SOLAR PROCESS HEAT (SO-PRO)

Publishable result-orientated report

of

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www.solar-process-heat.eu

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1. Executive summary

Background & objectives

In principle, there is enormous potential for using solar thermal systems in industry: about 30% of the total industrial heat demand is at temperature levels below 100°C which can be provided with commercially available solar thermal collectors. However, the market in Europe and globally is very much in its infancy - a few hundred installations exist.

The So-Pro project aimed to trigger the starting up of markets for low-temperature solar process heat in 6 European regions (Upper Austria, Region of Castillas y Madrid/Spain, South Bohemia/Czech Republic, North-Rhine Westphalia and Saxony/Germany), Podravje region (Slovenia).

Approach & main activities

Approach

- bringing together know-how from industrial processes, solar thermal and regional market development
- trans-sectoral approach (not limited to specific industrial sectors/branches)
- carrying out targeted awareness raising and information activities and identifying & supporting pilot projects

Main activities

- developing planning guidelines and check-lists
- carrying out comprehensive regional campaigns
- triggering and supporting pilot projects
- promoting solar contracting for process heat
- information dissemination outside the project regions
Main results

In qualitative terms, the main results achieved by the project include the following:

- stakeholders in the project regions met for the first time to discuss solar process heat
- a learning and market development process was started in the 6 project regions which will be continued through increased awareness and knowledge as well as range of activities which resulted from the So-Pro project
- the project activities managed to create a very positive interest on European level, including two well-attended international events, a good co-operation with the two major European platforms (ESTIF and Global Solar Thermal), and upon invitation, presentations on So-Pro were held on most major solar thermal conferences in 2011
- the press echo created by the partners was excellent with significant coverage in daily and technical press as well as in relevant online media
- the feedback on the tools developed within the project was very good, stakeholders confirmed that they found them very useful
- there are commitments to continue the training courses in all project regions
- project partners are looking into possibilities to continue and expand the cooperation, the first step is establishing an informal network "Solar Process Heat Network Europe".

Quantitative results include:

- 173 persons trained
- 1,684 participants in project events
- 9 pilot project triggered
- 18 companies present solar process heat on their website as a business field
- 168 press articles
- 21 professionally designed publications in 5 languages
Main lessons learnt

Economic viability
The main challenge in the implementation of solar process heat projects lies in the economic viability. It is more likely if:

- low temperature process heat is required during the warmer months, best below 50°C (except if for pre-heating water)
- no waste heat from other processes can be used (if usable waste heat is available, both from an economic and an environmental point of view, it generally needs to be used first)
- heating oil is the main fuel
- dedicated funding schemes are available

Knowledge and information levels

- in all regions, the level of knowledge about solar process across the value chain was even lower than expected
- therefore, a double approach was necessary: general awareness raising (mailings, press work) to spark a first interest in the subject, followed by specific information tailored to the needs of the target groups (training, descriptions of existing plants, technical advice, funding information etc.)
- continuous awareness raising activities and targeted information are needed
- it is important to continue to pin-point applications where solar process heat is economically feasible today

Policy support
Substantial policy support is needed to allow solar process heat to deliver its full potential in economic and environmental terms, most important instruments are:

- including solar process heat in national and regional renewable action plans and policies
- R & D support
- support to dissemination on European/national/regional levels
- dedicated financial support on national and regional levels through well-designed programmes, possibly also from existing programmes that support energy efficiency measures in industry.
2. Project data

Objectives

In principle, there is enormous potential for using solar thermal systems in industry: about 30% of the total industrial heat demand is at temperature levels below 100°C which can be provided with commercially available solar thermal collectors. However, the market in Europe and globally is very much in its infancy - a few hundred installations exist.

The project aimed at bringing together key actors and target groups, by combining perspectives and know-how of industrial and solar companies and by starting a market development process.

Approach

- bringing together know-how from industrial processes, solar thermal and regional market development
- trans-sectoral approach (not limited to specific industrial sectors/branches)
- carrying out targeted awareness raising and information activities and identifying & supporting pilot projects
Project duration: 01/06/2009 – 30/09/2011

Project partners:

- O.Ö. Energiesparverband (ESV),
  Upper Austria (Austria)
- ESCAN,
  Region of Castillas y Madrid (Spain)
- Energy Centre České Budějovice (ECCB),
  South Bohemia (Czech Republic)
- GERTEC,
  North-Rhine Westphalia (NRW, Germany)
- Sächsische Energieagentur (SAENA),
  Saxony (Germany)
- Energy agency of Podravje (Energap),
  Podravje region (Slovenia)
- Fraunhofer-Institut für Solare Energiesysteme (ISE),
  Germany

Work programme

The project partners implemented the following activities:

WP1 Project Management
- Six effective project meetings were held

WP2 Analysis
- For each region, regional inventories on the specific market conditions for solar process heat were developed in English and in the respective national language.
- 91 energy screenings in industrial companies were carried out.
- The results of the regional inventories and of the energy screenings were analysed in regional reports and in a summary report. Jointly, and with support from the scientific partners, the priority applications were selected and summarised in a report.
WP3 Tools
- A "European version" in English and 6 adapted regional versions of checklists for industrial decision makers were developed and printed.
- A "European version" in English and 6 adapted regional versions of the planning guidelines for 4 industrial processes were developed and printed.

