the system. This is to be compared with the price applying to deliveries under the technology procurement competition agreement, namely SEK 16,000 inclusive of VAT. This may seem a drastic increase at first sight, but it can also bee taken to indicate that, following the competition, Uponor is fearful of selling straight to the installation firms, and that the list price includes scope for installation discounts. The discounts in turn will be apparent from the installation item (if shown) in the end price charged to the house owner; that installation cost will probably be lower, relatively speaking, than if the house owner had asked for a separate installation price for a system purchased direct at SEK 16,000 inclusive of VAT.

Listed below, by way of comparison, are the prices per system published by the National Consumer Agency in its journal Råd&Rön, No. 4, 2002, after its system tests in the summer of 2001. These prices are inclusive of VAT but do not include installation or any solar heat subsidy.

Model:	SEK:
Solsystem 3300	32,900 (in three parts)
Batec B 2.30-280	33,900 (package)
Lesol 5	27,840 (in three parts)
Aquasol	24,750 (in three parts)
Inkasol	19,475 (package)
Uposun	16,000 (package)

Uponor have also announced that since the competition their system has been distributed for evaluation by the European sister companies in the same group.

Another point to add is that by November/December 22002 Uponor had delivered 170 systems and secured orders for another 400 or so. So far, by Uponor's estimates, 95% of the customers have fitted the collectors to the roof by themselves, which can be termed a creditable report and a result of light-weight collectors, good assembly instructions and ease of installation. This also reduces the total cost of installation to the house owner if all the installation firm has to do is connect up the water heater.

It is highly important that an innovation project like this should receive sustained support from al the parties by whom it was initiated. There are always risks of various kinds – technical, economic and informational – involved in formulating challenging requirements. It is vital to be able to include various checkpoints in the project, for example by prescribing, as in the present case, that laboratory tests and test installations are to be carried out and examined before full-scale delivery/installation can take place. It is also important for high-level policy-makers to be informed of the project's progress and to be able to defend the project should it come under fire from parties feeling that their own position in the market is liable to deteriorate.

The introduction of a prestigious award for innovative customer groups and suppliers can generate additional publicity and interest where solar heating is concerned. An award of this kind is now being introduced, at the suggestion of Task 24, for the whole of the field in which the international project is active. The first award presentation will take place at the ISES Solar World Congress in Gothenburg in June 2003.

Viewpoints from solar heat companies

Purely generally speaking, it is in the nature of things that technology procurement activities can come in for criticism by the industry, their very purpose being to accelerate market development, which can result n the structural changes which market development is bound to necessitate sooner or later. in Sweden's case the manufacturers comprise about 10 companies operating in regional markets. Observers have said that the present volume of the Swedish market is generally to small to crate significant development opportunities for all manufacturers.

The initial viewpoints (concerning both procurement and the competition) were as follows:

1. The cost requirements were too rigorous.

Remarks:

The discussions preceding the cost requirements in both the buyer groups can be said to have entailed "full stretch" as a concession to the energy and technology alternatives prevailing in the Swedish market. "Boom or bust" was the watchword. But there was an analysis of requirements showing that they were not entirely unrealistic, so long as a larger market base could be created. Despite this initial criticism, a relatively large number of entries were received in which the exacting cost requirements were contained.

2. The timeframe was too limited.

Remarks:

On the whole only a further development of known technology was expected. In the first instance a "proposal on paper" was to be presented, after which prototypes would be assessed and, in the case of systems for single-family dwellings, tested. The time allowed for these items was not intrinsically too short, but required the manufacturers to have enough development resources for moving from paper to prototype. This can be a problem to small firms, as was apparent among other things from the tendering documents not having been read properly, the prototypes not being sufficiently thought out when they came to be installed at SP for testing, and so on. Then again, the firms were invariably assisted with their system development during the first test and also in the Consumer Agency test which followed. There is generally a risk of timetables being overshot, especially where development projects are concerned. So if there is no room for flexibility, the project shouldn't be started. The question if anything is how much scope for manoeuvre can be obtained without prompting undue criticism. There was very little criticism from the buyers who had expressed interest in the systems in the technology procurement competition.

3. The installation cost was excessively weighted (in the assessment).

Remarks:

Firstly, this was clearly stated in both the procurement and the competition documents. Secondly, it was an important argument for enlarging the market. The aim was a product which was easy to install or a system which could be handled by the usual installation and building firms and not, as is usual today, a player directly marketing, selling to and installing for the customer.

Criticism mounted once the situation became "live", and especially when the winner had been chosen in the technology procurement competition, when testing presented problems and when deliveries were held up. It has to be said, however, that there was no criticism of the procurement of large collectors, which of course never advanced to this stage.

Other viewpoints (about the competition), uncommented:

4. Plastic could not be used and the winning collector had a low performance (per unit of area) in relation to other Swedish products.

5. The protracted process (the competition timetable) upset the market, i.e. customers waited for the winning system approved for delivery and did not place orders with other manufacturers.

6. The entrant with the best total score in the test should have won if so much importance had not been attached to the delivery requirement.

7. The malfunctioning collectors (the test buildings) would inflict bad will on the whole industry and the whole competition should be called off.

8. The rigorous cost requirement and the publicity surrounding it created unrealistic expectations among consumers concerning the price of a solar heating system.

Criticism was also expressed by the Active Solar Thermal Industry Group, ASTIG, which sent letters to the organisers (ExCo) in the IEA and SHC countries taking part. (*App. 10*, "Letter from ASTIG, dated 8th October 2001, and Sweden's reply, dated 25th October 2001").

International co-operation

It was already envisaged in the preparatory documents for Task 24 that the first phase of co-operation would take the form of national activities and that activities in the second phase would be enlarged to include co-operation international procurement.

The above mentioned procurement and technology procurement competition were carried out in Sweden. The other countries have employed different procedures.

The Netherlands has reinforced a pre-existing activity with regional campaigns for solar thermal. In these campaigns manufacturers, installation firms and a consulting organisation, Ecofys, are working together. Ecofys is co-ordinator for the regional campaigns in which manufacturers and installation firms are offering discounts to customers ordering systems. The systems are mainly hot water solutions for multi-family dwellings of the order of 20-100 sq.m. The advantage is that the campaigns reduce the marketing effort of the firms taking part and that customers obtain QA'd solutions as discounted cost.

Denmark has carried out several activities, e.g. marketing of solar thermal packages for single-family dwellings in association with an energy company in north Jutland. Not many systems were installed. The idea was for this to generate a buyer group, and so on, but co-operation was discontinued when the company's moving spirit resigned. Denmark has held a competition in the past year, partly inspired by Sweden. Very promising tenders were obtained at a firm price, installation included, for delivery anywhere in Denmark. A 20 per cent cost reduction could be noted. A solar thermal home page was built up to facilitate ordering. This home page was intended as a place where manufactures and installation firms could offer their system and buyers express interest – in short, a marketplace. But the new government which took office decided to make drastic cuts in all renewable energy initiatives, including the solar thermal grants which had been available. Statistics presented from the home page have not indicated any impressive degree of commercial interest.

In Switzerland manufacturers have clearly dissociated themselves from real competitive procurement, but they have taken part in a number of local marketing campaigns and in the compilation of solar thermal manuals. in addition, Switzerland is introducing virtual, on-line procurement as a marketing activity.

Canada has perhaps the smallest solar thermal market of any country, manufacturing companies included. Initially they carried out a small procurement of European systems to evaluate and publicise the technology. In addition a number of small local campaigns have been carried out and joint projects started together with a number of major power suppliers (substitute for electric heating), but these projects did not come to anything. A bigger initiative was started in 2002, aimed at raising the degree of industrialisation and thus heavily reducing costs.

Belgium is fairly new to this co-operation and has adopted the same approach as the Netherlands, i.e. regional campaigns. In one of the regions – the French-speaking one – impressive plans have been presented for a programme to continue until 2010.

The regular expert group meetings taking place have included an interchange and constructive scrutiny of experience.

Invitation to take part in a

Technology procurement competition

Solar collectors for use in larger solar heating systems

A Swedish technology procurement competition forming part of IEA Task 24, Solar Procurement

Contents

On behalf of the Swedish Purchaser Group for IEA Task 24,

2000-04-05:

Background

As part of the IEA 'Technology Procurement, Solar Heating' project (International Energy Agency, Solar Heating and Cooling, Task 24, Solar Procurement), Sweden, Denmark, Canada, the Netherlands and Switzerland are cooperating on joint procurements of solar heating technology. The Swedish Council for Building Research (BFR), the National Energy Administration (STEM) and the LIP Secretariat in Stockholm are the main financiers of the Swedish element of the work.

It has been noted at the international level that:

- although many countries have put a considerable amount of work into research, development and demonstration of solar heating technology there has not yet, despite this, been any significant market breakthrough. However, the work that has been carried out in these fields over many years has created a sound knowledge base for solar heating technology.
- the market for solar heating is local, and sales are generally through local contractors to a few environmentally aware purchasers. Most systems are manufactured in the same country as that in which they are installed, and there are significant price differences between countries.
- today, solar heating installations are too expensive to achieve any larger scale market penetration. A considerable fraction of this cost is simply due to the high proportion of marketing input needed in order to sell just a few installations. In addition, production volumes are low, insufficient to support rational production, which also contributes to an unnecessarily high cost.

The objective of this IEA project is to create an organised purchaser group interest in solar heating systems. This potential market exists in the form of the purchaser groups in each of the countries: other countries are considering joining the project. The purchasing volumes thus created create new opportunities for manufacturers to invest in more efficient production processes and to rationalise their marketing and distribution. In this way, technology procurement projects can open the way for manufacturers to find larger national or international markets.

The overall objective is to create and maintain an expanding market for solar heating systems. An important factor in any such attempt to influence the market is that the cost/performance relationship must be improved. This also includes more rational installation methods, as installation costs constitute an important part of the total cost.

This international project is being operated in two stages (see also under Time Plan), of which the first stage is at present in progress.

- Stage 1 (which was started in 1999) is concerned with national procurement activities for small solar heating systems and large solar collector units, with international coordination.

- A planned Stage 2 (from 2001 until and including 2002) will involve a greater degree of international harmonisation of performance specifications and coordinated procurement activities in a second round of purchasing.

These competition documents are concerned only with Stage 1, the Swedish procurement activities.

The project organisation and the purchaser group

Operation of the Swedish part of the project is in the hands of a project organisation that administers and runs the project. The National Coordinator is Hans Isaksson, of K-Konsult Energi Stockholm AB. A related technology procurement competition, for solar heating systems for the supply of domestic hot water in detached houses, is being run in parallel with this competition.

One of the tasks of the project group is to bring together a ***purchaser group***, whose members commit themselves to the purchase, within the framework of the project, of solar collectors for larger solar heating systems. In this context, 'larger systems' are those requiring over 200 m² per project, although there can be departures from this target size. The Chairman of the purchaser group is Björn Johansson, of AB Enköpings Värmeverk. At present, the group consists of about a score of interested purchasers from local authorities, housing companies, construction companies and energy utilities. (See Appendix 4 for further details.) The purchaser group is assisted by an ***evaluation group*** (see below) for evaluating competition entries received.

The Swedish technology procurement competition for solar collectors for larger solar heating systems

The Swedish 'Solar collectors for larger solar heating systems' technology procurement competition is for a complete system as specified in Appendix 1. It can be seen from Appendix 4, 'Composition of the Purchaser Group', that options have been placed for a total of about 8 000 m² of solar collectors for various projects. Publicity for, and marketing of, this technology procurement project will continue by various means, including advertising campaigns, until 15th August 2000. The objective is to have received binding orders by that time for at least 10 000 m² of collectors. If the amount of binding orders amounts to less than 4 000m², the purchaser group reserves the right to discontinue the procurement.

Phases of the technology procurement competition

The competition has been divided into the following phases (see also under Time Plan):

- *The evaluation phase* = evaluation of the collectors' technical performance and economic aspects, together with ranking of the tenders.

- *The delivery phase* = delivery in accordance with the framework incentive agreement (see the model form in Appendix 5), drawn up in accordance with the binding orders received by August 2000. See Appendix 4 for a list of those involved at the time of writing.

Advertising the technology procurement competition

The competition will be advertised both nationally and internationally via the EU Official Journal. The competition documents (in Swedish) will be sent directly to known Swedish manufacturers. In addition, the Swedish and English documents will also be available on BFR's website http://solupphandling.formas.se and on IEA Task 24's website at http://www.ieatask24.org

Qualifications for submitting entries

The solar collectors that are the subject of this competition shall have been tested and certified by an impartial test organisation, or shall have been submitted to the Swedish National Testing and Research Institute (SP) for initial testing for SP's P-marking approval scheme.

A prerequisite for participation in the competition is the ability to be able to fulfil the above phases of the procurement and also subsequently to be able to mass-produce and deliver solar collectors having a performance equal to that of the submitted tender.

A check will be made to ensure that participants fulfil the general requirements in respect of financial soundness set out in the Public Procurement Act.

Submission of entries

Entries must have been received by not later than 2000-05-31 at the address below. Three sets of all documents, in the form of one original and two copies, shall be supplied.

AB Enköpings Värmeverk
Attention: Björn Johansson
Box 910
SE-745 25 ENKÖPING

NB: Mark envelopes, wrappers etc.: 'Enquiry documents IEA Task 24 - Large systems'.

Evaluation of entries

Entries received before the closing date will be evaluated by an evaluation group, consisting of:

Björn Johansson, Chairman and convenor

Hans Westling, Promandat

Lennart Lundberg, Växjö City Council

Jan-Olof Dalenbäck, Chalmers University of Technology

Ivar Franzén, Eksta Bostads AB

If necessary, the evaluation group will call on the services of other experts.

Obligatory requirements must be fulfilled.

As mentioned above, a substantial improvement in the total cost/performance relationship is most important in achieving greater market penetration of solar heating technology. For this reason, the cost aspects of the system and hardware components, performance and the erection/installation time and cost aspects will be decisive in evaluating entries received.

In addition to the obligatory requirements, there are also ***desirable requirements***. Achievement or bettering of the desirable requirements, and analysis of other information provided, will be included in the evaluation with the relative weightings as shown below.

Evaluation/weighting	**%**
• Cost of erection/installation aspects, based on the supplier's information	30
• Solar heat costs less than the obligatory requirement cost of SEK 200/MWh for 1000 m² and other specified conditions in Appendix 1	30
• Environmental aspects	10
• Aesthetic aspects	10
• Degree of completeness of information in the proposal	10
• Maintenance/length of life aspects	10

In the event of an order volume which, at the time of entering into the agreement with the winner of the competition, is less than 10 000 m², the costs may be adjusted as set out in Appendix 1.

Final evaluation

The purchaser group will nominate one or more winners.

The purchaser group reserves the right to reject incomplete proposals.

Property in the goods/system, origination rights etc.

The manufacturer/supplier retains property in the goods/systems, origination rights etc. for the solar collectors described in the competition entry. If the entry contains information on components that will be the subject of patent applications, this shall be specifically pointed out in the entry.

Secrecy of competition entries and development

Section 8, Paragraph 6 of the Secrecy Act applies to the competition documents and other documents relating to the project and held by AB Enköpings Värmeverk. One of the effects of this is that a company's commercial and operating affairs and circumstances, such as inventions, designs or economic conditions, that have not been made public in any other way are regarded as secret provided that it can be assumed that the company would suffer if such information became available to the public, to competitors or to others. This protection under the Secrecy Act applies for 20 years from the date of receipt of the documents.

Questions

Please submit any questions concerning these documents in writing, to:

Björn Johansson, AB Enköpings Värmeverk, Box 910, SE 745 25 Enköping, fax number +46 171-25412, or by e-mail to bjorn.johansson@varmeverket.enkoping.se.

Questions received will be collated and replied to by not later than 27th April 2000. All questions and answers, in Swedish and in English, will be available from this date on websites http://solupphandling.bfr.se and www.ieatask24.org.

Time plan

Competition documents (Stage 1) sent out/published	2000-04-05
Submission of written questions concerning the competition documents	2000-04-20
Written replies to written questions received	2000-04-27
Latest date for submission of competition entries	2000-05-31
Evaluation	2000-06-01 - 06-30
Nomination of the winner(s)	2000-08-15
First deliveries, Stage 1	2000-11-01

Performance specification - Solar collectors for larger solar heating systems

General
Extent
1. Solar collectors
2. Connection
3. Cost
4. Environment
5. Marking

GENERAL

The following is a description of the requirements drawn up by the purchaser group for the International Energy Agency, Solar Heating and Cooling, Task 24, Solar Procurement technology competition.

EXTENT

This performance specification covers **solar collectors for larger solar heating systems** for use in Sweden (which has a Nordic climate). The collectors must be suitable for mounting on new or existing buildings, on flat or sloping roofs. Those suitable for mounting on flat roofs must also be suitable for ground mounting. In other words, the mounting arrangement can vary, depending on the construction of the building and/or roof as follows:

- mounting on a frame support structure (on a flat roof or on the ground)
- mounting on an existing roof, retaining the under-roof as a sealing layer. (The purchaser group has specified that the solar collectors must be mounted on the existing under-roof structure, or must replace it.)
- as roof hatches, with the collectors also providing a sealing function.