WP4 Regional campaigns
- Regional campaign concepts were developed to prepare the campaigns.
- In each project region, three regional round-table meetings and one regional conference were held to actively involve the regional stakeholders.
- In each project region, a regional training course was carried out.
- Regional publications were developed and disseminated at regional events.
- Targeted mailings were carried out, to a total of 7,500 stakeholders
- 168 press and online articles were published in which the So-Pro activities were mentioned.
- In all regions, a fruitful cooperation and dialogue was established with the relevant stakeholders, ensuring their active participation in the project activities.
- The regional campaign activities are summarised in a report.

WP5 Pilot projects
- The checklists were completed in total by 80 companies.
- The project partners put a significant effort in identifying and supporting potential pilot projects.
- 9 pilot projects were implemented.

WP6 New services
- For each region, a report, a roadmap and FAQs were developed which analysed the framework conditions for solar contracting.
- Regional info round-tables were held to discuss the framework for solar contracting.
- 14 projects received advice on the use of the financing and operation scheme of solar contracting.
- A summary report presents the findings.
- No solar process heat project using contracting was realised.

WP7 European dissemination
- A project website was managed and regularly up-dated.
- The international seminar, held in the framework of the World Sustainable Energy Days, attracted 180 participants from 35 countries.
• Three project newsletters were developed and disseminated to 2,500 - 2,700 addresses each.
• A project leaflet in English was developed and disseminated.
• A European training seminar was held as a side event of the Intersolar Europe tradeshow.
• An international seminar was held in the framework of the international conference World Sustainable Energy Days.
• A So-Pro stand at the Hanover Fair, one of the world's leading trade shows for industrial technologies, was staffed by the coordinator and the project partners.
• A range of activities were implemented to ensure the cooperation with Southern EU countries. Both, the activities with Southern EU countries and the general European dissemination activities are summarised in reports.
• A report summarises policy recommendations for solar process heat.
3. Focus areas of the project

3.1. Energy screenings

Based on the result of the regional inventories, energy screenings were carried out in industrial companies to further develop their knowledge base on potentials, application possibilities and the system integration of solar process heat. The screenings were short analyses that include relevant information needed to develop an initial evaluation of the feasibility of a solar system, such as data on the industrial sector, existing processes, heat demand, current energy supply or energy cost.

Results from analysis of the screenings include the following:

Industrial sectors

The following industrial sectors were identified in the screenings: food and breweries (37%), metal (16 %), building materials (10%) and chemical industries (9%), transport (car industry, trucks, etc.) (6%), other sectors (22%) of the total.

Relevant processes

The most relevant processes identified in the course of the screenings were: heating of vessels and baths (35%), cleaning and washing (26%), raw water production (10%), drying (4%), preheating (4%), others (21%).
**Company sizes**

Company size could provide guidance on application possibilities: larger companies are likely to have better investment potential, while smaller businesses usually take decisions quicker. In the screening, large companies represented 50%, medium size were 39% and small ones were 11%.

**Energy sources**

In the screenings, natural gas was used for process heat in 55% of the companies, followed by oil (39%), district heating (5%) and electricity (1%).
3.2. Checklists for decision makers in industry

Self-assessment checklists were prepared which allow decision makers in industry to make a first, preliminary analysis whether solar thermal would be suitable for their processes. Based on a draft “European” version in English, the project partners translated and adapted the checklist to their regional conditions, involving main stakeholders in their regions (planners of industrial technologies and of solar systems, solar companies, regional energy agencies and consultants, industrial companies).

The checklists are split into two steps:

- **first step: “K.O. criteria“**:  
  - does the company need process heat below 100°?  
  - is space available to install solar thermal collectors at company site?  
  - is this space oriented towards south/south-east/south-west or on a flat roof?  
  - does the company use fossil fuels for process heat during summer months?  
  → if answered with "no", rather unlikely that solar process heat will be economically feasible

<table>
<thead>
<tr>
<th>“K.O. criteria“</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Does the company need process heat at temperature levels below 100°C?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Is space available to install solar thermal collectors areas at the company site?</td>
<td></td>
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</tr>
<tr>
<td>Is this space oriented towards south/south-east/south-west or on a flat roof?</td>
<td></td>
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</tr>
<tr>
<td>Does the company use fossil fuels for process heat production during the summer months?</td>
<td></td>
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</tr>
</tbody>
</table>

- **second step: "O.K. criteria“**:  
  - is process heat required from March to September? at least during 5 days/week?  
  - plans for reconstruction/expansion at the site for the next years?  
  - is heat recovery from other processes technically or economically not possible?  
  - is a pay back period of > 5 years for energy investments acceptable?  
  - is there a general interest in the use of renewable energy sources?

In total, 9,500 copies of the regional checklists and 2,000 copies of the European version were printed and disseminated.
Why solar thermal process heat?

Solar process heat is the production of hot water by solar thermal collectors which is used by commercial and industrial companies for process heat purposes. It can be an attractive solution for companies that investigate process heat at a temperature which allows with solar thermal alone (with auxiliary fuel heating).

Solar thermal process heat can be used for a variety of processes, for example for district and meeting heating, tank and waste drier, pre-heating oil.

The solar thermal collectors are usually mounted on the roof. The size of the system depends on the heat demand, the intensity solar energy is required. The solar system must be able to cover the total process heat demand. A cost analysis of solar thermal process heat is only a part of the process heat demand in standard plants.

The starting solar heat utility is crucial for the system design. For which sufficient experience is available, the economic viability of solar process heat installations remains a viable strategy in power generation, meeting, solar process heat is especially suitable for companies that are interested in innovative technologies, but not using solar heating, the solar heat increase process heat production.

Examples for solar process heat installations

- Lirot Bayns, Hinwil, Switzerland
  - Production of hot water for household preparation of the hot water system
  - 800 m² solar thermal collectors
  - 220 m² auxiliary system
  - The solar thermal system covers 45% of the total heat demand.

- Munters, La Capriola, Spain
  - Production of hot water for hospital preparation of the hot water system
  - 200 m² solar thermal collectors
  - 150 m² auxiliary system
  - The solar thermal system covers 40% of the total heat demand.

- Tameside, UK, Middlesbrough, Germany
  - Production of hot water and hot air
  - Solar process heat for heating of steam boilers
  - 400 m² solar thermal collectors
  - 2200 m² auxiliary system
  - The solar thermal system covers 35 – 50% of the total heat demand.

The SO-PRO project is a project supported by the Intelligent Energy Europe Programme, which targets the development of solar energy and renewable energy technologies for solar process heat in 11 European regions: Italy, Austria, Norway, Finland, Germany, Belgium, Germany, the Netherlands, the Czech Republic, and Switzerland.

www.solar-process-heat.eu
3.3. Planning guidelines

The development of the planning guideline was a rather challenging task as only a limited amount of respective literature existed. A task force was formed which - based on proposals by ISE - discussed and decided which solar and industrial system concepts to include and which representative temperatures and daily, weekly and annual load profiles to use.

One main objective of the guidelines was to link industrial process engineering and solar thermal engineering by providing the basic information necessary for both of these fields. This European publication was entitled "Solar Process Heat Generation: Guide to Solar Thermal System Design for Selected Industrial Processes" and based on this, six regional versions were developed. The approach to include the guideline in one publication allowed the project partners to include a fourth process "Heating of make-up water for steam networks" which was found to be highly relevant by the regional stakeholders.

For the regional versions, ISE provided the raw data files of the load profiles, system concepts and other data to the partners. Each of the partners selected a location within their region, for which ISE carried out solar system design simulations (on which the nomograms in the regional versions are based). After finalisation of the regional versions by the partners, ISE cross-checked the documents before they were printed.
Partners strongly involved regional stakeholders in the development process of the planning guidelines, for example by detailed discussions with the engineering departments of solar companies and industrial companies, universities and other experts, by organising specific meetings and by proof-reading of the document by solar companies, energy consultants and planners.

One European and 6 regional planning guidelines were developed, printed and disseminated including among others: load profiles / nomograms / system concepts for the four priority applications:

- heating of hot water for washing or cleaning
- heating of make-up water for steam networks
- heating of baths or vessels
- convective drying with hot air
3.4. Regional campaigns

Approach

One of the main barriers for developing sustainable markets for solar process heat is to overcome significant deficits in awareness and information. At the project start, solar process heat was a widely unknown solution in most production companies and also only a small number of solar companies and specialised planners were familiar with it.

The aim of the regional campaigns was to overcome (some of) these information and awareness deficits by using a well-targeted approach which was developed with the input of the main stakeholders.

The main target groups of the regional campaigns were solar and industrial companies, specialised planners, ESCOs, energy companies, consultants and other persons with a business interest in this field. The campaigns aimed to make optimal use of the materials and tools developed in the framework of the So-Pro project.

The project used a two-level approach:

- general information (e.g. regional publications, press articles) were used to spark a first interest in solar process heat
- specific information (e.g. checklists, planning guidelines) was provided to companies interested in using solar process heat in their company or in developing solar process heat as business fields

Such a two-level approach was necessary because the general information levels were found to be so low that starting out with specific information would not have been effective.

Involvement of stakeholders and key target groups

The main stakeholder and target groups of the regional campaigns were:
• Companies which require low-temperature process heat as well as business networks and associations of companies

Companies which require low-temperature process heat actively participated in a range of ways: from the screenings to the completion of checklists and as potential and realised pilot projects but also as participants and speakers in round-table meetings, conferences and training seminars (also their networks and associations). The So-Pro stand at the Hanover Fair was another way to reach out to them.