The enquiry material is for the solar collector system itself, i.e. for the collectors, including the necessary hardware for mounting the collectors on frames, directly on the roof or integrating them into the roof, together with all necessary interconnection components. See also Item 1.1.

Site-built solar collectors (i.e. collectors that are finish-assembled on the roof) are not covered by this enquiry.

1. Solar collectors

Obligatory requirements

1. The solar collectors must have been approved when tested by SP or by some other internationally recognised test institute, or ***an application must have been submitted*** to SP for the collectors to undergo initial testing for SP's P-marking scheme.
2. Collectors not yet certified, but for which applications have been submitted to SP for initial testing for P-marking, must have completed ***all the initial testing*** (or must have been tested by some other internationally recognised test institute) before they can be nominated as the winners.
3. It must be possible for the solar collectors to be mounted in at least two of the following three alternatives:
   a) on a frame (on a flat roof or on the ground)
   b) on the roof, while retaining the existing under-roof as a weatherproof layer
   c) on the roof trusses, to serve as a fully weatherproof structure.

Desirable requirements

1: It should be possible for the collectors to be mounted in all three of the obligatory mounting requirements above, i.e.:
   a) on a frame (on a flat roof or on the ground)
   b) on the roof, while retaining the existing under-roof as a weatherproof layer
   c) on the roof trusses, to serve as a fully weatherproof structure.

2: The area of each collector module should be of an appropriate size to facilitate transport, installation and connecting up.

A larger module has better thermal performance, but the area of the collectors must be such as to enable them to be rationally transported and installed.

Information required

1: A test certificate from SP or some other internationally recognised test institute, or notification of submission for testing for P-marking (see also obligatory requirement 1.2).

2: Manufacturing drawings of the collectors, with details of materials.

3: Details of collector dimensions and weights.

4: Installation instructions.

   Instructions shall be provided for mounting the collectors in at least two of the following three alternatives. See also Appendix 3.
   a) on a frame (on a flat roof or on the ground)
   b) on the roof, while retaining the existing under-roof as a weatherproof layer
   c) on the roof trusses, to serve as a fully weatherproof structure.

Sharp corners and edges, and the use of a large number of loose parts, should be avoided. If the weight of any item exceeds 60 kg, it must be provided with lifting points, devices etc.

2. Connection

Obligatory requirement:

The collectors must be designed so that they can be easily connected into larger hydraulic units suitable for use in/with larger systems.

Information required

1: System drawings that show how the units are intended to be connected into larger hydraulic units, with information on pressure drop, suitable thermal media and flow rates.

2: Instructions for commissioning.

3. Costs

Obligatory requirements

1: The cost of solar heat, SK, must not exceed SEK 200/MWh, at an annuity rate of 0.08 and when operating at a mean temperature, TC, of $0.5 * (T_{in} + T_{out}) = 50$ °C.

The cost of heat shall be given on the basis of an order quantity of 10 000 m². (See also below under 'Cost variation as a function of purchased quantities'.)

Base calculation of the energy yield of a collector on insolation for Stockholm in 1986 on an unshaded south-facing collector mounted at an angle of 45°. These parameters are also those used by SP in its evaluation and testing. Collectors tested by some other test institute must give values as based on historic insolation data for Stockholm for 1986 and the above orientation.

The cost of solar heat shall be taken to mean the cost of the collectors, including all components necessary for connecting them to an operating solar collector system/array of at least 200 m² in size, and including two connection points and any necessary shut-off, venting, connecting or safety devices. Costs of support frames, installation, transport and value-added tax are not to be included in this calculation.

As an example, the solar heat cost of SEK 200/MWh can be achieved with an energy yield of 380 kWh/m²,year if the cost of a complete collector installation of the minimum competition size (200 m²) does not exceed SEK 950/m², excluding the cost of support frames, transport and value-added tax. Alternatively, it can be achieved by collector arrays with other cost/yield relationships at TC = 50 °C, e.g. SEK 800/m² and 320 kWh/m²,year, SEK 1200/m² and 480 kWh/m²,year or SEK 1500/m² and 600 kWh/m²,year.

2: The collectors shall have at least two years' guarantee.

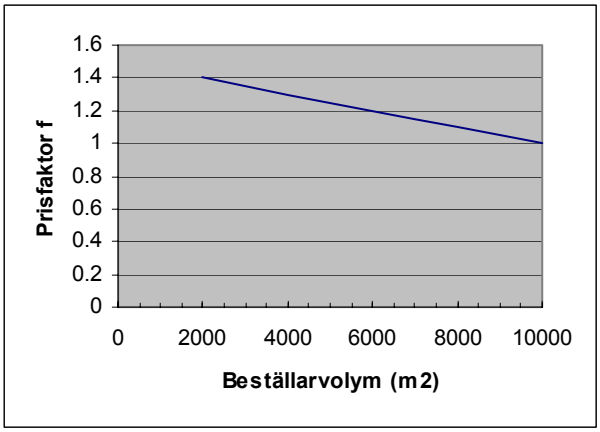
3: It must be possible to transport the collectors by road and install them in a straightforward manner at a low cost.

Cost variation as a function of purchased quantities

If, at the time of signing the contract, the purchaser group's ordered quantity is less than 10 000 m², the cost of solar heat as above, SK_{tender}, may be upwardly indexed as follows:

$$S_{off}^{BV} = f \times S_{off}^{10000} \quad \text{with } f = 1.4 - (BV-2000)/20000$$

where BV is the quantity ordered in m², and SK_{tender} is the tendered cost of solar heat in SEK/MWh. The lower limit for application of this index is 4000 m².



Pricing for individual sub-orders less than 200 m²:

If the quantity of any individual sub-order is less than 200 m², the supplier shall be entitled to charge separately for the (inter) connection components which, in accordance with obligatory requirement 3.1 above, are to be included in the supply, subject to a maximum of 10 % of S_{tender}^{BV} .

Information required

1: Typical erection costs for a minimum order unit (200 m²).

The erection costs shall include erection/installation and connection of the collectors to a solar collector system/array, having two connection points for the supply and return connections, and including miscellaneous materials, support framework, lifting equipment as needed for installation on a three-storey building, site costs and costs of safety equipment. Labour costs shall be given in the form of man-hours, with other costs in SEK.

Quote costs for at least two of the following three alternatives:

a) collectors mounted on a frame (on a flat roof or on the ground)
b) collectors mounted on the roof, while retaining the existing under-roof as a weatherproof layer
c) collectors mounted on the roof trusses, to serve as a fully weatherproof structure.

2: Typical freight costs for a distance of 300 km (within Sweden), for a minimum order unit (200 m²).

4. Environment

Obligatory requirements

Thermal insulation materials may not contain CFC gases, and nor may they contain materials which, at stagnation temperatures, can release gases that can cause serious irritation of the skin or eyes.

Information required

1: Environmental declaration (see Appendix 3).

2: Indication of whether the system manufacturer or sub-contractor(s) is/are certified to ISO 14000 or EMAS.

Solar collectors and all other materials used in the system are intended to save energy and to reduce pollution and emissions. For this reason, the design of the collectors shall, as far as possible, accommodate ultimate re-use of the materials at the end of the collector life. Materials that cannot be re-used/recycled shall not be used unless absolutely necessary.

5. Marking

Obligatory requirements:

Each collector module shall be marked in a suitable and easily accessible position with a plate etc. showing the following information:

- The name of the manufacturer
- The type number, model name/number etc.
- Production or serial number and year of manufacture
- The maximum permissible pressure in the collectors (MPa)
- The maximum stagnation temperature (°C)
- The volume of heat transfer medium for the whole module
- The weight of an empty collector module.

Information required

A description of the data plate and its position.

Tests, standards and references
- Solar collectors for larger solar heating systems

SOLAR COLLECTOR TESTING

SP's initial testing:

- Examination of drawings and materials specifications
- Examination of installation and operation and maintenance instructions
- Pressure testing
- Stagnation and thermal shock testing
- Resistance to wind and snow loading
- Resistance to rain
- Determination of thermal performance
- Calculation of annual energy yield at T_c = 25, 50 and 75 °C
- Resistance to freezing
- Material tests (certain components)
- Preparation of description of properties

SP's procedure for P-marking of thermal solar collectors

After the initial qualifying tests and inspections, collectors are exposed outdoors for a year under stagnation conditions, which can be regarded as accelerated testing. They are then examined, and must show no substantial deterioration in performance, and no substantial changes in components or materials. If all the required tests are successfully passed, and when procedures for future quality control and manufacturing inspection have been agreed with the manufacturer, the particular type of collector may display the P-symbol of approval.

Theoretical yields

SP calculates the collectors' expected annual energy yields at T_c = 25 °C, 50 °C and 75 °C. These values must be stated in the competition entries. When evaluating the entries, the evaluation group will make its own calculations of solar energy yield, based on efficiency factors stated in the test certificate.

SP's annual energy yield figures are calculated for south-facing collectors, mounted at an angle of 45°, and using meteorological data for Stockholm for 1986, for which year the total available insolation amounted to 1062 kWh/m². Calculation is performed using the MINSUN simulation program, using efficiency parameters as measured by SP. Note that the theoretical annual yields will be used primarily for comparison purposes. The actual energy yield of a solar heating system depends not only on available insolation, but also on system design, collector orientation, user habits etc. The reference area, which is usually the same as the transparent frontal area of the collectors, is used when calculating the thermal performance and annual energy yields.

Mean temperatures of T_c = 25 °C, 50 °C and 75 °C are defined as being the mean values of entry and exit temperatures of the heat transfer medium when passing through the collectors. 50 °C is a suitable temperature for comparing solar collectors.

Solar collector testing in accordance with prEN 12975-2

In addition to the above, testing in accordance with prEN 12975-2 includes the following:

- Resistance to shocks and hail.

STANDARDS AND REFERENCES

Standards applied

In general, testing is performed in accordance with a preliminary European standard, prEN 12975-1:1997. It prescribes minimum requirements in respect of performance, materials, tests and documentation. In addition, this competition includes certain requirements that are specific to the competition, including such as reference to the 1994 Swedish Building Regulations, the Swedish climate conditions and the requirement for low system costs. These requirements are clarified below.

Standards and building regulations:

prEN 12975-1:1997 E
Thermal solar systems and components – Collectors – Part 1: General requirements

prEN 12975-2:1997 E
Thermal solar systems and components – Collectors – Part 2: Test methods

National Board of Housing, Building and Planning: BBR94, Building Regulations. BFS 1993:57, with updates BFS 1995:17 and BFS 1998:38.

Hans Wennerholm. Rules for P-marking of thermal solar collectors. SP Swedish National Testing and Research Institute. CEN TC2312/N16, 1994.

INFORMATION ON SOLAR COLLECTOR TESTING

For further information on development testing and performance testing and evaluation in accordance with SP's P-marking regulations, please contact Hans Wennerholm (+46 33-16 55 40) (hans.wennerholm@sp.se) or Peter Kovacs (+46 33-16 56 62) (peter.kovacs@sp.se).

During the period 1998-2000, the Swedish National Energy Administration (STEM) is subsidising the testing of solar collectors by SP by 50 %. This subsidy is available for: 1) development testing, and 2) testing and evaluation for P-marking. The subsidies are handled by SP, from whom further information is available.

Performance details

- Solar collectors for larger solar heating systems

Type/name of the system:	
Place of manufacture:	
Company submitting the tender:	
EN ISO 9000 quality assurance, certificate no.:	
Date/Signature:	
Name in block capitals:	
Address:	
Telephone:	
Fax:	
E-mail:	

Contents

1. Information required

Enter the information required in the right-hand column. Enter quantified data in figures, with other requirements confirmed as appropriate, in accordance with Appendix 1, Performance Specification, e.g. by 'Fulfilled', 'Included', 'See technical description' (pages 4-10 in this appendix), 'See our Appendix x' etc.

COMPETITION CONDITIONS			PROPOSAL
OBLIGATORY REQUIREMENTS	**DESIRABLE REQUIREMENTS**	**FORM OF PRESENTATION**	
1. Solar collectors			
1: Certification			
2: Submitted to SP for initial testing for P-marking			
3: Two of three mounting arrangements			
	1. All three mounting alternatives		
	2. Purpose-designed.		
		1. Test certificate	
		2. Drawings	
		3: Dimensions and weights (per collector module)	Width m Height m Depth m Weight kg
		4: Installation instructions	
2. Connection			
1. System drawings with technical instructions for array			
2. Commissioning instructions			

3. Costs			
1: Max. SEK 200/MWh			SEK/MWh
2. Guarantee (at least two years)			years
3. Low transport and erection costs			
		1. Erection cost (for 200 m²)	Labour hours Other costs SEK
		2: Transport cost (200 m² x 300 km)	SEK
4. Environment			
1: No CFCs or other hazardous gases in the insulation			
		1: Environmental declaration (see App. 3, Item 5)	
5. Marking			
1: Data plate			
		1: Information on plate and siting	

2. Technical description

The solar collectors shall be documented in sufficient detail to enable the evaluation group to form a reasonable idea of the system's cost/performance relationship. In addition, the documentation must clearly indicate the most important material and environmental characteristics, in order to be able to gain an idea of the collectors' life and of the environmental impact of both normal operation and subsequent disposal. Please use the following forms in order to facilitate presentation and make it easier to compare all entries on an equal basis.

Definitions:

Solar collector module: The smallest constituent unit of a solar collector (e.g. a solar collector case).

Hydraulic solar collector unit: The combination of parallel and series-connected collector modules that forms a unit for connection. Hydraulic collector units are then, in turn, connected only in parallel.

Solar collector system: An area of solar collectors, consisting of one or more hydraulic collector units.

Solar collectors [1)]	**Description**
Type (flat plate, vacuum, CPC etc.)	
Method of mounting (Yes / No) - on frame (flat roof and ground) - on sloping roof - on roof trusses	
Minimum slope angle (°)	
Lifting device (required if module weight exceeds 60 kg)	
Number of fixing points per module	
Module dimensions - gross area (m²) - glazed area (m²) - absorber area (m²) - width (horizontal) (m) - height (up the roof surface) (m) - thickness (m) - reflector area (m²)	
Module data - Weight including heat transfer medium (kg) - Max. operating pressure (MPa)	
Solar collector coefficients, test results	η_0 = b_1 = (W/m²·K) b_2 = (W/m²·K²)
Thermal yield , in accordance with test certificate.	At 25 °C (kWh/m²) At 50 °C (kWh/m²) At 75 °C (kWh/m²)
Stagnation temperature (ambient temperature 30 °C, and insolation 1000 W/m²)	
Cover sheet	

- type or material - thickness - coefficient of transmission	
Absorber (colour if applicable) - type - thickness - surface coating (colour if applicable) - coefficient of absorption, α - coefficient of emission, ε	
Recommended heat transfer medium - concentration - boiling point (°C) - freezing point (or bursting point) (°C)	
Recommended flow / pressure drop Flow (l/h,m²) Pressure drop (kPa) - per module - per hydraulic unit	
Mounting plates (flashing) included? (Material, colour)	

1) If information is provided in appendices, please refer to them.

3. Example of data plate

Marking (see Appendix 1, Item 5)

4. Aesthetic aspects

Aesthetic aspects of the appearance of the collectors and the collector system will be considered when evaluating the entries. As far as it is possible to judge such an aspect objectively, the appearance of the roof-mounted collectors shall be 'natural', and of a style that is likely to be accepted by the general public. This means that the design of the collector, the glazing and the design and colour of the absorber need to be considered in order to achieve a satisfactory solution. Roof structure designs that look as if they belong on factory roofs should be avoided. If necessary, the evaluation group will be asking architects and/or other experts to consider the architectonic aspects.

Aesthetic aspects: Design aspects that the manufacturer wishes to emphasise from an aesthetic point of view.

Refer if necessary to attached documents, illustrations, photographs etc.

5. Environmental declaration

The solar collector modules offered and specified in these documents

Type .....

Serial no. .....

contain the ***following reusable materials per 200 m²:***

Metals	Aluminium	kg
	Iron and steel	
	Galvanised steel	
	Copper, brass, bronze	
	Other metals	
Other	Glass	kg
	Polymers (plastic, rubber etc.)	
	Foamed materials	
	Mineral wool and glass fibre	
	Wood	
	Other material	

Recommended heat transfer medium/media
- Chemical substance
- Environmental impact
- Discharge restrictions

In addition, each 200 m² of solar collector contains the following quantities ***of the following non-reusable*** materials:

.....

.....

In addition, the system contains the following products (e.g. tin, Teflon™, paints and varnishes, toxic substances etc.), the use of which is covered by restrictions due to their adverse environmental impact:

.....

.....