• Solar companies and specialised planners

Solar companies - either producers, wholesalers or distributors of solar collectors - are the group with potentially the highest economic interest in the market development of solar process heat. Therefore, they were actively involved in the project through individual contacts, round-table meetings and through their inputs and support to the development and dissemination of the checklist and the guideline.

• Regional energy agencies

The regional energy agencies involved in the project included solar process heat in their activity portfolios and will this way ensure that the market development process will also continue after the project end. Additionally, other regional energy agencies were involved in project events and received information about the project.

• ESCOs

The number of Energy Service Companies (ESCOs) differs greatly among the partner regions. For some partners, it was very difficult to find active stakeholders in this field. Others could rely on well functioning "contracting markets". Where ESCOs exist, they were actively involved in the project through individual contacts, round-table meetings and support to the dissemination of the checklist.

• Energy advisers

Where specific programmes exist, the know-how of energy advisers on industrial processes and the decision making mechanisms in industry is a great resource of knowledge for implementing solar process heat installations. In these regions, the energy advisers were involved in the screenings as well as in the follow-up to the checklists, by providing technical support where required. Also they helped identify possible candidates for solar process heat through their own contacts to industrial companies in the region. Additionally, they provided inputs in the development of the checklists and the guidelines.
- **HVAC companies**
  Companies specialised in building services and HVAC engineering are also an important target group to trigger solar process heat installations. Their know-how of industrial processes as well as their access to potential users of solar process heat is important. Innovative HVAC companies were actively involved in the project through individual contacts, round-table meetings and through the dissemination of the checklists.

- **R&D organisations and universities**
  Project partners actively involved universities and specialised R & D organisations, mostly as speakers at events and in some cases also in the technical support for the pilot projects.

At the end of the project, an additional round of stakeholder interviews was carried out by the project partners, in total 120 stakeholders provided their inputs which are included in the conclusions at the end of this document.

**Overview main campaign activities**

Based on a campaign concept developed by each project partner, the following activities were implemented within the campaign:

- **Round-table meetings:**
  3 round-table meetings per region were held which aimed to gather stakeholder input and feedback and to actively involve them in the project.

- **Regional training courses:**
  One training course was organised in every project region to ensure that stakeholders who are potentially interested in implementing solar process heat installations are enabled to do so. The training courses made special use of the guidelines developed as a part of the So-Pro project.

- **Regional conference:**
  In each region, a regional conference was held. The regional conference was an important opportunity to promote the project results and to trigger replication projects.
• **Regional publication:** Each regional partner produced and disseminated a regional publication which summarises the main results of the project and highlights the information that will continue to be available after the project end (checklist, guideline, training courses etc.)

• **Targeted mailings** were carried out to stakeholder groups, disseminating project information, such as the checklists as well as the publications and information on events.

• **Press articles:** Partner communicated "news-worthy" activities (a new publication, a larger event etc.) through press releases.

• **International dissemination activities:** The international dissemination activities (European training seminar, international seminar, project newsletter etc.) were also communicated to regional stakeholders.

**Regional round-tables**

In each region, 3 round-table meetings were held which were the backbone of the interaction and the feedback from the target groups, especially those representing solar companies (including specialised planners), ESCOs and organisations/networks representing industrial companies, relevant R & D organisations etc. In total, the round-tables attracted 650 participants.

The regional round-table meetings provided valuable input in the development of the campaign concepts and key materials, such as the checklists and the planning guidelines. At the meetings, major players in each region gave short presentations and companies which participated in the energy screenings were invited. The participants very much appreciated and made use of the opportunity for exchanging ideas and for developing strategies for further market development together with other actors in the solar thermal field.

An important element in all meetings was the identification of barriers as well as the debate on how to overcome them. The roundtables dealt with economic issues, information and awareness raising as well as technical details. Additionally, pilot projects were presented, success factors analysed as well means to disseminate know-how.
among the different target groups. Another focus point was to jointly identify economic application possibilities for solar process heat.

For each of the round-tables, an event description is available with specific conclusions.
Regional training courses

A training course was organised in each region, targeting technical experts (mostly engineers) from solar companies and from industrial companies as well as specialised planners. The aim of the courses was to provide the principle know-how to size and plan installations for solar process heat.

Based on some general information on solar thermal (functioning principles, sizing etc.), the courses put a focus on the selected industrial processes and made use of the guides. Additionally, information on funding programmes and innovative financing schemes were included. Existing case studies played an important role.

The training seminars were implemented with the support of ISE and GERTEC. After each training course, the participants were invited to give their feedback via a questionnaire.
The main results of these questionnaires can be summarised as follows:

- solar process heat is a challenging field and much remains to be done in the next years to speed up market development.
- the examples presented made it clear that solar process heat is no standard solution yet and in general plants are individually planned. Therefore the tools developed within the SO-PRO project are very helpful.
- In general, the feedback received was very positive, the main motivation to participate in the seminar was to learn more about designing, sizing and installing larger solar thermal systems and to get a deeper insight in the possibilities of solar thermal process heat. The professional expertise, the exercise session and the presentations of best practice examples were liked best. For further improvement, more detailed technical information on the implementation of large solar process heat installations and further exercises were suggested.

In total, the training seminars attracted 143 participants.

Early in the project, project partners established contacts with organisations which could support the continuation of the training courses after the project end. All partner will continue the training courses: ESV in curriculum of the "Energy Academy", ESCAN in the framework of the EUREM training course, ECCB with its own course programmes, GERTEC in co-operation with Centre for Environment and Energy of the Chamber of Crafts, Energap in co-operation with Viessmann and ISE in the framework of the OTTI seminars as well their university lectures.

Press work and targeted mailings

The project partners were very active and also quite successful in promoting the project and its results to the daily and specialised press in their regions and countries. This was done mostly through press releases, through direct contacts to relevant medial as well as in partnership with regional stakeholders. Information about So-Pro appeared in articles in daily and technical press, in eMails newsletters, online portals, etc. In addition, a number of presentations (outside So-Pro events) were held, in which the So-Pro project was mentioned. In total, 168 articles in press and online media were published in which SO-PRO and its activities were mentioned.
Highlight among the press echo are:

- a press conference of the regional minister for energy in Upper Austria where solar process heat was presented
- an interview in the German Handelsblatt
- a significant coverage in relevant specialised press, including: Chefinfo; A3 Eco; OÖN; Alpenkonvention; Energía y Renovable; Construible; NT22; EnergéticaXXI; Energie Kolemnás; Sonne, Wind und Wärme; Solarportal; energie.de; B&I Betriebstechnik & Instandhaltung; Sonnenenergie; Energie & Management; Solarthemen; Solar News; Instalater;

Despite a wide availability of electronic information, targeted mailings are still an important communication tool, especially when the information disseminated is a subject which is not yet known to the target group and a principle interest needs to be sparked. Targeted mailings were carried out to a total of more than 7,500 stakeholders.

**Regional conferences and publications**

In each region, a regional conference was organised. The regional conference was an important opportunity to promote the project results and to trigger replication projects. Presentations included information on:

- solar thermal systems in general as well as innovative aspects
- technical solutions for solar process heat
- economic aspects, especially which technical concepts could be economically viable
- funding programmes and innovative financing systems, such as contracting
- case studies and practical examples
The combination of presentations with a technology focus (technology overview, planning details) and case studies (including details on the implemented solar thermal concept) turned out to be of great interest for the participants. Presentations were made, among others, by representatives from the project partners, solar and industrial companies, R&D organisations, etc. The objective to attract key stakeholders and potential solar process heat users was achieved.

Near the end of the project, each regional partner published a professionally designed brochure which summarises the main findings. These regional publications are an important tool for wider dissemination of the project findings.
The target groups are mainly solar and industrial companies, ESCOs, public bodies, energy companies, consultants and other persons with a business interest in this field.

The publications were for examples disseminated at the regional conferences and training seminars.

Additional dissemination within the project regions

Events outside the So-Pro project

In addition to the specific action foreseen in the work programme, project partners made a dedicated effort in including information in a wide range of their other information channels. The best opportunities for doing so were either events organised by the project partners themselves (outside the So-Pro project) or events where they were speakers. In total, the project partners disseminated So-Pro information at more than 40 events outside the So-Pro project activities.
Activities supporting companies in establishing and expanding "Solar process heat as a business field"

Project partners were active in supporting regional companies in establishing and expanding "Solar process heat as a business field". This support included personal contacts, advice, information by e-mail, support in identifying potential customers, networking with other solar companies and services providers etc. As a result of these efforts, 18 companies in the project regions now offer products or services related to solar process heat on their websites.

Conclusions & lessons learnt from the regional campaign

When implementing the campaign, it was important to understand that there are information deficits in all important actor groups and that there is a lack of information across the value chain:

- solar companies often lack an understanding of the complexity of industrial processes and system integration
- specialists in industrial energy systems know generally very little about solar thermal technologies
- management in industrial companies is not aware of the possibility of using solar thermal
- lack of standardised solutions and communication among these groups

Therefore, partners tried to involve as many relevant actors as possible and offered information and promotion tools for all of them.

The following success factors of implementing the regional campaigns were identified:

- doing a wide information reach out:
  awareness levels and know-how about solar process heat were nearly non-existent among industrial companies, therefore, a dedicated effort was needed to spark a first interest
- building up skills in the relevant products and service provider companies
- identifying and triggering pilot projects which will help to demonstrate economic viability and help to gather planning and operation experience
• bringing the different stakeholders together to discuss solar process heating. One important aspect of the meetings was to understand the role of different actor groups and to try to identify ways to interest them in solar process heat.