6. Other documentation

The following documentation must be attached to the entries:

- *Drawings of the solar collectors, showing dimensions and with details of materials and any restriction on mounting angle*
- *Drawings and instructions for connecting the solar collector unit into hydraulic modules*
- *Installation instructions for the solar collectors, including transport instructions*
- *Instructions for recommended heat transfer medium, as well as for filling, draining and changing the medium*
- *Recommended heat transfer medium flow rate*
- *Any instructions needed for protection against overheating and/or freezing*
- *Instructions for replacing the glazing*
- *Any special requirements in respect of maintenance*
- *Instructions for end-of-life disposal*
- *Illustrations, photographs etc. to illustrate aesthetic aspects (not obligatory).*

Appendix no.	Description

Technology procurement of solar collectors for larger solar heating systems

The purchaser group

Publicity for the technology procurement programme for larger solar heating systems is being run from the autumn of 1999 until 15th August 2000, by which time options on collector quantities should have been firmed up into orders. As at 31st March 2000, options to purchase collectors have been given by the companies listed below. In addition, further marketing activities are being carried out, which means that further new purchasers should come forward.

The companies listed are members of the sector associations etc. listed below.

Purchasers who have placed orders or given options for the technology procurement of solar collectors for larger solar heating systems:

Behrn Fastigheter
Birka Energi AB
BOEK AB
Bromölla District Council
Byggnadsfirman Bullarhöjden
Byggnadsfirman Lund AB
Drott AB
Eksta Bostads AB
Höör District Council
Kungälv District Council
Mölndalsbostäder AB
Trosa Närvärme AB
Regionfastigheter Sydväst
PRB Boden
Skanska Bostäder AB
Stadsfastigheter i Malmö
Sunne kommunfastigheter
Sydkraft AB
Vattenfall AB
Västerviks bostads AB
Västerås City Council
Örebro City Council
Örebrobostäder AB

Companies that have expressed interest in participating belong to the following sector organisations:

- Byggentreprenörerna (Swedish Construction Federation)
- HSB Riksförbund
- Sveriges Bostadsrättsföreningars Centralorganisation, SBC
- HBV
- Kommun- och Landstingförbundet (Swedish Association of District and County Councils)
- SABO

2000-04-05

- Riksbyggen
- Sveriges Fastighetsägaresförbund (Swedish Federation of Rental Property Owners)
- Svenska Fjärrvärmeföreningen (The Swedish District Heating Association)

The purchaser group project

The group was invited to join the technology procurement project as potential purchasers of solar collectors for installation as follows:

a) mounting on a frame support structure (on a flat roof or on the ground)

b) mounting on an existing roof, retaining the under-roof as a sealing layer (the purchaser group has specified that the solar collectors must be mounted on the existing under-roof structure, or must replace it)

c) as roof hatches, with the collectors also providing a sealing function.

As at 31st March, the purchaser group has given options for the purchase of about 8000 m² of solar collectors, as follows:

a) mounting on a frame support structure (on a flat roof or on the ground) 500 m²

b) mounting on an existing roof, retaining the under-roof as a sealing layer 7 000 m²

c) mounting on roof trusses, providing a sealing function 500 m²

Publicity for, and marketing of, this technology procurement project will continue until 15th August 2000, by which time it is hoped that the existing options will have been firmed up into binding orders for at least 10 000 m² of collectors. If the amount of binding orders amounts to less than 4 000m², the purchaser group reserves the right to terminate the procurement.

Model form of framework agreement

FOR THE SUPPLY AND DELIVERY OF SOLAR COLLECTORS FOR LARGER SOLAR HEATING SYSTEMS

The following points will be included in any framework agreement:

1. The parties to the agreement:
   The purchaser:
   The supplier:

2. The purchaser undertakes to support the ordering of at least ..... m² of solar collector in the form of call-off orders from various property owners/organisations/private persons, as based on the terms and conditions in this framework agreement. Orders are subject to the receipt of any necessary public authority permissions etc. and to the achievement of approved test results.

3. Delivery of systems . . . .

4. The competition is divided into phases, as described in the competition documents. The Purchaser shall authorise the start and continuation of each phase.

5. Contract documents
   These consist of the contract, the competition documents and appendices, any requirements associated with orders, the competition entry and applicable parts of AOLS 81.

6. Prices
   Solar collectors: SEK/MWh
   Erection/installation cost:
   Transport cost:
   Prices including value-added tax.

7. Times
8. Testing in accordance with ...
9. Guarantee
10. Terms of payment
11. Property rights, design rights etc. and the right to refer to this competition in marketing.
12. Confidentiality
13. Service and maintenance
14. Representatives
15. Resolution of any disputes
16. Termination (if results cannot be achieved within the intended time etc.)
17. Call-off rights within the prescribed time period for the specified group of purchasers.
18. Rights to, and prohibition of, assignment.

The Swedish technology procurement competition for solar collectors for larger solar heating systems

Part of IEA SHC Task 24

The competition

Background and purpose

This competition was initiated as part of Sweden's participation in IEA SHC, Task 24 "Solar Procurement", and was funded through BFR (now FORMAS), the Swedish Energy Agency and the City of Stockholm LIP Office. The purpose of this IEA co-operation is to develop solar thermal systems by showing a more organised buyer interest. Through the order volumes thus exposed, new opportunities will be created for manufacturers to invest in more efficient manufacturing and rationalise their marketing and distribution.

The purpose of the present technology procurement competition is to provide collectors for large solar heating systems in Sweden. In addition, these systems are to have a better price-performance relation than the systems marketed hitherto.

Jury

The entries were evaluated by a jury consisting of the following persons:

Björn Johansson Chairman Enköping	*Hans Isaksson* Secretary K-Konsult Stockholm AB	*Hans Westling* Expert Promandat AB
Jan-Olof Dalenbäck Expert Institution for Building Services Engineering, Chalmers University of Technology	*Peter Kovacs* Expert The Swedish National Testing and Research Institute	*Ivar Franzén* Expert EKSTA Bostads AB

Assessment

The entries were assessed on the overriding condition of the system supplier being able to deliver **10,000 sq.m.** of solar collectors, with a heating cost of less than **SEK 200/sq.m.** (in accordance with the conditions stated in the competition documents) and at low installation cost. As a basis for decision, selected entries were evaluated with reference to obligatory and desirable requirements with the following criteria and weighting.

Assembly/installation aspects – 30%: Assembly comprises at least two of three stated alternatives, viz mounting on a ceiling, on roof trusses and on a frame support structure. The assessment is based on the state cost of a minimum unit of 200 sq.m. together with a parallel assessment of differences in mode of installation on the ceiling of a three-storey apartment building..

Environmental aspects – 10%: The assessment is based on the specific weight of the collector in relation to a stated specific heat yield. **Aesthetic aspects – 10%:** This is a subjective assessment, based above all on how well the collectors are integrated with the ceiling and how they have been adapted for mounting on a frame support structure. **Completeness of particulars furnished in the entry – 10%:** This assessment is based on previous experience of various collector designs.

The entries

Initially the jury received 11 solar collector entries. Six of these contained collectors already approved in SP's introductory inspection for P-labelling (or the equivalent), 2 contained collectors at the testing state, 2 contained new designs registered for testing and 1 tender was judged to be below standard.

A review of the designs showed some entries to contain collectors less suitable for installation in large facilities (small modules). None of the other tenders contained a general solution which would work equally well with all three modes of installation. Some have been developed for frame support mounting and adapted for roof mounting, some have been developed for roof mounting and adapted for frame support mounting, while one tender was developed with dimensions for roof truss installation.

Jury pronouncement

The jury has found several entries to meet the technical requirements for two modes of installation with pre-existing collectors. No significant adjustments to a third mode of installation have been discernible. The mode of installation and form of contract therefore have a decisive bearing on the outcome. Choice in a specific project should be based, apart from stated price, on the suitability of the collector, with reference to an appropriate description of the specific on-site conditions.

On the other hand the jury notes that the purpose of the technology procurement, namely that of co-ordinating orders for 10,000 sq.m. of collectors (and not less than 4,000 sq.m.) was not achieved, so that for the time being the procurement of solar collector technology for larger systems cannot be pursued any further.

This being so, the jury has seen no justification for selecting a winner but has instead to name the entries found to best satisfy the technical requirements; see Appendix.

Stockholm, 15th September 2001

Björn Johansson	Hans Isaksson	Hans Westling
Jan-Olof Dalenbäck	Peter Kovacs	Ivar Franzén

Appendix to:

The Swedish technology procurement competition for solar collectors for larger solar heating systems

Part of IEA SHC Task 24

Entries mentioned

The following table shows (in alphabetical order) the 5 suppliers whose entries were judged to met the stated requirements in such a way as to deserve mention. All the suppliers mentioned have solar collectors which are nearly equal in terms of performance. The stated heat yield (as per the stated conditions) varies between 410 and 445 kWh/yr x sq.m., the highest performance being that of collectors with anti-reflex coated glass.

Supplier	Brief description
ARCON Solvarme A/S	Modular collectors, mainly for mounting on frame support structure and outer roof.
Arnes Plåt AB	Modular collectors, mainly for mounting on ceiling and frame support structure.
Derome AB	Roof module, mainly for mounting on roof trusses and frame support structure.
S.O.L.I.D. gmbH	Modular collectors, mainly for mounting on ceiling and frame support structure.
Solsam Sunergy AB	Modular collectors, mainly for mounting on frame support structure and outer roof.

The main differences concerning the choice of material for absorbers, the constituent material and design of box (especially as regards measurements) and the way in which the modules are interconnected, while on the other hand they all have about the same weight.

The suppliers mentioned and their collector designs are described in greater detail below, with examples of reference installations.

ARCON Solvarme A/S

The entry comprises ARCON's "standard collector", i.e. a modular collector mainly of aluminium, with an aluminium absorber (Sunstrip NIOX), convention barrier (PTF) and glass covers. The standard collector size is 12.5 sq.m. aperture area. ARCON has erected a large number of installations in Sweden, Denmark and Germany, with both frame support and roof mounting, e.g. 10,000 sq.m. ground-level collectors in Kungälv (illustrated below). The collector has been awarded the German *Bauartzulassungskennzeichen*.

Arnes Plåt AB

The entry comprises Arnes Plat AB's "standard solar collector (Aquasol BIG), i.e. a modular collector mainly of galvanised sheet steel with a copper absorber (coated with black chromium) and glass

covering. This collector comes in sizes ranging from about 10 to 20 sq.m. Arnes Plåt AB has erected a number of installations in Sweden, both support-frame and roof-mounted, including for example 1,200 sq.m. roof-mounted collectors in Fränsta (pictured below).

Derome AB

This entry comprises Derome AB's "standard solar collector", i.e. a modular collector (really a roof element with in-built collector) mainly of wood, with an aluminium absorber (Sunstrip NIOX) and glass covering. This collector is available in a standard width of 2,400 mm (or alternatively 1,200 mm) and to the required length (the collector part in multiples of 600 mm) and in sizes from about 10 to 20 sq.m. As subcontractor Derome AB has erected several installations in Sweden with both roof-truss and roof mounting, e.g. 705 sq.m. collectors at Gårdsten in Gothenburg (illustrated below).

SOLID gmbH

The entry comprises SOLID gmbH's "standard solar collector", i.e. a modular collector mainly of wood, with an aluminium absorber (Sunstrip NIOX) and glass covering. This collector is available in sizes from about 10 to 20 sq.m. SOLID gmbH has erected several installations, mostly in Austria (but also in Germany and in Henån, Sweden) with both roof-truss and roof mounting, e.g. 1,200 sq.m. roof-mounted collectors in Eibiswald, Austria (pictured below). The collector has been awarded the German *Bauartzulassungskennzeichen*.

Solsam Sunergy AB

The entry comprises Solsam Sunergy AB's "standard solar collector", i.e. a modular collector mainly of galvanised sheet steel with an aluminium absorber (Sunstrip NIOX), a convection barrier (PTF) and glass covering (AR glass). This collector is available in sizes from about 6 to 30 sq.m. Solsam Sunergy AB has erected a large number installations with both roof-truss and roof mounting, e.g. 700 sq.m. roof-mounted collectors at Hågaby, Uppsala, Sweden (pictured below).

Invitation to take part in a

Technology procurement competition

Systems for solar-heated domestic hot water supply in detached houses

A Swedish technology procurement competition forming part of IEA Task 24, Solar Procurement

Contents

On behalf of the Swedish Competition Organisation for IEA Task 24, 2000-01-21:

Background

As part of the IEA 'Technology Procurement, Solar Heating' project (International Energy Agency, Solar Heating and Cooling, Task 24, Solar Procurement), Sweden, Denmark, Canada, the Netherlands and Switzerland are cooperating on joint procurements of solar heating technology.

It has been noted at the international level that:

- although many countries have put a considerable amount of work into research, development and demonstration of solar heating technology there has yet, despite this, not been any significant market breakthrough. However, the work that has been carried out in these fields over many years has created a sound knowledge base for solar heating technology.
- the market for solar heating is local, and sales are generally through local contractors to a few environmentally aware purchasers. Most systems are manufactured in the same country as that in which they are installed, and there are significant price differences between countries.
- today, solar heating installations are too expensive to achieve any larger scale market penetration. A considerable fraction of this cost is simply due to the high proportion of marketing input needed in order to sell just a few installations. In addition, production volumes are low, insufficient to support rational production, which also contributes to an unnecessarily high cost.

The objective of this IEA project is to create an organised purchaser group interest in solar heating systems. This potential market exists in the form of the purchaser groups in each of the countries: other countries are considering joining the project. The purchasing volumes thus created create new opportunities for manufacturers to invest in more efficient production processes and to rationalise their marketing and distribution. In this way, technology procurement projects can open the way for manufacturers to find larger national or international markets.

The overall objective is to create and maintain an expanding market for solar heating systems. An important factor in any such attempt to influence the market is that the cost/performance relationship must be improved. This also includes more rational installation methods, as installation costs constitute an important part of the total cost.

This international project is being operated in two stages (see also under Time Plan), of which only the first stage is at present confirmed.

- Stage 1 (up to and including 2000) is concerned with national procurement activities (types and number of systems with separate performance specifications etc.), but with an overall international coordination.

- Stage 2 (from 2000 until and including 2002) will involve a greater degree of international harmonisation of performance specifications and coordinated procurement activities.

This competition documents are concerned only with Stage 1, the Swedish procurement activities.

The Swedish technology procurement competition for solar-heated domestic hot water systems in detached houses

The Swedish 'Solar-heated domestic hot water systems in detached houses' technology procurement competition is for a complete system as specified in Appendix 1.

- It is estimated, as stated in Appendix 1, that the total number of systems to be supplied in this stage of the competition will be at least 1000.

- It is also a requirement that it will be possible for purchasers to buy only the solar collector modules, at prices stated in the material submitted.

- It is expected that the first systems would be supplied in the autumn of 2000, with deliveries continuing over a year from that date, in accordance with a framework incentive agreement.

Phases of the technology procurement competition

The competition has been divided into the following three phases (see also under Time Plan):

- *The 'paper' phase* = written proposals, which will be assessed against the competition's performance specification after opening the tenders. Parties submitting tenders will be notified if their proposals have been selected to go forward to the next phase.

- *The testing and evaluation phase* = laboratory testing of selected systems, in accordance with the test procedures described in Appendix 2. In addition, factors relating to installation will be assessed.

- *The delivery phase* = distribution in accordance with the framework incentive agreement (see the model form in Appendix 4). Orders will be grouped in conjunction with regional campaigns, starting in the spring of 2000, and complemented by other information activities and the taking of orders via the project's website.

Advertising the technology procurement competition

The competition will be advertised both nationally and internationally via the EU Official Journal. The competition documents (in Swedish) will be sent directly to known Swedish manufacturers. In addition, the Swedish and English documents will also be available on BFR's website http://solupphandling.formas.se and on IEA Task 24's website at http://www.ieatask24.org

Qualifications for submitting entries

A prerequisite for participation in the competition is the ability to be able to fulfil the above phases of the procurement, i.e. not only to have the capacity to supply samples or prototypes for evaluation, but also subsequently to be able to mass-produce and deliver solar heating systems having a performance equal to that of the samples or prototypes.

A check will be made to ensure that participants fulfil the general requirements in respect of financial soundness set out in the Public Procurement Act.

Submission of entries

Entries must have been received by not later than 2000-03-31 at the address below. Three sets of all documents, in the form of one original and two copies, shall be supplied.

Miljöaktion Värmland (Värmland Environmental Action Programme)
Attention: Matti Nordenström
Landstingshuset
SE-651 82 KARLSTAD

NB: Envelopes, wrappers etc. must be marked: 'IEA Task 24 SOLAR PROCUREMENT'.

Evaluation of entries

Entries will be evaluated by a jury appointed by the Swedish Competition Organisation. The jury will be looking for entries that are "most economically preferable", as set out in the Public Procurement Act.

Obligatory requirements must be fulfilled.

As mentioned above, a substantial improvement in the total cost/performance relationship is most important in achieving greater market penetration of solar heating technology. For this reason, both the cost aspects of the system and hardware components and the erection/installation aspects in relation to performance will be decisive in evaluating entries received.