In all project regions, stakeholders from the solar, the industry and the public sectors met for the first time and in general participated actively. The level of knowledge about solar process both in the solar sector and in industry was even lower than expected, and therefore a double approach was necessary: a general approach to spark a first interest as well as specific and targeted information and support.

Project partners managed to establish a number of longer-term co-operations (e.g. with training institutes to continue the training courses) which will help to ensure the continuation of the information dissemination. Also, the project partners have decided to establish an informal network called "Solar Process Heat Europe" and committed themselves to continue the co-operation.
3.5. European dissemination

Approach and summary

A number of project activities ensured that the know-how gained in the SO-PRO project is applied throughout Europe. Well targeted dissemination activities were implemented, based on a comprehensive communication plan, which addressed mostly the following European target groups:

- solar companies and their national organisations and European association
- organisations of companies and companies active in the relevant sectors
- organisations promoting renewable market development (e.g. energy agencies)

The European communication and dissemination activities included:

- the project website
- round-tables on specific issues
- a European training seminar
- a project leaflet
- a project newsletter
- an international seminar
- a So-Pro stand at the Hanover fair
- activities to involve Southern and South-Eastern European countries (this is described in a separate report)

Additionally, the project partners made an effort to present So-Pro at a number of relevant European conferences and in relevant publications.

In general, the interest generated by the project on European level was very satisfactory and the international communication activities were well received by the target groups: the two international events were well attended and the newsletters and publications was received with interest, shown by the feedback received (more than 150 persons registered to receive further information).

The co-operation with the two major European platforms - ESTIF and Global Solar Thermal - was excellent: they actively supported the dissemination of information about events. In addition to the communication activities foreseen in the work programme, So-
Pro was presented at a number of major European conferences, including the ESTEC 2011 conference, the Intersolar 2011 conference and the Solar World Congress 2011.

So-Pro managed to reach the following numbers of international stakeholders:

- 10,000 visitors on the project website
- about 2,500 recipients of the project newsletter
- about 250 participants in European So-Pro events, 200 documented contacts at the So-Pro stand in Hanover, more than 1,000 participants in conference sessions at international conference where So-Pro was presented
- through the co-operation with ESTEC, Global Solar Thermal and articles placed in relevant media, So-Pro reached several thousands of experts in the field

The So-Pro project partners managed to establish a European network for solar process heat which will continue to be useful beyond the project.

**The project website**

The professionally designed website, [www.solar-process-heat.eu](http://www.solar-process-heat.eu), was one of the major information and communication platforms of the project. It was regularly updated and all relevant deliverables as well as information about upcoming events were placed there. It also included an internal workspace for the project partners.
The website was promoted through a range of activities, including:

- the project newsletter, the project folder and the project events
- cross-promotion with other IEE projects
- links from the partners websites
- co-operation with relevant networks (such as ESTIF and Global Solar Thermal) which provided information to their members/target groups
- through presentations held by project partners at regional and European events
- a small info card was produced and disseminated as a reminder to visit the website.

The website invited visitors to register for further information and to provide comments, in total more than 150 persons made use of this facility. The comments included mainly request for further information and information about own activities. It will be maintained and promoted by the project coordinator for at least 3 years.

**Round tables on specific issues**

Two round-tables were held in connection with the project meeting in Madrid and in Essen. The first round-table was organised by ESCAN. It was dedicated to the operational experiences with existing solar process heat installations. It included a site-visit to one of the most important solar thermal installations for process heat in Central Spain (at the Nissan plant) with a collector surface of 529 m² and a storage capacity of 40,000 litres and provided the partners with first-hands experience which was especially useful as in several of the partner regions, no solar process heat installations exist yet.

The second round-table, held in Essen and organised by GERTEC, was dedicated to discussing solar contracting and practical examples using solar air collector for solar process heat, presented by ISE, the second scientific partner. Additionally, a representative of the Greek Solar Industry Association gave an overview of the state of the art of solar process heat in Greece (linked to the activities 7.4), followed by a lively discussion on how these could be applied in the So-pro regions.
The European training seminar

A European training seminar was organised to disseminate the knowledge gained in the project. It was held on 9 June 2011 in Munich as official side event of the tradeshow Intersolar Europe, the world's largest exhibition for the solar industry. It was organised by ESV and ISE, with the inputs from the project partners.

It attracted 30 participants from 11 countries, representing technical experts from solar and industrial companies, specialised planners and energy consultants as well as public organisations and universities. The training team consisted of solar thermal experts from the So-Pro project consortium, a representative of the Greek Solar Industry Association as well as one solar thermal company.

The presentations included information on:
- information on selected industrial processes which require low temperature heat
- an interactive training session on different planning approaches
- discussion of different system concepts and collector types
- case studies including financing aspects and "solar contracting" examples

At the end of the training course, the participants were invited to give their feedback via a questionnaire. The feedback was very positive: all participants considered the seminar as good, over 40 % even excellent/very good.
The project leaflet

A project leaflet (4 pages) was developed and 5,000 copies were printed.