In addition to the obligatory requirements, there are also ***desirable requirements***. Achievement or bettering of the desirable requirements, and analysis of other information provided, will be included in the evaluation with the relative weightings as shown below.

Evaluation/weighting	**%**
• Erection/installation aspects	40
• Price/performance aspects for the system and components	30
• Environmental aspects	10
• Degree of completeness of information in the proposal	10
• Maintenance/length of life aspects	10

Physical submission of test installations/prototypes etc.

Test installations/prototypes that have been selected for further consideration shall be sent by the manufacturer/supplier, at the latter's cost, to the specified test site.

At the test site, the manufacturer/supplier will be responsible for erection and installation of the system, but will follow the instructions and time plans of the test organisation in all other respects. The actual testing will be financed by the competition organisation.

Final evaluation

The competition organisation will nominate one or more winners.

The competition organisation reserves the right to reject incomplete proposals.

Property in the goods/system, origination rights etc.

The manufacturer/supplier retains property in the goods/systems, origination rights etc. for the test installations/prototypes submitted. If the entry contains parts etc. that will be the subject of patent applications, this shall be specifically pointed out in the entry.

Secrecy of competition entries and development

Section 8, Paragraph 6 of the Secrecy Act applies to the competition documents and other documents relating to the project and held by Miljöaktion Värmland, Värmland County Council. One of the effects of this is that a company's commercial and operating affairs and circumstances, such as inventions, designs or economic conditions, that have not been made public in any other way are regarded as secret provided that it can be assumed that the company would suffer if such information became available to the public, to competitors or to others.

This protection under the Secrecy Act applies for 20 years from the date of receipt of the documents.

Decisions on secrecy considerations are the responsibility first of the Värmland County Council, and may be appealed to the Administrative Court of Appeal and thereafter possibly to the Supreme Administrative Court.

After competition entries have been received, all entrants will be asked for information indicating on which parts of their entries information may not be released due to secrecy considerations.

Questions

Please submit any questions concerning these documents by not later than 2000-02-07, in writing, to one of the following addresses:

matti.nordenstrom@miljoaktionvarmland.org, (Matti Nordenström, Miljöaktion Värmland, Landstingshuset, SE-651 82 Karlstad) or to fax number +46 54 19 43 06.

Questions received will be collated and replied to by not later than 21st February 2000. All questions and answers, in Swedish and in English, will be available from this date on websites http://solupphandling.formas.se and www.ieatask24.org.

Time plan, Stage 1

Competition documents (Stage 1) sent out/published	2000-01-21
Submission of written questions concerning the competition documents	2000-01-24 - 02-07
Written replies to written questions received	2000-02-21
Latest date for submission of competition entries	2000-03-31
Notification of selected samples/prototypes	2000-05-05
Submission of selected samples/prototypes to SP	2000-05-29
Testing/evaluation	2000-05-29 - 07-31
Nomination of the winner(s)	2000-09-29
First deliveries, Stage 1	2000-11-01

Performance specification - Solar-heated domestic hot water systems for detached houses

General

Extent

1. System
2. Costs
3. Solar collectors
4. Solar collector circuit
5. Heat storage tank/water heater
6. Energy meter
7. Environment
8. Marking

General

The following is a description of the requirements drawn up by the competition organisation for the International Energy Agency, Solar Heating and Cooling, Task 24, Solar Procurement technology competition.

Extent

This performance specification covers **solar heating systems for the production of domestic hot water** for detached houses or for apartments in smaller apartment buildings, both new and existing, in Sweden (which has a Nordic climate). The system consists of the following main component groups: solar collectors, a hot water heat storage tank and the necessary equipment for transferring heat from the solar collectors to the domestic hot water system. The requisite control equipment is also to be included.

Those systems which, after a first investigation 'on paper', are regarded as being worth testing, will be tested in accordance with prEN 12976-2 - ISO/DIS 9459-5: see Appendix 2. **Manufacturers whose equipment is sent forward for testing in this way must have a prototype available for testing by not later than the date specified in these competition documents**.

1. System

Obligatory requirements

1: The proportion of heat supplied by solar energy must amount to at least 50 % of the total annual domestic hot water requirement for a household, under the following conditions: a south-facing position, with a 30° roof slope, climate data as for Stockholm, 1986, domestic hot water requirement of 2650 kWh/year (= on average, 150 l of hot water per day at a temperature of 50 °C).

If the annual tank losses are assumed to be 500 kWh, the solar collectors should supply at least 1825 kWh/year to the hot water storage tank (1325 + 500). See Appendix 2.

2: With the electric immersion heater or other non-solar heat input turned off, and with an incident solar energy input of at least 6 kWh/m², day, it must be possible to raise the temperature of at least 150 l of water to >50 °C by the end of the day.

3: In all other respects, the system shall fulfil the requirements for domestic hot water production set out in the 1994 Swedish Building Regulations.

Information required

1: A drawing of the system showing the various components in it, together with a description of the method of hot water production (i.e. whether it is stored directly in the heat storage tank or heated in a heat exchanger). If some other arrangement is employed, it must be described.

2: A function description (possibly with details of different operating modes, such as spring, summer, autumn and winter).

3: User instructions, with suggestions for suitable installation arrangements, maintenance procedures, fault-tracing etc.

4: Installation instructions and instructions for commissioning.

These instructions must describe the installation work on a step-by-step basis, such that the intended function and performance are achieved. Installation must not require anything other than normal professional trade skills. If some special authorisation is required for any particular part of the work, it must be pointed out.

Comments: Requirements 3 and 4 need be fulfilled only in connection with prototype testing.

2. Costs

Obligatory requirements

1: The cost for a complete system must not exceed SEK 16 000, including value-added tax, as delivered to a customer in Karlstad.

Costs shall be expressed assuming an annual production/sales volume of 1000 systems.

2: The system shall have at least two years' guarantee.

3: One of the objectives of this technology procurement competition is to achieve low installation costs for the complete system. Entrants must therefore state attested typical installation times as needed by an authorised installer.

Desirable requirements

1: The cost for a complete system must not exceed SEK 14 000, including value-added tax, as delivered to a customer in Karlstad.

Costs shall be expressed assuming an annual production/sales volume of 2000 systems.

Information required

1: The cost of a complete system, with all components.

The cost of the solar collectors alone must also be stated, as a basis for evaluation.

2: Attested typical installation times by an authorised installer for the typical house as described below, broken down as further described:

A 1½ storey house, having existing heat supply equipment/hot water storage tank for domestic hot water on the ground floor.

a) Installation of the solar collectors on an existing roof. Assume that the roof is tiled.

b) Installation of connection pipes to and from the solar collectors (indicating their routing and length) between the collectors and the heat storage tank (running the pipes outside the house and through the exterior wall to the connection point).

c) Installation of a new heat storage tank with circulation circuit, or of a complete equipment unit, additional heating equipment and connection to the existing domestic hot water circuit.

3: The cost for possible options, e.g. energy meter, regular maintenance and the amount of electrical energy required for operation.

3. Solar collectors

Obligatory requirements

1: The solar collectors must be approved by testing by SP or some other internationally recognised test institute.

2: The solar collectors winning the competition must be P-marked.

Information required

1: Test certificate from SP or from some other internationally recognised test institute.

New solar collector designs must have been submitted for SP's initial inspection for the P-marking process, and test certificates must be submitted by not later than one month after the concluding date of this stage of the technology procurement competition.

2: The solar collector dimensions, weight, performance etc.

3: A description of installation etc.

4. Solar collector circuit

Obligatory requirements

1: Electronic control unit, with sensors for starting and stopping functions, pressure protection and overheating protection to be included.

2: The system shall have a circulation circuit, with thermally insulated pipes for connection between the solar collectors and the heat storage tank.

Desirable requirements

1: As far as possible, the equipment of the circulation circuit shall be built into a factory-made 'drive unit' in order to facilitate as quick and simple installation as possible.

The circulation circuit for the solar collectors should include: circulation pump, reverse-flow protection, antifreeze to prevent the heat transfer medium in the solar collector circuit from freezing, any temperature limitation device if needed for the solar collectors, filling and drain valves, collecting vessel (drain tank) if required etc. Pressure limitation and expansion device in order to avoid damage to the collectors, including safety valve and pressure gauge. Thermometers for indication of temperatures to and from the collectors. Insulated double pipe connection between the solar collectors and the heat store.

2: The signal cable for the sensors in the solar connectors should be integrated in the piping connection between the solar collectors and the heat store.

One way in which this could be done is to use the 'lifeline' system, which has been developed in Canada and consists of an integrated and insulated set of pipes and wires, comprising the liquid supply and return connections and the signal connections for sensors fitted in the collectors.

Information required

1: The design and standard lengths of the pipe and wire connections.

2: A function description, including recommendation for suitable siting of the control unit.

5. The heat storage tank/water heater

Obligatory requirements

1: The maximum size of the heat storage tank must not exceed 600 x 600 x 2200 mm (width x depth x height).

2: The heat loss from the tank must not exceed 600 kWh/year.

3: The heat storage tank must be approved for use as a hot water calorifier, and be modified as required for use with solar heating systems.

Pressurised tanks must be approved for a hydraulic pressure of at least 1 MPa, with allowance for any water hammer. The normal tap water system pressure is 0.6 MPa. The heat storage tank must be made of suitable materials and in such a manner as to resist corrosion.

See Reference /1/ and ISO TR 10217 for further information on corrosion.

The tank must be fitted with all necessary filling and drain devices, together with safety devices for pressure and temperature protection. A set of valves for connecting to the cold water supply is not included in the delivery.

4: A complete set of auxiliary heat supply equipment shall be included. This may consist, for example, of an electric immersion heater or of some means of supplying additional heat to the solar heating circuit.

> *The 1994 Swedish Building Regulations require immersion heaters to have a rating of at least 1.7 kW if the system includes a hot water storage tank with a capacity of about 200 l. Alternatively, the water temperature may also be raised outside the hot water storage tank, using some form of electrical storage or through-flow heater. Note, however, that this generally requires a higher installed power supply capacity in order to meet the 1994 Building Regulation requirements, amounting to about 35 kW for on-demand heating of cold water.*

The additional heating system must be straightforward to set up and adjust, and the hot water storage tank must be fitted with a least one thermometer, displaying the temperature in the upper part of the tank.

If the additional heat is supplied directly to the heat storage tank, the internally or externally fitted immersion heater must be installed in, or connected to, the upper third of the tank in order to be able to maintain the necessary temperature there. In systems in which the domestic hot water is stored directly in the heat storage tank, the top of the tank must be continuously maintained at a temperature of at least 60 °C. In systems in which the tap water is heated by drawing it off through a heat exchange coil or a heat exchanger, it must be heated to a temperature of 55 °C.

The heat storage tank must be prepared for possible later connection of waterborne additional heating instead of electric heating (i.e. incorporating a heat exchange coil).

Desirable requirements

1: The tank should be fitted with an integral heat exchange coil, with connections for connecting a source of waterborne additional heating.

Information required

1: The dimensions, weight and U-value of the tank (or a detailed description of how the tank is insulated).

2: The type of tank to be used (an unpressurised storage tank for indirect production of domestic hot water, or a pressurised tank for direct storage of domestic hot water), identification of materials used in order to resist corrosion, measures taken to prevent the transfer of taste or odour to the domestic hot water and how any input of health-hazardous substances, or the growth of micro-organisms in the water, is prevented. In general, features must comply with the requirements of prEN 806-1 and prEN 1717.

3: A description of how and where additional heating is supplied, and of how it can be controlled.

4: A description of the preparations for an inbuilt heat exchange coil, or a description of an inbuilt coil, with connections for connecting to a waterborne heating system.

5. A description of the necessary electrical connections, i.e. single-phase or three-phase.

6. Energy meter

Desirable requirements

1: An energy meter to indicate the amount of solar energy supplied to the tank or the net solar energy withdrawn from it.

This information may also be provided by simple calculation in/by the control unit.

2: Energy meter for additional heating, e.g. electricity meter.

This information may also be provided by simple calculation in/by the control unit.

Information required

1: Type of meter, costs, information for quality assessment and siting of the meter.

7. Environment

Obligatory requirements

1: The heat transfer medium used in the solar collector circuit must not be toxic, cause serious irritation of the skin or the eyes, or pollute watercourses, and must be biologically degradable.

2: Thermal insulation materials used in the solar collectors may not contain CFCs. In addition, the insulation must not contain substances which, when raised to stagnation temperatures, could release gases that can cause serious irritation of the skin or the eyes.

Information required

1: The type of materials used in the solar collectors and the type of heat transfer medium, together with their potential or possible environmental effects.

2: Environmental declaration (see Appendix 3).

3: Indication of whether the system manufacturer or subcontractors is/are certified to ISO 14000, EMAS or similar environmental management systems.

Comments: For the time being, polypropylene glycol is acceptable as an antifreeze, provided that steps are taken to prevent it being discharged to a watercourse. The solar collectors, and all other materials in the system, are intended to save energy and to reduce pollution and emissions. The system must therefore be designed to facilitate re-use of the materials as far as possible.

8. Marking

Obligatory requirements

1: Each system shall be fitted with a label, in a suitable and clearly visible position, with indication of the following:

- The name of the manufacturer or system supplier
- The system type designation
- The manufacturing or serial number, and year of manufacture
- The type of solar collector
- Absorber and aperture areas of the collectors
- Nominal tank volume in litres
- Permissible domestic hot water pressure (MPa)
- Recommended heat transfer medium, with any necessary warning of toxicity
- Maximum pressure in the solar collector circuit
- Any necessary warning to indicate that a safety component depends on an electrical supply
- The power requirement (W) for the circulation circuit and for the additional electric heater.

Information required

1: A description of the label and of its siting.

Tests, standards and references - Solar-heated domestic hot water systems for use in detached houses

SOLAR COLLECTOR TESTING

SP's initial testing:

- Scrutiny/examination of the drawings and material specifications
- Scrutiny/examination of the installation and operation/care instructions
- Pressure testing
- Stagnation and thermal shock testing
- Resistance to wind and snow loading
- Resistance to rain
- Determination of thermal performance
- Calculation of annual yield at 25 °C, 50 °C and 75 °C
- Resistance to freezing
- Material tests (certain components)
- Preparation of a properties profiles.

SP's procedure for P-marking thermal solar collectors

After the qualifying inspection tests, collectors are exposed outdoors under stagnation conditions for one year, which is regarded as constituting accelerated testing. At the end of this period, when retested, the collectors must show no significant deterioration in performance, and no significant deteriorations in components or materials. The collector may then be awarded P-marking approval if all the test requirements are fulfilled and agreements are reached with the manufacturer concerning future quality control.

Theoretical annual energy yield

SP calculates collectors' expected annual energy yield at T = 25, 50 and 75 °C. These values must be stated. When evaluating the entries, the evaluation group will make its own calculation of the expected solar energy production, based on efficiency factors as indicated by test certificates. SP's figures of annual energy yield are calculated for south-facing solar collectors at an inclination of 45°. The meteorological data used is that for Stockholm, 1986, for which year the total available insolation amounted to 1062 kWh/m². Calculations are made using the MINSUN simulation program, based on efficiency parameters as measured by SP. Note that the theoretical annual yields will be used primarily as a means of comparison between systems. In addition to insolation, the actual yield of a system depends also on the design of the system itself, the orientation of the collectors, user

habits etc. The reference area, which is usually the same as the transparent frontal area of the collectors, is used when calculating the thermal performance and annual energy yield. Mean temperatures of 25, 50 and 75 °C are defined as being the mean value of the input and output temperatures of the heat transfer medium when passing through the collector. 50 °C is a suitable temperature for comparison of solar-heated domestic hot water systems.

Solar collector testing to prEN 12975-2

In addition to what is described above, testing in accordance with the prEN standard involves:

- Function checking of drainability (for solar collectors intended for use in drainable systems)
- Resistance to shocks and hail.

SYSTEM TESTING

So far, system testing to prEN 12976-2/ISO/DIS 9459-5 has not become a routine procedure applied by all test institutions. A somewhat simplified system test is therefore proposed here, to be regarded as a minimum requirement for the first procurement.

- *Antifreeze protection*

  for the solar collector circuit, but only for drainable (drainback) systems. It is important that filling and complete drainage are reliable. If necessary, testing of any electronic antifreeze protection system.

- *Overheating protection*

  for protecting the system against boiling and to protect users against scalding. Possible temperature limitation for the solar collectors and for the heat transfer medium.

- *Pressure testing*

  Testing to ensure that the system features withstand the permissible pressure, and testing the operation of pressure limitation devices. The applied standard is ISO/DIS 11924 or, in the case of non-metallic materials, at +10 °C above their maximum permissible temperatures.

- *Marking*

  Checking that a plate with the necessary marking is fitted in a suitable, easily accessible position on the system (e.g. on the heat storage tank). (See also the requirements in Appendix 1 concerning marking.)

- *Reverse flow protection*

  Inspection to ensure that a check valve, or other suitable device to prevent self-circulation, is fitted.