It includes information on the project, the main activities, a pilot project and lessons learnt. In addition, the SO-PRO checklist and planning guidelines are presented and promoted.

The leaflet was disseminated at the international events of the SO-PRO project (international conference and training seminar, stand at Hanover Fair, etc.) but also at the occasion of number of other international meetings in which the project partners were involved.
The project newsletters

A project newsletter was developed which was disseminated 3-times during the project duration. Stakeholders were invited to give feedback. The newsletters were widely disseminated. Each issue was sent out to 2,500 - 2,700 addresses in the solar thermal field, to energy agencies, to industry networks and R&D organisations. In addition to the addresses already available in ESV's database, a detailed internet research was carried out in order to have a comprehensive coverage. Additionally, more than 150 persons registered to receive the next issues.

The international seminar

The international seminar "Solar Process Heat" was held from 3 to 4 March 2011 in Wels. It was attended by more than 180 participants from 35 countries. The audience covered a wide range of actors - from solar companies, HVAC specialists and ESCOs, industrial companies, associations, media, research bodies and representatives of public bodies.

The conference programme - which was developed in cooperation with the project partners - included the following main elements:
- introduction & overview session
- sessions on "technology and examples"
- session on "potentials, markets and practical experiences with solar process heat"
- round-table discussion: Developing markets for solar process heat - how to make it happen?
- technical site-visit

In total, 24 speakers from Europe and beyond presented the technology solutions, market reports and best practice examples.

The discussion during the conference very much focused on technological issues as well as on how economically viable solutions can be found. Also, the issue of expanding future projects also into the field of mid-temperature applications was raised.

The international seminar was held in the framework of the annual international conference "World Sustainable Energy Days" (2-4 March 2011, www.wsed.at) and was included in all its comprehensive promotional activities (direct mailings per post and e-mail, announcement in technical magazines, dissemination of event folders at relevant other events etc.).
The So-Pro stand at the Hanover fair

An additional dissemination channel to industrial decision makers was the So-Pro stand at the Hanover Fair. The Hanover Fair is one of the world's leading trade shows for industrial technologies and therefore offers the opportunity for reaching out to this important target group.

A small booth (12 m²) was rented and staffed by the coordinator and the project partners.

In total, 200 documented contacts with persons from 32 countries were made during the tradeshow - many of them came from the manufacturing industry and related consultancy fields, also energy companies and R&D organisations were among the frequent contacts. Additionally, there were about 200-300 more persons who just picked up publications or just asked one or two short questions.

Involvement of Southern and South-Eastern EU countries

The project partners implemented several activities to better involve Southern and South-Eastern EU countries in the project. Personal contact to industry associations were established, intensive cooperation was carried out especially with the Greek Solar Industry Association. A separate report on these activities is available.
Additional activities by the project partners to promote So-Pro outside the project regions

As the project partners managed to create significant interest by European experts in the projects, they were invited to make the presentations at the following important international conferences:

- Intersolar Europe Conference, "Solar Process Heat", Munich, 08.06.201
- Estec 2011, the largest European conference on solar thermal, Marseille, 20.10.2011, "Solar Process Heat: Trigger the starting-up of markets for solar process in 6 European regions"

Additionally, the project partners included the So-Pro project in other international presentations, for example:

- Solar thermal conference (held in the framework of the World Sustainable Energy Days 2010), Wels/Austria, 04.03.201
- INTERREG IVa project City Network - bilateral meeting, 16.11.2010, Graz/Austria

The project partners also managed to place several press articles which also included information on the project and/or its activities and results in European/global media, e.g:

- Global Solar Thermal, the most important solar thermal internet platform: several articles were published at www.solarthermalworld.org, including an overview of the project and announcements of events. Several of the project publications were uploaded upon this platform.
- In the framework of the ESTEC conference, the project co-ordinator gave an interview on the So-Pro project which was published at http://www.techcast.com/events/estec/egger/
- an article was published in the Portuguese magazine MEDIALINE
• the project co-ordinator was recently also invited to write an article for the "Renewable Energy World Magazine" on solar process heat which is expected to appear in early 2012, following a short report already published in early 2010.

A very good and successful co-operation with ESTIF, the European Solar Thermal Industry Federation, was set up. Several meetings were held with the Secretary General (who also participated in the international seminar) and his team. ESTIF supported the promotion of the events and also the dissemination of the SO-PRO tools.

An important impact of the So-Pro project is expected from the incorporation of the results in the new IEA-Task 49 "Solar Process Heat for Production and Advanced Applications" through ISE participation in the two task definition meetings (27/28 April 2011, Graz and 2 Sept. 2011, Kassel). The Task is expected to start officially in February 2012. ISE will take the lead of Subtask C: "Design Guidelines, Case Studies and Dissemination", where also a worldwide collection of best practice installations will be done.