Calculation of thermal performance

Initially, the system performance, i.e. $f_{sol} = Q_{sol}/Q_{load}$, will be calculated from the specified parameter values and using the software used in ISO 9459-5, where:

$Q_{sol} = Q_{load} - Q_{aux}$

Q_{load} = 'load demand', calculated from $T_{hot\ water} - T_{cold\ water}$, here assumed to be 2650 kWh/year

Q_{aux} = electricity for immersion heater.

Measurement of thermal performance

The prototypes submitted for testing will be given a complete performance test for solar heating systems, in accordance with ISO 9459-5. f_{sol} will be determined as above, based on the identified parameter values, instead of on the specified parameter values. The performance specification requires that $f_{sol} > 50$ %.

The daily draw-off profile will be as set out in the 'Reference conditions for performance prediction' in ISO/DIS 9459-5, using the meteorological data for Stockholm, 1986.

Capacity testing with solar heating only (Obligatory Requirement 2): Conditioning to +10 °C prior to 07.00, no hot water draw-off during the day, draw-off at the end of the day (18.00) at 6 l/min until the tap water temperature has dropped to 40 °C. Insolation: > 6 kWh/m².

Hot water capacity and heat losses will be calculated on the basis of measurements in accordance with SS EN 255-3.

STANDARDS AND REFERENCES

Applied standards

In general, the systems will be required to conform to preliminary European standard prEN 12976-1:1997, which prescribes minimum requirements in respect of performance, materials, tests and documentation. In addition, there are certain requirements that are specific to this procurement competition, including compliance with the 1994 Swedish Building Regulations, Swedish climatic conditions and the need for low system costs. These requirements are clarified below.

Standards and building codes:

prEN 12975-1:1997 E
Thermal solar systems and components – Collectors – Part 1: General requirements

prEN 12975-2:1997 E
Thermal solar systems and components – Collectors – Part 2: Test methods

prEN 12976-1:1997 E
Thermal solar systems and components – Factory-made systems – Part 1: General requirements

prEN 12976-2:1997 E
Thermal solar systems and components – Factory-made systems – Part 2: Test methods

ISO/DIS 9459-5
Solar heating – Domestic hot water systems – Part 5: Outdoor test method for system performance characterisation by means of whole-system test and computer simulation.

ISO/DIS 11924:1995
Solar heating – Domestic hot water heating systems – Test methods for the assessment of reliability and safety.

ISO TR 10217
Solar energy – Water heating systems – Guide to material selection with regard to internal corrosion.

SS EN 255-3 'Air conditioners, liquid chilling packages and heat pumps with electrically driven compressors - Heating mode - Part 3: Testing and requirements for marking for sanitary hot water units'.

preEN 806-1
Specifications for installations inside buildings conveying water for human consumption – Part 1: General

preEN 1717
Protection against pollution of potable water in drinking water installations and general requirements of devices to prevent pollution by backflow.

National Board of Housing, Building and Planning: BBR94 Building Regulations. BFS 1993:57, with changes BFS 1995:17

Hans Wennerholm. Rules for P-marking of thermal solar collectors. SP Swedish National Testing and Research Institute. CEN TC2312/N16,1994.

Other references:

/1/ Hans Wennerholm
The durability of domestic hot water heaters. SP Swedish National Testing and Research Institute, SP Report 1995:22 (in Swedish).

Information on solar collector testing

Information on development testing and other testing and evaluation in accordance with SP's P-marking rules for solar collectors is available from Hans Wennerholm (+46 33 16 55 40) or Peter Kovacs (+46 33 16 56 62).

For the years 1998-2000, the Swedish Government (through the National Energy Administration, STEM) is subsidising the cost of solar collector testing at/by SP with 50 %. This subsidy is available for 1) development testing, and 2) testing and evaluation for SP's P-marking. Grant applications are processed by SP.

Performance details

- Solar-heated domestic hot water systems for detached houses

Type/name of the system:	
Place of manufacture:	
Company submitting the tender:	
EN ISO 9000 quality assurance, certificate no.:	
Date/Signature:	
Name in block capitals:	
Address:	
Telephone:	
Fax:	
E-mail:	

Contents

1. Information required

Enter the information required in the right-hand column. Enter quantified data in figures, with other requirements confirmed as appropriate, in accordance with Appendix 1, Performance Specification, e.g. by 'Fulfilled', 'Included', 'See technical description' (pages 4-10 in this appendix), 'See our Appendix x' etc.

COMPETITION CONDITIONS			PROPOSAL
OBLIGATORY REQUIREMENTS	**DESIRABLE REQUIREMENTS**	**FORM OF PRESENTATION**	
1. System			
1: 50 % solar heat			%
2: >150 l >50 °C			litre
3: 1994 Building Regs.			
		1: System drawing	
		2: Function description	
		3: User instructions	
		4: Installation instructions	
2. Costs			
1: Max. SEK 16 000, incl. value-added tax		1: Complete system of which solar collectors	SEK SEK
	1: Max. SEK 14 000, incl. VAT	1: Complete system of which solar collectors	SEK SEK
2: Guarantee period			years
3: Typical installation times (hours)		2: Installation times for a) solar collectors, b) piping, c) heat storage tank and drive unit/circulation circuit	a) hours b) hours c) hours
		3: Accessories (type and cost)	SEK
3. Solar collectors			
1: Tested		1: Test report	
2: P-marking			
		2: Dimensions, weight etc.	
		3: Installation descr.	
4. Solar collector circuit			
1: Control unit			
2: Circulation circuit			
	1: Drive unit		
	2: Signal cable		
		1: Design	
		2: Function description	

5. Heat storage tank/calorifier			
1: 600 x 600 x 2200 mm			mm
2: 600 kWh/year			kWh/year
3: Approved calorifier			
4. Additional heating			
	1: Integral heat exchanger		
		1: Dimensions, weight etc.	
		2: Type	
		3: Additional heating	
		4: Integral heat exchanger	
		5: Electrical connection	
6. Energy meters			
	1: Solar heat		
	2: Additional heat		
		1: Type, cost, siting etc.	
7. Environment			
1: Heat transfer medium			
2: Insulation			
		1: Environmental impact	
		2: Environmental declaration	
		3: Certification	
8. Marking			
1: Rating and data plate			
		1: Information on plate and siting	

2. Technical description

The domestic hot water heating system, including the solar collectors, shall be documented in sufficient detail to enable the evaluation group to form a reasonable idea of the system's cost/performance relationship. In addition, the documentation must clearly indicate the most important material and environmental characteristics, in order to be able to gain an idea of the system's life and of its environmental impact due both to normal operation and subsequent disposal. Please use the following forms in order to facilitate presentation and make it easier to compare all entries on an equal basis.

Definitions:

Solar collectors: The smallest unit of a solar collector (e.g. a solar collector case).

Solar collector circuit: The circuit that connects the collector(s) with the heat store/domestic hot water calorifier, including pumps, valves, other equipment and sensor signal cables.

Heat store/domestic hot water calorifier: Heat storage tank, including additional heating equipment.

Solar heating system control system: A control unit for starting and stopping the solar collectors and system features and functions.

Solar collectors	Description
Type (flat plate, vacuum, CPC etc.)	
Mounting (incorporated in roof, surface mounting, free-standing etc.	
Minimum slope angle (°)	
Lifting device (required if module weight exceeds 60 kg)	
Number of fixing points per module	
Module dimensions - gross area (m²) - glazed area (m²) - absorber area (m²) - width (horizontal) (m) - height (up the roof surface) (m) - thickness (m) - reflector area (m²)	
Module data - Empty weight (kg) - Weight including heat transfer medium (kg) - Max. operating pressure (MPa) - Max. permissible temperature (°C)	

Test certificate attached, Yes/No - Issued by - Date of issue	
Solar collector coefficients, test results η_0, b_1 (W/m².K), b_2 (W/m².K²)	
Thermal yield (kWh or kWh/m²) as obtained by SP. - at 25 °C, 50 °C, 75 °C	
Stagnation temperature (ambient temperature 30 °C, and insolation 1000 W)	
Cover sheet - type (colour if applicable) - thickness - coefficient of transmission	
Absorber (colour if applicable) - type - thickness - surface coating (colour if applicable) - coefficient of absorption α - coefficient of emission ε	
Module - Edges (material, thickness) - Base (material, thickness) - Insulation (material, thickness)	

Solar collector circuit	**Description**
Drawing attached - Yes/No	
Solar collector unit (number. of modules, area)	
Flashing included? (material, colour)	
Fluid connection (within collector unit) - Parallel (number of modules) - Series (number of modules)	
Connection pipe - module (material, size)	
Connection pipe - solar collector unit (material, size)	
Volume of heat transfer medium in the system with standard length circulation connection (litre)	
Recommended heat transfer medium - concentration - boiling point (°C) - freezing point (°C)	
Recommended flow rate/pressure drop - per module (l/h,m²) - per module (Pa)	

- solar collector circuit (l/h or l/h,m²) - solar collector circuit (Pa)	
System has - internal heat exchanger - external heat exchanger	
Pump, solar collector circuit, including two shut-off valves - type - power	
Expansion vessel - volume (l) - safety valve - opening pressure (MPa) - pressure gauge	
In addition, the circulation circuit includes: - check valve - filling valve - drain valve - vent valve (nipple) - flow regulator (e.g. Tarco) - number of shut-off valves - thermometer in the return connection	
If an external heat exchanger is used to charge the heat store with solar heat: pump, solar heat charging, including two shut-off valves - type - power	
Circulation connections to the collectors: - standard length - material - integral insulation - insulation material - integrated double connection - integrated signal cable	

Heat store / domestic hot water calorifier	**Description**
Schematic drawing attached - Yes/No	
Type of heat storage tank (pressurised, unpressurised etc.)	
Test certificate attached - Yes/No - issued by - date of issue	
Volume (l) (Total, heat store or calorifier volume)	
Dimensions (overall) for installation (mm) - Height / Width / Depth	

- Necessary clearance height (mm)	
Net weight (kg)	
Pressure - Max. test pressure (MPa) - Operating pressure (MPa)	
Method of solar heat transfer: (external heat exchanger, integral coil, integral inner tank, shell type tank, direct with drainage, other) Heat transfer capacity (W/K, LMTD)	
Type of domestic hot water production: (Directly in the pressurised calorifier, integral heating vessel, integral coils, external heat exchanger, other)	
Heat transfer capacity with indirect domestic hot water production at a flow rate of 0.2 l/s (W/K, LMTD)	
Charging with waterborne external heat: (Directly to an unpressurised tank, via integral heating coil, integral inner tank, shell type tank, other)	
Heat transfer capacity with indirect domestic hot water production at a flow rate of 0.2 l/s (W/K, LMTD)	
Is there an active temperature stratification system in the tank? Yes, No	
Materials of/in the: - tank - solar heating charging circuit as above - domestic hot water production as above - any other heat charging as above - active corrosion protection?	
Connection sizes: - solar collector - for hot water and cold water - electric immersion heater in the tank - other heat supply	
Electrical supply: - single phase or three phase - power (kW)	
Tank insulation - material - thickness (mm) Loss at $\Delta T = 30$ °C (W)	
Type of cladding (must be hose-proof) - material - colour	
Type of thermometers (in the top of the tank and in the water heating portion),	

position	
Type of solar heat sensors (in the bottom of the tank), position	

Solar heating control system	**Description**
Control diagram attached - Yes/No	
Test certificate attached - Yes/No - issued by - date of issue	
Control principle: - Differential temperature - Insolation sensor - Other	
Entire system integrated in a control unit - Yes/No	
Start/stop sensors - in the solar collector, type, position - in the tank, type, position	
Differential temperature control: - ΔT_{start} (°C) - ΔT_{stop} (°C)	
Insolation sensors: - H_{start} (W/m²) - H_{stop} (W/m²)	
Type of overheating protection: - Function description - Solar collectors, operates at (°C) - Type of sensor - Tank, operates at (°C) - Type of sensor - Positioning	
Type of antifreeze protection: - Function, operates at (°C) - Type of sensor - Positioning	

Energy meters	**Description**
Solar collectors: - Type of meter - Placing - Cost	
Control unit: - Calculating - Cost	
Solar heat (net): - Type of meter - Placing - Cost	

Additional heat: - Type of meter - Placing - Cost	
Electricity meter: - Type of meter - Placing - Cost	

Marking (example of the rating/data plate)

3. Environmental declaration

The solar collector modules offered and specified in these documents

Type .....

Serial No. .....

contain ***more than 1 kg of the following reusable materials:***

Metals	Aluminium	kg
	Iron and steel	
	Galvanised steel	
	Copper, brass, bronze	
	Other metals	
Other	Glass	kg
	Polymers (plastic, rubber etc.)	
	Foamed materials	
	Mineral wool and glass fibre	
	Wood	
	Other material	

Recommended heat transfer medium/media
- Chemical substance
- Environmental impact
- Discharge restrictions

In addition, the solar collector contains the following quantities ***(over 1 g) of the following non-reusable*** materials:

.....
..

.....
..

In addition, the system contains the following products (e.g. tin, Teflon™, paints and varnishes, toxic substances etc.), the use of which is covered by restrictions due to their adverse environmental impact:

.....
..

.....
..

4. Other documentation

The following documentation must be attached to the entries:

- *Drawings of the solar collectors, showing dimensions and with details of materials and any restriction on mounting angle*

- *Drawings and instructions for connecting the solar collector unit to the hydraulic modules*

- *Installation instructions for the solar collectors, including transport instructions*

- *Instructions for recommended heat transfer medium, as well as for filling, draining and changing the medium*

- *Recommended heat transfer medium flow rate*

- *Any instructions needed for dealing with overheating and antifreeze protection*

- *Instructions for replacing solar collector glazing*

- *Any special requirements in respect of maintenance*

- *Instructions for end-of-life disposal*

Appendix no.	Description

MODEL FORM OF FRAMEWORK AGREEMENT

FOR SUPPLY AND DELIVERY OF SOLAR-HEATED DOMESTIC HOT WATER SYSTEMS FOR DETACHED HOUSES

The following points will be included in any framework agreement:

1. The parties to the agreement:
   The purchaser:
   The supplier:

2. The purchaser undertakes to encourage the ordering of at least 1000 systems in the form of call-off orders from various property owners/organisations/private persons, as based on the terms and conditions in this framework agreement. Orders are subject to the receipt of any necessary public authority permissions or acceptance of their requirements or conditions and to the achievement of approved test results.

3. Delivery of systems . . . .

4. The competition is divided into phases, as described in the competition documents. The Purchaser shall authorise the start and continuation of each phase.

5. Contract documents
   These consist of the contract, the competition documents and appendices, any requirements associated with orders, the competition entry and applicable parts of ALOS 81.

6. Prices
   Prices including value-added tax.
   Options

7. Times
8. Testing in accordance with ...
9. Guarantee
10. Terms of payment
11. Property rights, design rights etc. and the right to refer to this competition in marketing.
12. Secrecy
13. Service and maintenance
14. Representatives

15. Resolution of any disputes
16. Termination (if results cannot be achieved within the intended time etc.)
17. Call-off rights within the prescribed time period for the specified group of purchasers.
18. Rights to, and obstacles in the way of, assignment.

Description of the reference house

-Front of the house facing due south (see the elevation drawing, 'Entry facade')
-Exterior walls are described from the outside and in: floor/ceiling structures from the top and down.

Exterior walls
22 x 120 mm vertical cover boarding
Wind barrier paper
22 x 70 mm nailing battens on 45 x 95 mm studs, 600 mm centres
120 mm Grade A mineral wool insulation between the studs
Plastic film vapour barrier
13 mm gypsum board
Surface finish

Internal load-bearing walls
45 x 70 mm studs, 400 mm centres
On both sides: 13 mm gypsum board
Surface finish

Internal non load-bearing walls
45 x 70 mm studs, 400 mm centres
On both sides: 13 mm gypsum board
Surface finish

Ground floor
Floor covering
22 mm particle board
45 x 220 mm floor joists, 400 mm centres
100 mm Grade B mineral wool insulation between the joists
13 mm asphaboard

Upper floor
Floor covering
22 mm particle board
45 x 220 mm floor joists, 400 mm centres
13 mm mineral fibre board
Woven textile ceiling, except in the kitchen utility room, which have a ceiling of hard surface-finished wood fibre board, and the bathroom and shower room, which have ceilings of woven-reinforced plastic.

Roof void floor structure
13 mm mineral fibre board
45 x 120 mm joists, 1200 mm centres
Woven textile ceiling

Outer roof structure
45 x 220 mm T 200 structural timber or double 34 x 220 mm stress-graded timber roof beams, 1200 mm centres
30 mm building paper-clad Grade A mineral wool insulation
150 mm Grade B mineral wool insulation
Plastic film vapour barrier
Hard wood fibre board cladding to occupied area
Surface finish

Outer roof cladding
Concrete tiles
45 x 70 mm tile battens
3,2 mm hard wood fibre board

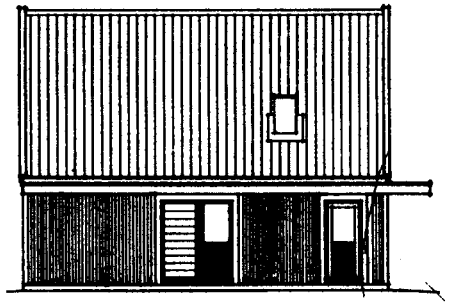
Translation: Swedish - English

Fasad och sektion	Elevations and section
Skala	Scale
Fasad mot gata	Street elevation
Entréfasad	Entrance elevation
Sektion	Section
Fasad mot trädgård	Garden elevation
Långfasad	Side elevation
Plan	Plan
Skala	Scale
Förråd	Store
Sovrum	Bedroom
Vardagsrum	Sitting room
Sop	Refuse
Bilplats ...	Carport
K	Shelf
KPR	Cloaks
VV	Domestic hot water
G	Wardrobe
WC	WC
Bad	Bathroom
TM	Washing machine
DM	Dishwasher
Tvätt	Utility
Kök	Kitchen
TS	Dryer
KS	Refrigerator
F	Freezer
Allrum	Breakfast room
ST	Cleaning items
L	Wardrobe
Bottenplan	Ground floor
Dusch	Shower
KLK	Walk-in wardrobe
Överplan	Upper floor

Fasad och sektion

Typhus
Skala 1:200

FASAD MOT GATA



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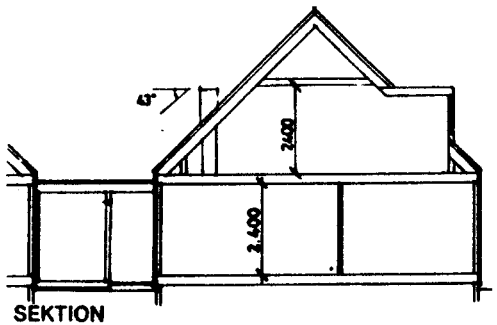
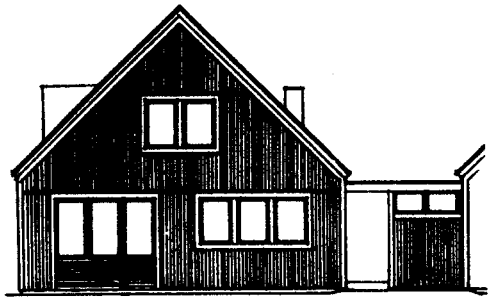
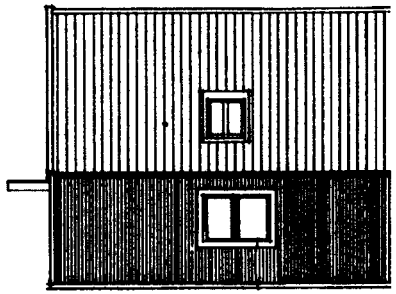


SEKTION



FASAD MOT TRÄDGÅRD



LÅNGFASAD

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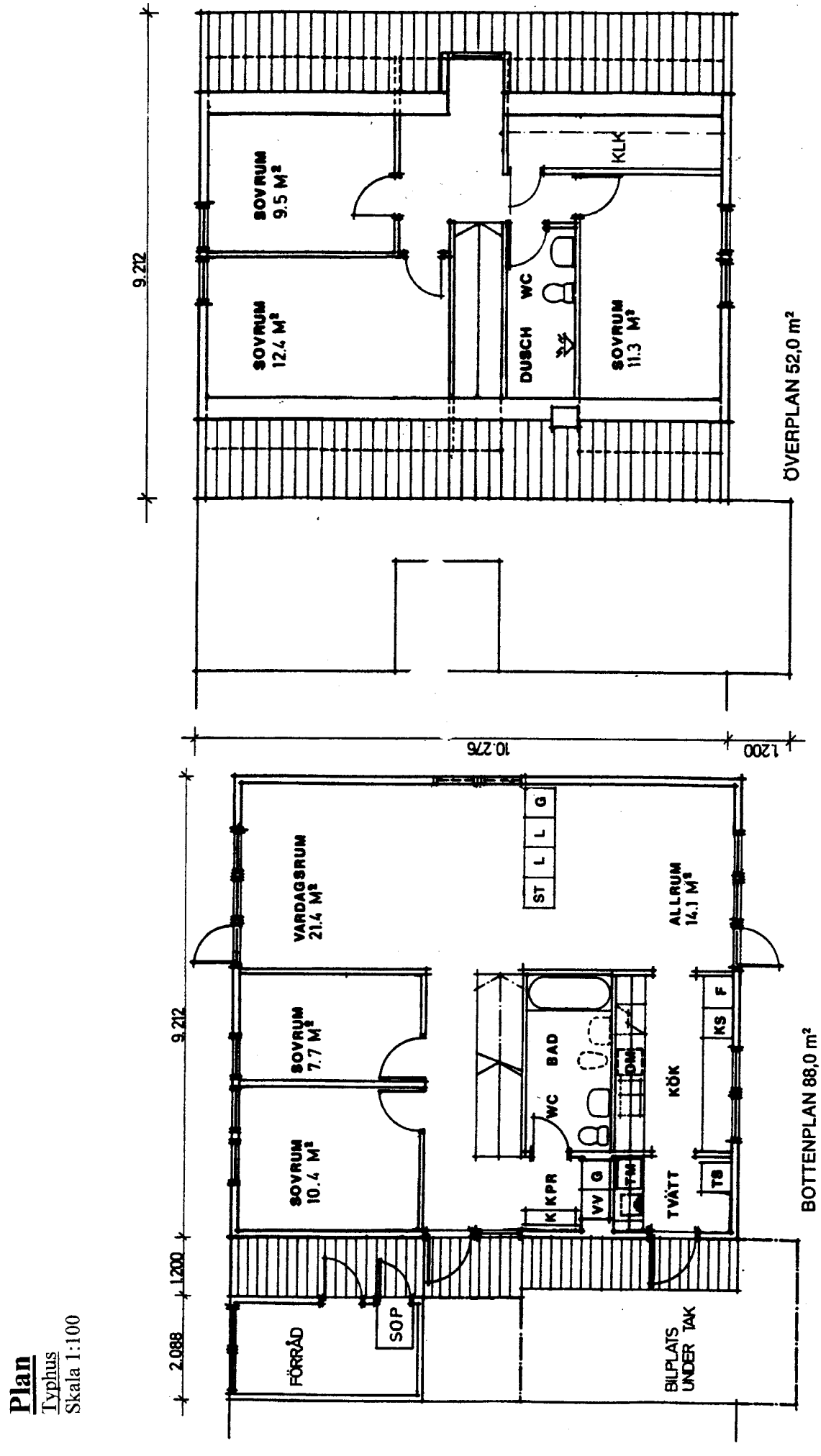
Typhus
Skala 1:100



REPORT

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Datum / *Date*
26th Sept. 2000
Rev. 2001-03-14

Beteckning / *Reference*
P0 05201

Evaluation of solar heat systems

(12 enclosures)

Remit

Evaluation and testing of nine solar-heated domestic hot water systems for detached houses, as per specification of requirements (enclosed as App. 12). In addition, an assessment was made of the feasibility of simple, functional installation of seven of the systems.

Evaluation of requirement compliance was primarily based on systems delivered.

Test objects

The following solar thermal systems were included in the test.

Supplier	**Name of system**
INKA Energi Stala 6591 SE-474 96 NÖSUND	InkaSol
BATEC A/S Danmarksvej 8 DK 4681 HERFØLGE	B 2.30-280
SOLID GmbH Herrgottwiesgasse 188 8055 GRAZ	Solar gluatmugl EURO-3

SP Sveriges Provnings- och Forskningsinstitut, Box 857, 501 15 BORÅS, Tfn 033-16 50 00, Fax 033-13 55 02, E-post info@sp.se, Org.nr 556464-6874
SP Swedish National Testing and Research Institute, Box 857, SE-501 15 BORÅS, SWEDEN, Telephone + 46 33 16 50 00, Telefax + 46 33 13 55 02, E-mail info@sp.se, Reg.No 556464-6874

Solsam Sunergy AB (publ) Box 12870 SE-112 98 STOCKHOLM	Solsystem 4000
Arnes Plåtslageri AB Oskarsvägen 38 SE-702 14 ÖREBRO	Aquasol
BORÖ pannan AB Bangårdsvägen 1 SE-952 31 KALIX	Solpaket E1
Uponor AB SE-513 81 FRISTAD	UPOSUN HT 2000 med VVB
Effecta Pannan AB Rågdal 6699 SE-434 96 KUNGSBACKA	Effecta ST/300
Miljö-Konsult Energi AB Östra Storgatan 5 SE-771 50 LUDVIKA	SUNMAX 2000 VV1

The systems were fitted by the suppliers themselves or by a consultant retained by them. The documents requested were: technical descriptions, installation instructions, operating and maintenance instructions and a completed accounting form.

Time and place of testing

Testing and inspection were carried out at the Energy Technology Unit, SP Borås, between May and September 2000. A supplementary examination was carried out in November 2000.

Accounting of test objects delivered

The systems were identified on delivery to SP and an overview compiled as per the specification in Apps. 2-10.

Test procedure

The tests were carried out in compliance with ISO/DIS 9459-5, with the addition of testing electrical and solar thermal capacity plus heat losses for electrically heated water heaters. See App. 1 fro a more exhaustive description of the test procedure and measuring points.

Calculation of annual yields

To facilitate objective comparisons of the solar thermal systems, the annual yield was simulated with the program “Dynamic System Testing, Version 2.7”. For climatic data, Stockholm 1986 was used with an

incident radiation of 1,060 kWh/sq.m. on a surface 30 degrees off the horizontal plane and facing due south. The following operational data were simulated:

Collector orientation:	due south
Collector gradient:	30 degrees off the horizontal
Incoming cold water temperature	8.1^{o} C
Load:	7.32 kWh/day
Tap water flow:	10 l/min.
Min. hot water temperature:	50^{o} C

The electric cartridge setting for simulating each system was determined by choosing the lowest possible setting on condition that the lowest hot water temperature of 50^{o} C and the load of 7.32 kWh/day were contained.

Capacity test

The purpose of these tests was to evaluate the system's attainment of the required hot water capacity as per the building regulations of the National Board of Housing, Building and Planning with only an electric heater operating. In addition, the hot water capacity requirement with only solar collectors operating was evaluated in accordance with the specification of requirements.

Heat losses in connection with electric heating

Tests were carried out to measure losses from the tank during electric heating and then calculated whether the systems met the predefined requirements of max. 600 kWh/yr at a mean tank temperature of 50^{o} C.

A more detailed description of the test procedure will be found in App. 1.

Test equipment

The pre-assembled systems wee connected to a temperature-regulated cold water supply. Drawing of water was controlled from a computer, with the aid of magnetic valves on the hot water outlet. The flow and temperature of the running hot water were measured with inductive flow meters and Pt-100 transducers. Electrical effects and energies were determined with kWh meters. Solar irradiation was measured with precision pyranometers and outdoor temperature with a ventilated and radiation-protected Pt-100 transducer.

Measuring equipment

The following measuring equipment was used in the course of testing:

- Data collection system based on a PC and an HP 1401B scanner
- Pt-100 (1/10 DIN) resisten temperature transducer
- CEWE WH 3063 electrical energy meter (640 pulses/kWh)
- Enermet MP115 flow meter (5760 pulses/litre)
- Eppley PSP 15834 global irradiation pyranometer

Examination of operating and maintenance instructions

Operating and maintenance instructions were examined and an assessment made of their compliance with the accounting requirements as per the specification of requirements.

Assessment of the installation and installation instructions

In connection with the installation and commissioning of the nine systems in the SP test building, all of them were examined with regard to design and function. Certain weaknesses and potential improvements could be identified in the light of the performance test results. Observations of note have been presented in the appendices for each system.

An assessment of an installation in the standard house and of the plausibility of stated installation times was made for seven of the systems. In addition, installation instructions and the true design of the systems were examined with a view to identifying strong and weak points from the viewpoint of assembly and installation.

Corrosion examination

The risk of corrosion in the tanks of the participating systems (eight storage heaters, an accumulator tank with flow-through water heater) was assessed in the light of data from the documentation supplied with the systems. For two of the systems (those from Inka Energi and Batec) the assessment was deepened and a number of supplementary data requested.

Conspectus of results

System supplier	Solar heat coverage ratio/yr	Electric heat energy requirement/yr	Energy in hot water capacity test, solar (requirement 7.0 kWh)	Energy in hot water capacity test, electrical (requirement 2*4,9 kWh)	Tank loss from electrically heated portion of tank (requirement max. 600 kWh/yr)
INKA Energi	51.2	1,310	>15[1)]	14.6	347
BATEC	55.0	1,200	16.9	9.0	278
SOLID	40.0	1,600	>15[1)]	13.0	472
Solsam Sunergy	43.4	1,520	12.1	11.2	437
Arnes Plåtslageri	40.6	1,590	12.5	14.7	477
BORÖ PANNAN	43.6	1,510	10.3	8.3	418
UPONOR	43.2	1,520	17.3	14.3	337
Effecta Pannan	39.2	1,620	>15[1)]	3.6	-[2)]
Miljö-Konsult	14.6	2,280	9.9	3.5	897
(Average)	*(41.2)*	*(1,570)*	*(11.2)*	*(10.2)*	*(498)*

[1)] Owing to the adverse summer weather we failed to complete the second round of solar capacity testing. Daytime irradiation totalled 43. kWh/sq.m. as compared with the requirement of 6 kWh/sq.m. 6.6 kWh/sq.m. of the first round of testing. Since, however, a system from the first round was included in round 2, we can relate to this with reasonable accuracy and extrapolate the results to the values shown here.

[2)] For several reasons, the Effecta boiler's tank did not permit a firm assessment of heat losses.

Apps. 2-10 show identification and detailed results for each individual test object.

SP Swedish National Testing and Research Institute
System and Ventilation Technology

Geron Johansson
Head of Section

Peter Kovács
Technical Officer

Appendices

1. Test procedure
2.-10. System specification and presentation of results for each system
11. Measurement uncertainty
12. Specification of requirements

CONTRACT DOCUMENTS
FOR DELIVERIES OF SOLAR-HEATED
DOMESTIC HOT WATER SYSTEMS FOR DETACHED HOUSES

- ***FRAMEWORK AGREEMENT***

- ***APP. 1***
The Co-ordinator's obligations

- ***APP. 2***
Model agreement applicable to deliveries under the framework agreement
App. attachment 2.1 Requirements as per the competition document
App. attachment 2.2 The entry

- ***APP. 3***
Costing example

FRAMEWORK AGREEMENT
for Technology Procurement Competition, IEA Task 24 "Solar Procurement", concerning delivery of solar-heated domestic hot water systems to Purchasers notified through the Co-ordinator

1. Contracting parties:

The Värmland County Council, represented by
Miljöaktion i Värmland (MAV), Landstingshuset, 651 82 KARLSTAD, hereinafter called **the Co-ordinator.**

The Co-ordinator represents the purchasing group, hereinafter called **the Purchasers**, who, by notification to the Co-ordinator, declare their interest in purchasing solar thermal systems. The competition document states that the Co-ordinator shall endeavour to secure deliveries of at least 1,000 systems for the winner chosen. The register of Purchasers who have registered their interest passes to the winner when nominated. The Co-ordinator will then resolve to classify the document as secret, since it is of commercial interest to the winner. The purchasers are placed in an order of priority corresponding to their registration dates. The purchaser group comprises upwards of 1,700 notifications at the time of signing this agreement. Notifications are not binding. Delivery must be preceded by a binding order from each purchaser.

UPONOR AB, SE-513 81 FRISTAD, hereinafter called **the Supplier**

2. Contract documents apply in the order given

1. This framework agreement
2. The Co-ordinator's obligations (App. 1)
3. Model agreement (App. 2)
4. Specification of requirements with appendices in the Competition Document dated 21st January 2000 (App. attachment 2.1)
5. The Supplier's competition entry, dated 30th March 2000 (App. attachment 2.2)

3. Background and purpose

The Council for Building Research (BFR/FORMAS), the National Energy Agency (STEM) and the City of Stockholm LIP Office (LIP) are financiers for the co-ordinated technology procurement competition, the purpose of which is to create and sustain a growing market for solar heating. A market change of this kind is greatly dependent on improvements in the performance/cost relation of solar heat systems. The technology procurement competition has been accompanied by system testing, which has shown good system performance and durability values for the components included.

Society has devoted considerable efforts to actively publicising the great future need for energy from renewable sources. The State, acting through the Council for Building Research and the National Energy Agency, municipalities and county councils, has endeavoured, by setting up and funding special secretariats and action groups, to increase the involvement of various players and individual consumers. Through participation in international co-operation projects such as IEA SHC Task 24 "Solar Procurement", a concerted effort is being made to create a larger and sustainable market for solar energy systems. Recently too, the Swedish Riksdag (parliament) has introduced grants for solar energy solutions. Taken together, thee public commitments add up to considerable sums of money.

4. General conditions

The Co-ordinator promises to work to obtain orders for deliveries comprising 1,000 solar heat systems, based on the conditions of this framework agreement, from various property owners/organisations/private individuals. The Co-ordinator's undertakings are defined more closely in App. 1 to this framework agreement. The Co-ordinator shall not be regarded as purchaser. This agreement serves to clarify general conditions for the particular delivery agreements/orders.

5. Deliveries

The Supplier promises, after orders have been placed, to deliver 1,000 solar heat systems to the Purchasers. The deliveries shall be made in accordance with the Model Agreement appended (App. 2).

6. Test installations and approval of the same

The first 5 installations (test installations) shall be made at buildings designated by the Co-ordinator. Delivery of these systems shall take place not more than 3 weeks after the buildings have been designated. The Purchasers will pay for system and installation in connection with the test installations. The Supplier promises, not later than at the time of delivering the first test installations, to draw up the following documents:

- Instructions for assembly and installation, also including alternative modes of installation and solutions for the solar collectors.
- Instructions for use.

Before deliveries continue, the test installations and documentation shall be examined and approved by an inspector at SP nominated by the Co-ordinator. It shall then be verified that the systems agree with the prototype tested and have been modified in keeping with the Supplier's obligations, as indicated in connection with the comments and test results previously communicated by SP.

7. Order form

The Supplier shall draw up and, for delivery under this agreement, use an order form containing general provisions based on the Consumer Purchases Act. These documents shall be approved by the Co-ordinator before delivery agreements are entered into with the Purchasers.

8. Duration of this framework agreement

The framework agreement shall apply from the signing of the same until 1,000 systems have been ordered and delivered to the Purchasers. Orders under this agreement can be placed on 31st December 2001 at the latest, failing exercise of the option provided below.

9. Delivery times and capacity

Buildings designated for test installations	19th March 2001- 30th March 2001
Test installations ready and approved by SP	not more than 7 weeks after the designation of each building
Commencement of deliveries (after test installations)	21st May 2001
The delivery agreement applies to deliveries up to and inc.	31st December 2001

Delivery capacity of the period 21st May-8th August 2001 shall total at least 300 systems and for the period thereafter at east 140 systems per month for the duration of the agreement.

10. Option

The Co-ordinator is entitled, not later than 1st October 2001, to increase the volume ordered by 500 systems on the same terms, for an ordering period of one additional year after 31st December 2001, i.e. ending 31st December 2002. On the Co-ordinator giving notice of intent to exercise the option, both parties are entitled, within 14 days of the notification date, to request negotiations concerning a change of price. The right to change the price is subject to the Euro exchange rate in relation to the Swedish krona having changed by at least 5.0 per cent, and in that case shall be limited to 50 per cent of each price, or to an official raw material index, as agreed on later, having changed by at least 5.0 per cent, in which case it shall be limited to 50 per cent of each price. The starting point for a future price comparison is the contract date.

11. Indemnity

On a party contravening the provisions of this agreement, the other party shall be entitled to indemnity for the danger he suffers as a result of the breach of contract. The indemnity shall then be computed on the grounds defined in Section 67 of the Contacts Act (1990:931). If the breach of contract is of material importance to the other party – and if the defaulting party does not make a correction within 30 days of being called upon in writing to do so – the opposite party shall also be entitled to repudiate this agreement; see also below, point 16, Cancellation.

12. Assignment of this agreement

The Supplier is not entitled to assign this agreement without written consent from the Co-ordinator.

13. Copyright, right of user

A design in a competition entry submitted and subsequent development work are the Supplier's property.

14. Marketing occasioned by this delivery

The Supplier shall consult the Co-ordinator concerning marketing measures within the scope of this agreement.

The Co-ordinator shall be given the opportunity of examining and giving prior written consent to advertising/information concerning products developed through this technology procurement competition and information material in which the name of the Co-ordinator or the names of public authorities are referred to.

The Co-ordinator and public authorities taking part are entitled to disseminate information concerning the outcome of the competition and continuing development work.

15. Disputes

Disputes between the parties shall be tried by a Swedish court, subject to Swedish law.

16. Cancellation

The commencement of deliveries to the Purchasers is conditional on the Co-ordinator having approved the first 5 installations. If these test installations cannot be approved, the Co-ordinator is entitled to cancel the agreement without incurring any liability for indemnification.

17. Secrecy

The Supplier has not requested secrecy concerning the competition entry submitted.

18. Copies of the framework agreement

This framework agreement has been drawn up in duplicate and the two copies signed by and exchanged between the parties.

Co-ordinator:	Supplier:
The Värmland County Council represented by Miljöaktion Värmland Corporate reg. no. 232100-0156	UPONOR AB Corporate reg. no. 556548-9738
Jonas Lagneryd	Magnus Kårestedt
Date	Date

APP. 1
The Co-ordinator's obligations

The Co-ordinator (Miljöaktion Värmland – MAV) shall endeavour to secure orders for at least 1,000 systems from various Purchasers on conditions defined in this framework agreement and its appurtenant documents. The Co-ordinator's commitment comprises general information measures concerning the generally positive nature of energy from renewable sources as a replacement for energy produced from non-renewable sources, and concerning the advantages of solar energy in particular. Several regional campaigns have been started and are now in progress. A large number of persons living in detached houses have declared their interest. A list of prospective purchasers will be provided by the Co-ordinator. The Co-ordinator intends drawing up a plan for orders from the Purchasers taking part. The Purchasers are to be structured in terms of geographic location and date of notification.

The Co-ordinator will provide the Supplier with address labels for the Purchasers who have expressed interest.

The Co-ordinator further intends:

- sending letters to the Purchasers, informing them of winners and the possibilities of ordering,
- announcing winners via the home page,
- convening seminars on solar heat and the winners of the competition,
- conducting information campaigns,
- taking other measures of public information.

BFR (FORMS), STEM and LIP will support the Co-ordinator in these matters and will themselves engage in marketing and information relating to the Competition and winners.

In the event of the number of orders received being fewer than planned, the Co-ordinator and other national or local government organisations will not be liable for any expenses incurred by the Supplier or his subcontractors.

APP. 2

Model agreement applicably to deliveries under the framework agreement drawn up for the Technology Procurement Competition, IEA Task 24 "Solar Procurement", concerning delivery of solar-heated domestic hot water systems to Purchasers notified through the Co-ordinator

1. Contracting parties

This delivery agreement has been drawn up between:

(notified Purchaser*)	*hereinafter called* ***the Client***
and	
UPONOR AB	*hereinafter called* ***the Supplier***

*) *The Co-ordinator, Miljöaktion Värmland (see Framework Agreement),registers notification of interest in orders under this delivery agreement.*

2. Contract documents

1. This delivery agreement (Model Agreement).
2. An order form containing general terms and conditions based on the Consumer Purchases Act and approved by the Co-ordinator.
3. Specification of requirements, as per the competition document, App. attachment 2.1.
4. The competition entry App. attachment 2.2.

3. General

The deliveries concern systems for solar-heated domestic hot water systems in accordance with the specification of requirements in the Competition Document (App. attachment 2.1) and the Supplier's competition entry (App. attachment 2.2).

4. Scope and pricing of the delivery – components included, with options, if any

Reference is also made to a costing example for a fully installed System Alternative A, as per App. 3.

Furthermore, before choosing System Alternative A or B, the Purchaser should ascertain the current solar heating grant and its extent for 4 or 5 collector modules. Further information is obtainable from the Supplier or the Co-ordinator.

The measurements of the collector modules are as follows:

External measurements "installation measurement"),	1995*1307*90 mm (height, width and depth)
Glazed area ("aperture area"),	2.04 sq.m.

System Alternative A:

A complete UPOSUN solar heating system, containing:

- 4 UPOSUN HT collectors, each of 2 sq.m.
- 1 flex-tube containing 6 m insulated media tubing and temperature transducer cable
- 16 angle brackets for mounting collectors on a tiled, felt or sheet metal roof
- 1 sealed tube carry-through for double-depression roof tiles (no equivalent is included for other types of roof)
- 1 tubing kit for 4 collectors, plus 10 litres of antifreeze
- 1 water heater (300 l) complete with flexible connecting hoses. Manufactured of Duplex 2205 stainless steel, which is corrosion resistant.

Price: SEK 15,988 inc. VAT

System Alternative B:

Complete as above, but with one more collector module (5 collectors of 2 sq.m. each).

Price: SEK 18,316 inc. VAT

Extras:

- DeLux version of the system
    - Operating time meter for the solar heat pump
    - Operating time meter for electric cartridge (auxiliary heat)
    - Hot water consumption meter, delivered separate for fitting to input cold water pipe
    - An additional temperature transducer for reading off hot water temperature from the top of the heater.

    Price SEK 3,450 inc. VAT

- UPOSUN HT2 2 sq.m. collector (not inc. roof-mounting parts). N.B. This collector can only be used in modified systems with max temperature and max pressure monitoring.

  Price SEK 1,908 inc. VAT

- Roof-mounting parts for one collector section (tile, felt or sheet metal roof)

  Price SEK 420 inc. VAT

- Flex-tube containing 6 m. insulated media tube and cable for temperature transducer, inc. jointing sleeves for tube and cable.

  Price SEK 1,276 inc. VAT

Freight and packing

Freight is charged at SEK 600 to any address in Sweden. The fixed price for each system does not include packing. Freight and packing for separate deliveries of extras will be charged at true cost.

5. Warranty etc.

An extended warranty period for defects of material, manufacture and design applies to solar heating systems and extras in point 4, above, subject to defects being reported within 5 years of delivery. Otherwise the Consumer Purchases Act shall apply.

The Supplier further guarantees immediate rectification, free of charge and within 7 days at most, of any component found to be defective or missing at the time of delivery.

It is the duty of the Purchaser, within 10 days of delivery at the latest, to check and report any damage caused to the goods in transit, in order for the transport insurance to apply. Damage is to be reported as indicated in the Order Form.

The Purchaser should also bear in mind the information given in point 10: "The Purchaser's agreement with an installation contractor …" in which a recommendation is made concerning installation contract forms. Installation is subject to a separate warranty under the Consumer Services Act.

6. Terms of payment

The Purchaser has a choice of two alternatives, both referring to delivery through a forwarding agent:

1. Payment against invoice, at 30 days, of the full amount plus an invoicing charge of SEK 500, subject to the customary credit assessment.
2. Payment of the full amount by money order to the forwarding agent on delivery.

7. Official permission, certification etc.

The Purchaser shall ascertain whether the municipality stipulates permission for an installation in advance of ordering. Any application shall be filed by the Purchaser, who will also bear the cost of any building permit.

The Purchaser should also enquire concerning possible State support for solar heating ("solar heating grant").

The Supplier is certificated to both ISO 14001, Environmental Management Systems, and ISO 9001, Quality Assurance Systems.

8. Service and maintenance

Spares and maintenance parts shall be kept available by the Supplier for a 10-year period from the time of completion of delivery under this agreement.

9. Disputes

Any dispute between the parties shall be resolved by the National Board for Consumer Complaints or by a Swedish court and under Swedish law.

10. The Purchaser's agreement with an installation contractor, extra insurance etc.

In their dealings with the Purchaser the Supplier and the Co-ordinator shall both inform the Purchaser and recommend him in his agreement with an installation contractor to make use of the contract form, RK99, recommended by VVS-installatörerna or of an equivalent form. The Supplier and Co-ordinator should also inform the Purchaser of the possibility of taking out a separate security insurance policy. A policy of this kind can be taken out through the authorised plumbing contractor engaged. The Purchaser should also check the scope of existing household insurance coverage for the installation concerned.

APP. 3

Costing example for standard house designated in the technology Procurement Competition and in the event of replacement of a pre-existing water heater

N.B.
The cost of installation may differ for installation in houses of a different type.
All prices are inclusive of VAT.
Building permission may be an additional item of expenditure in certain municipalities.
Expenditure may be entailed by disposal of the old water heater.

Complete UPOSUN solar heating package (System Alternative A: 300-litre water heater, drive and control equipment, 8 sq.m. collector)	**SEK 15,988**
Freight costs	**SEK 600**
Assembly + installation (approx.) (Complete assembly, inc. dismantling existing water heater. It is a reasonable assessment that this can be done by two men in a single day, travelling time not included. The price must be agreed by the Purchaser with a local installation contractor.)	**SEK 6,600**
Approx. total cost	**SEK 23,188**
Alternative cost of new conventional electric water heater (approx.) (inc. installation, source: VVS-I)	**SEK 13,000**
Additional cost of solar heating (approx.) (compared with installation of a conventional electric water heater)	**SEK 10,000**
Reduction of annual electricity purchasing requirement (1,500 to 2,500 kWh/yr @ SEK 0.60/kWh)	**SEK 900-1,500/yr**
Payback time, without solar heating grant (allowing for reduced electricity purchasing)	**7-11 years**
Payback time, with solar heating grant Solar heating grant as per SFS 2000:287 and BFS 2000:16 Grant of SEK 5,671 for relevant collector (4*2.04 sq.m.*278 kWh/sq.m.*SEK 2:50) (allowing for solar heating grant and reduced electricity purchasing)	**3-5 years**

Solar-heated domestic hot water systems in detached houses

The competition

Background and purpose

This competition, initiated as part of Sweden's participation in IEA SHC, Task 24 "Solar Procurement", has been in progress for one year and has been funded through BFR (now FORMAS), the Swedish Energy Agency and the LIP office, City of Stockholm. The purpose of this IEA co-operation is to develop solar thermal systems by showing a more organised buyer interest. Through the order volumes thus exposed, new opportunities will be created for manufacturers to invest in more efficient manufacturing and rationalise their marketing and distribution.

The purpose of the present competition is to provide a solar-heated domestic hot water system adapted to electrically heated detached houses in Sweden. In addition, these systems are to have a better price-performance relation than the systems marketed hitherto.

Jury

The competition jury comprised the following persons:

Matti Nordenström
Chairman
Miljöaktion Värmland

Hans Isaksson
Secretary
K-Konsult Stockholm AB

Jan-Olof Dalenbäck
Expert
Institution for Building Services Engineering, Chalmers University of Technology

Peter Kovacs
Expert
The Swedish National Testing and Research Institute

Hans Westling
Expert
Promandat AB

Assessment

The entries were assessed on the overriding condition of the system supplier being able to deliver **1,000 systems at SEK 16,000 inclusive of VAT**. As a basis for decision, the selected entries were evaluated with reference to the following criteria and weighting.

Assembly/installation aspects – 40%: The assessment referred to installation in a standard tile-roofed house and was based on evaluation of a number of assembly and installation aspects with a view to arriving at a simple, safe, low-cost installation.

Price/performance aspects of system and components – 30%: The assessment was based on the quoted price together with prototype testing. Entries are expected to meet a number of obligatory and desirable requirements, one being that they must provide the same hot water comfort as an ordinary water heater, but with about half the electrical power requirement.

Environmental aspects – 10%: The assessment was based above all on an analysis of materials including in the system, the water heater normally having greater environmental impact than the solar collector.

Degree of completeness of particulars furnished in the entry – 10%: The assessment referred above all to system and component descriptions. Detailed scrutiny of installation instructions and of operating and maintenance instructions takes place in connection with test installations.

Maintenance/lifetime aspects – 10%: The assessment was based on previous experience of various collector designs and on water heaters of standard design.

The entries

Initially, 13 system proposals were submitted to the jury. The following table summarises essential data for the 8 entries judged to meet the predefined performance requirements in such a way as to deserve mention.

No.	**Power requirement** [kWh/yr]	**Solar collectors**[[m²]*	[kg]	**Water heater** Litres	[Material]	[kg]
1	1,310	6.0	2 x 58	300	Stainless steel	3 kW - 400 V
2	1,200	6.3	2 x 50	280	Enamelled steel (anode)	3 kW - 400 V
5	1,600	6.0	2 x 70	300	Enamelled steel (anode)	2.6 kW - 250 V
7	1,520	4.8	92	270	Stainless steel	3 kW - 400 V
9	1,590	4.4	110	300	Stainless steel	3 kW - 400 V
10	1,510	5.5	2 x 60	300	Stainless steel	1.9 kW - 250 V
11	1,620	5.5	2 x 40	300	Steel (accumulator)	6 kW - 400 V
12	1,520	9.8	4 x 17	300	Stainless steel	2.6 kW - 250 V

* External dimension (e.g. requisite roof area)

The power requirement given in the table is calculated for an average year in Stockholm and the observed performance of a prototype submitted for a hot water requirement of 2,670 kW/yr (150 litres/day). A corresponding water heater without solar collectors has, at best, a power requirement of more than 3,000 kW/yr for the corresponding hot water requirement, so that the power saving can be estimated at between 1,400 and 1,800 kWh/yr. Most of the systems, moreover, will have been improved in the light of the test results by the time they are marketed.

In the following table, entries and entrants, 6 Swedish and 2 foreign, are listed by name, together with a brief description of each system.

No.	System / Entered by	Brief description
1	InkaSol Inka Energi	Solar collectors mainly for countersunk installation. Separate drive package and round water heater.
2	2 B 2.30-280 Batec A/S	Solar collectors for external or countersunk installation. Drive package integrated with water heater in a cabinet.
5	Solar glautmugl Euro-3 S.O.L.I.D. gmbH	Solar collectors mainly for countersunk installation. Integral drive package on a round water heater.
7	Solsystem 4000 Solsam Sunergy AB	Solar collectors (vacuum tubes) for external installation. Drive package integrated with water heater in a cabinet.
9	Aquasol Arnes Plåtslageri AB	Solar collectors for external or countersunk installation. Separate drive package and round water heater.
10	Solpaket E1 Boröpannan AB	Solar collectors mainly for countersunk installation. Drive package integrated with water heater in a cabinet.
11	Effecta ST/300 Effectapannan AB	Solar collectors for external or countersunk installation. Drive package integrated with accumulator tank in a cabinet.
12	Uposun HT 2000 med VVB Uponor AB	Solar collectors for external installation. Drive package integrated with water heater in a cabinet.

Most systems contain solar collectors suitable for both countersunk and external installation, and the majority have an integral ”drive package” (pump, expansion vessel and valves for the solar collector circuit) and water heater in a standard modular “cabinet” measuring 60 x 60 cm.

The jury’s pronouncement

Following comprehensive assessment on the predetermined criteria, the jury has selected Uponor AB as the winner of the technology procurement competition.

The “Uposun HT 2000 with water heater” system is easy to install, with its low collector weight and simple connection between collector and water heater. The performance of the system can well bear comparison with systems from other competitors, and the water heater is of high quality. No. 12 has also given proof of innovative thinking and a positive attitude to the matter of accommodating both suggested system improvements and terms of delivery within the prevailing cost frame.

No. 12, moreover, is a well-established firm, judged amply capable of offering both the requisite customer service and an enduringly low price for the system. Delivery of the system will begin as soon as 5 test installations have been approved by SP.

Stockholm, 15th March 2001

Matti Nordenström Hans Isaksson

Jan-Olof Dalenbäck Peter Kovacs Hans Westling

22nd March 2003

Memorandum: evaluation of T 24 Småsol competition entries

The text has been itemised and numbered off for ease of reference.

1.
As part of the international project IEA SHC Task 24 Solar Procurement, a number and variety of activities, preparations, tests, demonstration projects, competitions and procurements have been carried out in the participant countries. The present account is concerned with the evaluation of competition entries for small solar-heated domestic hot water systems for detached houses in Sweden.

2.
A group has compiled competition documents containing obligatory and desirable requirements in a special specification of requirements, and also including references to various standards for tests etc. The invitation was sent out at the end of January 2000. It was advertised in the Official Journal of the European Communities and mailed direct to known manufactures and suppliers in Sweden and in Europe. An automatic reference for downloading all competition documents from the Internet was added to the advertisement. About 10 days later the full documentation was available for downloading in English at the same home page address, under the "English" button. The closing date for the submission of entries was 31st March 2000. Up till then a question facility was available, and the answers to all questions could be accessed on the home page and were sent to everyone receiving or requesting documents.

3.
The competition entries were opened and listed in a record dated 3rd-4th April 2000.

4.
The competition proved to have aroused greater interest than expected. Entries had been received from 14 companies. One entry (No. 8) was a letter only. Three of the tenders (Nos. 3, 4 and 6) were rejected early on as being far too scanty. This left 10 entries to be evaluated.

5.
It was quickly established that at least eight entries contained systems meeting the requirements on paper and thus with prospects of passing the test, whereas SP had only 6 test stations. It was therefore decided to carry out the testing in two rounds, and additional particulars were requested from 10 entrants. One entrant (No. 14) did not reply and was therefore struck off. One of the remainder (No. 13) did not really give a satisfactory reply, but the competition organisers nevertheless called in all the remaining 9 systems (Nos. 1, 2, 5, 7, 9, 10, 11, 12, 13) for prototype testing.

Testing took place in the summer of 2000 and had to be prolonged, owing to the extremely poor weather. The test results were compiled by SP and a general presentation given in a preliminary report dated 26th September 2000. That report included sub-reports, later communicated to the entrants, on each system. The sub-reports also contained various suggestions concerning possible improvements to the systems.

The report showed:
- that two systems (Nos. 1 and 2) had met the predefined performance requirements,
- that one system (No. 13) clearly failed to meet several of the performance requirements,
- that in principle the other 7 systems met all the requirements except that of 50% solar thermal share (the tests indicated between 39 and 43%).

In addition, one participant (No. 10) contacted the competition organisers during the test period, informing them that an incorrect price (too low) had been indicated in the entry (due to a

misunderstanding). No. 10 did not, however, provide written clarification, despite being repeatedly called upon to do so.

6.
Testing and examination of the competition entries thus suggested that two participants (Nos. 1 and 2) had met all the obligatory requirements, such as function, price etc. Special meetings and visits among the suppliers were therefore concentrated primarily on these two, with a view to further clarification.

At the same time the technical specialists inaugurated a preliminary evaluation based on the various criteria and weights indicated in the competition documents.

7.
Meetings with one of the two companies (No. 2) showed them to have misunderstood the terms of the price indication and not to have included VAT as required. With VAT included their adjusted price would exceed the stated obligatory requirement by over SEK 1,800. It also emerged that the company was doubtful about taking responsibility for delivery and marketing to individual buyers and only wanted to deliver the full order to one "customer" (MAV, for example) and to one address ("the main square in Karlstad" was suggested). This, coupled with the price overrun, implied such a serious departure from the terms of the competition that the entry was rejected.

At the end of November the jury decided to reject the entry whose system had been shown by the prototype testing to be wholly inadequate (No. 13) and the entry submitted without VAT etc. (No. 2), as well as the entry carrying the wrong price (No. 10). This left 6 systems for further assessment.

8.
The other company (No. 1) was asked, following a meeting, to give an account of its financial status and capability of making deliveries to a large number of small customers. It transpired that the company, which officially was a one-man business, proposed starting a new, public company with 5 partners for this commitment. The competition organisers explained that the account initially given was not satisfactory and that more convincing particulars of financial standing, delivery capacity and stability would have to be furnished. The firm was allowed considerable time, upwards of one month, in which to furnish these particulars. The competition organisers also recommended the form to contact a business consultant or venture capital organisation (ALMI, for example) with a view to improving its position. Meanwhile, to avoid loss of time, negotiations were opened concerning a possible framework agreement. Later, in December, it became clear that, despite having itself contacted ALMI, the firm was unable to provide the requisite clarifications concerning the financial strength and structure of the new business. The jury decided that the firm would not be able to satisfactorily complete deliveries of up to 1,000 systems to a large number of individual customers, despite possibilities of successive start-up. Moreover, the firm indicated that it would need to raise the price considerably, and at this point the jury found it very uncertain whether the firm would be capable of meeting a delivery commitment. Accordingly the jury, referring to the qualification requirements given in the competition document, decided not to go any further in its deliberations with this firm.

9.
The jury now faced a situation where none of the entries met all the obligatory requirements and qualification requirements for the competition. This being a competition, as was clearly stated in the documents right from the beginning, the jury has extensive powers of discretion (orders are placed by the individual consumer), and this led it to consider amending one of the obligatory requirements, that of "solar coverage ratio", from 50 to 40%. The jury took this decision after consultations with its principals.

The technical members of the jury then factored together all the test and assessment results for the 5 systems remaining. The weighting was based on the evaluation criteria stated in the competition document.

No.	Weighting (high score = best weighting)
5	86
7	77
9	81
11	97
12	87

At a meeting in late December the jury decided for the time being to continue by contacting the 4 with the highest weighting, i.e. Nos. 5, 9, 11 and 12, though without rejecting No. 7 at this stage of things.

All the above mentioned firms were also judged, on the basis of financial data received, to have good financial stability and delivery capacity for completing deliveries to a large number of individual consumers.

Letters were sent to firms Nos. 5, 9, 11 and 12, informing them that the competition jury had amended the obligatory "solar coverage ratio" requirement from 50 to 40% and that it wished to know whether they stood by their competition entries until 28th February 2001. They were given until 12th January 2001 to reply.

In order to proceed further with No. 11, however, SP would have to carry out supplementary testing of hot water capacity. During the summer round of testing that system had not met the hot water capacity requirement as per BBR. SP soon came to the conclusion that this was due to carelessness by the manufacturer when commissioning the system, and so it was decided to repeat this part of the test with optimum starting conditions, but once again the system failed the test and so entry No. 11 was now rejected.

10.
One company (No. 12) declared its willingness early on to stay in the competition. To avoid losing time, the jury opened contacts with this company for a discussion to clarify the terms of a framework agreement. They showed that they were prepared to quickly build up a distribution organisation with adequate coverage, capable of offering customers deliveries on reasonable terms, added to which the company's interface included links with a large number of installation firms and the company displayed innovative thinking with regard to production-line automation – one of the main purposes of the competition. This, coupled with the firm's financial strength, as judged to augur well for sustainable deliveries to buyers already registered and to future buyers, i.e. to facilitate a long-term market build-up.

11.
Another two firms (Nos. 5 and 9) listed for further discussions submitted written replies within the allotted time, to the effect that they stood by their entries on given, amended conditions.

12.
These firms were also contacted for clarifications regarding the prospects of drawing up framework agreements with them.

Meanwhile the technical specialists carried out further sensitivity analyses, as a basis for the jury's assessments.

Those analyses did not indicate any appreciable change in the ranking order of the companies compared. (N.B. The absolute figures are different in the new weighting, compared with the previous one, the reason being that the comparison only includes the remaining companies.)

No.	Weighting (high score = best weighting)
5	94
9	88
12	97

13.
Thus participant No. 12 also came top in the jury's supplementary assessment. Among other things, the sensitivity analyses included allowance for different modes of assembly (external/countersunk) etc.

Deliberations with the three companies also revealed differences in the assessment of the prices of systems delivered (especially as between Nos. 5 and 12).
Company No. 5 made a written proviso for movements in the SEK-EURO exchange rate, for the extra cost of a sacrificial anode required for certain water qualities, for the (relatively high) extra cost of direct deliveries to individual consumers, and for the additional cost of a thermostatic mixing valve which is considered standard for Swedish systems.
Finally we may also note that entrant No. 12 showed good preparedness for rapid deliveries to individual customers in different parts of Sweden. Entrant No. 5 also presented good capacity for deliveries of materials and components but is judged to need more time to build up a network of Swedish agents (orders, customer contacts and installation support) and also to establish an interface with Swedish installation firms.

14.
A framework delivery agreement was then drawn up and signed by company No. 12. After comprehensive assessment of the criteria defined, the jury was thus able to announce No. 12 as the winner of the technology procurement competition.

The jury citation concerning No. 12 describes the system as easy to install, with its low collector weight and simple connection between collector and water heater. The performance of the system can well bear comparison with systems from other competitors, and the water heater is of high quality. No. 12 has also given proof of innovative thinking and a positive attitude to the matter of accommodating both suggested system improvements and terms of delivery within the prevailing cost frame.

No. 12, moreover, is a well-established firm, judged amply capable of offering both the requisite customer service and an enduringly low price for the system. Delivery of the system will begin as soon as 5 test installations have been approved by SP.

Attn. Mr. L. Bosselaar,
Chairman IEA Executive Committee Solar Heating & Cooling Program
C/o Novem
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Date: 08-10-2001 *Reference:* A044

Conc.: Task 24/Solar Procurement

Dear Mr. Bosselaar,

On behalf of the members of ASTIG I would like to inform you of our big concern with regard to the activities of IEA Task 24/Solar Procurement. As of the start of this task ASTIG and some of its members have had irregular contacts with the people involved in this task. On many occasions we have expressed our concern with regard to the goals set out and the manners and ways to achieve these goals. We have always proclaimed that a serious effort to get a further price reduction and stimulation of the solar thermal market could only be accomplished with a strong co-operation between industry and other parties in the market. Unfortunately, according to our perception, this co-operation has not reached the level we prefer.

One of the activities of Task 24 has been to start pilot projects in some countries. In the course of this year one of those projects in Sweden turned out to have an extremely negative impact on the total solar thermal market in that country. This can never be the purpose of the activities of such a Task. The procurement process was initiated and apparently selected inferior products (without regular experience and proven technologies), have been proposed in connection to a lower price level than normally anticipated in the market. As a result of this program almost 2000 Swedish households have applied for a system which cannot be delivered, caused by poor technical performances, while at the same time an unrealistic low price level in the market has been communicated. Such activity disturbs the general marketing effort of companies in Sweden. It leads to frustration of consumers and it has led to an unacceptable drop in sales of other existing companies in the Swedish market. Our Scandinavian members of ASTIG, have all expressed their grave concern about these activities and tend to hold the IEA Task 24 responsible for the situation of the Swedish market which presently exists.

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We like to suggest to you that any further activities of Task 24 Procurement will be carried out in strong corporation between industry and the parties involved in that Task and that none of these procurement activities, which can potentially harm the market situation, will be carried out under the name of IEA. As we have indicated earlier, ASTIG has always set out on a constructive approach to Task 24, however we have observed that the Task is not seeking the involvement of industry, with the result of these negative effects. We invite you to discuss this matter with us in order to turn this IEA Task 24 activities into a more constructive approach.

We are looking forward to your response.

Best regards,

T.P. Bokhoven
President ASTIG

c.c. Hans Westling

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2001-10-25

NOVEM b.v.
Lex Bosselaar
P.O. Box 8242
NL-3503 RE Utrecht
HOLLAND

Task 24, The Swedish Technology Competition, "Systems for solar-heated domestic hot water supply in detached houses"

Dear Mr Bosselaar,

Regarding the letter from ASTIG (08-10-2001), the Swedish Task 24 Team would like to give you the following information.

The competition carried out in Sweden concerns Solar DHW-system, a system type that has not yet been exploited by the Swedish industry to a high degree. Some 500 000-1 000 000 households in Sweden have an electric water heater which must be renewed after its lifetime. The idea behind the competition is that the consumer with a relative low marginal cost should have the possibility to chose an electrical water heater which also includes the solar component and thus forms a complete DHW-system. The maximum price, set to SEK 16 000 (approx 1 600 Euro) excluding installation cost, was calculated based on certain assumptions on the market potential for the system type, and the price the consumer will pay i.e. the price for competing systems on the market.

The aims and contents of the competition have been communicated regularly with the industry since its start.

14 companies, out of which 3 were foreign, entered the competition with their products. After a theoretical evaluation, 9 systems were selected for testing at the Swedish National Testing and Research Institute. Results from the evaluation, including suggestions on improvements, have been communicated to the participating companies. During the summer 2001 an additional testing activity took place, without any additional cost for the industry. In this way companies which did not enter the competition was given an opportunity to test their products and companies participating in the competition had a chance to validate the improvements suggested by the testing institute in the first round.

UPOSUN HW 300 from UPONOR AB, a Swedish company within the Finish Industry group UPONOR, was chosen as the winner of the competition. Uposun offered a new, light weight and corrosion-free construction, which to great extent can be made of recycled materials. In addition to the winner 7 systems was appointed as good quality systems under the provision that the systems were improved in accordance with advice from SP

In accordance with the originally stated evaluation process a real test on 5 houses was carried out during the summer 2001. At the same time further tests on the collector in the awarded system were initiated at SP. These tests, following the new EU standard and additional durability tests, aimed at a Quality Certification of the collector as this was a requirement on the winner. The testing and the test installations revealed one weakness in the collector design. This lead to a prolonged time schedule, giving Uponor the time to solve the problem. In order to minimize the time for the certification Uponor has agreed to carry out the outdoor test in Australia. All the required tests will be evaluated in February/ March 2002, with the intention that the deliveries of the certified collector can start in spring 2002.

Several times all the interested buyers were informed about the prolongation and have been asked if they still wanted to stay on the waiting list. Buyers, who wanted their equipment soon, were recommended to withdraw and to contact some of the other manufacturers recommended by the jury. Out of approx. 4 000 members in the buyer groups, only 136 have shown sign of "frustration" until today.

When it comes to the statement about the competition causing 'extremely negative effect on the total solar market' and 'unacceptable drop in sales', the facts are that the reported sales of collectors in small systems (<15 m²) have dropped with 15% during the third quarter of 2001, compared to the same period 2000, which coincided with the introduction of the new Swedish solar-subsidy. But at the same time collectors installed in larger systems 15-100 m² have dropped much more (45-65%) which indicates that there is no relation between the drop in the Swedish market, and the competition. Our opinion is, on the contrary, that an objective analyse will give the result that several other factors have caused the slight drop in sales for small systems. Our belief is also, that the strong positive interest from the media and from the consumers have strengthened the image of solar heating in Sweden. It is also our strongest belief that the competition still will result in a substantially larger solar market in Sweden – in benefit for the environment and the industry.

For further information we would like to advise ASTIG to consult a document describing the whole evaluation process, which has been documented (in Swedish) and communicated with the industry through SEAS, on a meeting in spring 2001.

With the Best Regards,

Hans Isaksson

National Coordinator for Sweden, IEA Task 24
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