Conclusions & lessons learnt

The dissemination activities of SO-PRO were very well received by the targeted stakeholders and the following conclusions can be drawn from the feedback received:

• there is a significant interest in the topic of solar process heat, especially from the solar thermal industry now that the market in domestic applications is quite low in many countries. The project and its results can help to provide realistic expectations and support to concrete market development
• generally, the level of information on solar process is very low across stakeholder groups, most of the knowledge can presently be found in research institutions
• the feedback on the tools developed within the project was very good, stakeholders confirmed that they found them very useful
• dedicated funding programmes are needed to kick-start markets
• a need for further R&D exists, including the following topics:
  - mid & high temperature components (> 100°C)
  - integration concepts of solar thermal systems into existing energy systems
  - advanced control and operation strategies
  - increase in efficiency and cost reduction
3.6. Pilot projects

WP 5 supported the implementation of pilot plants in each region. From the very beginning of the project, the partners made an effort in identifying companies where solar process heat would be technically and economically feasible and where the respective decision makers could also be interested in applying this technological solution.

At each of the project meetings, information and ideas were exchanged on how to identify, approach and support companies to trigger solar process heat installations. An important element in identifying pilot project was the completion of the checklist.

In total, 80 companies completed and returned the checklists. When looking at the data which was filled in, on the "positive" side, in most companies, sufficient and appropriate space was available and that nearly all companies needed process heat at temperatures below 100 degree during the warmer months. Nearly half of the companies were considering construction measures or changes in their energy systems in the coming years which typically present opportunities to install solar thermal systems. The most frequent "barrier" was the availability of yet unused waste heat from processes.

The support to the companies by the regional partners depended on the type of company and their needs and interests. Frequently, the following approach was used:

- checklist completed
- personal contact by phone to find out more technical and economic details and to discuss if and how the project could be supported
- site-visit if the data were promising and the company was interested
- provision of specific information and support (often in co-operation with other partners from the regional networks and the scientific project partners ISE and GERTEC) which included for example:
  - analysis of the process and discussion of optimisation possibilities
  - solar simulations/calculations
  - information on subsidy programmes, support in preparing subsidy applications
  - discussion whether contracting could be an option for the specific site
  - contacts to specialised companies
In addition to the activities foreseen in the work programme to identify and trigger pilot projects, a number of activities were carried out by the partners.

The regional partners were supported by the scientific partners ISE and GERTEC throughout the process of triggering pilot projects.

The following pilot projects were identified, supported and documented in a template developed by ESV:

<table>
<thead>
<tr>
<th>Partner</th>
<th>Company name</th>
<th>Business sector</th>
<th>Main process</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESV</td>
<td>Fixkraft</td>
<td>animal feed production</td>
<td>pre-heating make-up water for steam production</td>
</tr>
<tr>
<td></td>
<td>Asamer</td>
<td>gravel mining</td>
<td>washing, space heating</td>
</tr>
<tr>
<td>ESCAN</td>
<td>Montesano</td>
<td>food industry</td>
<td>washing</td>
</tr>
<tr>
<td></td>
<td>Vaporizados</td>
<td>washing of trucks cisterns</td>
<td>washing</td>
</tr>
<tr>
<td></td>
<td>Palencia</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L’Oréal</td>
<td>production of hair and beauty products</td>
<td>heating, washing, cleaning and osmosis</td>
</tr>
<tr>
<td>GERTEC</td>
<td>Hustert Galvanik</td>
<td>surface treatment and electro plating (galvanizing)</td>
<td>heating process of industrial baths</td>
</tr>
<tr>
<td></td>
<td>Zeltverleih</td>
<td>rental agency for tents</td>
<td>cleaning, washing</td>
</tr>
<tr>
<td></td>
<td>Wielprütz</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ENERGAP</td>
<td>Soven</td>
<td>textile industry</td>
<td>washing</td>
</tr>
<tr>
<td></td>
<td>PP Agro</td>
<td>animal feed production</td>
<td>washing and sanitation</td>
</tr>
</tbody>
</table>

**Examples of SO-PRO pilot projects**

**Montesano: Solar process heat for Iberic products, Spain**

Montesano is a company specialised in meat products and well-known for its Iberic ham. As in many food industries, the production process requires high-amounts of warm water for cleaning and washing processes. Based on the positive experience with a solar thermal installation at another company site, a solar thermal system of 252 m² was installed in Jerez de los Caballeros, with two 15,000 litre buffer storages. The process supplied by the solar system include the washing processes of the raw products, the first
and second product treatments as well as the washing of the final products and the cleaning of vessels and machinery. The investment costs were 175,000 Euro, with a pay-back time of about 7 years.

**SOVEN: Sheep wool processing, Slovenia**

SOVEN is a sheep wool processing company in Selnica ob Dravi, producing wool as well as semi and final wool products. Environmental considerations are important to the company and are an element in the marketing of their products. The hot water demand is mostly for washing, sanitizing and colouring processes in wool processing which require 40 - 45 °C. A solar thermal system with 7 m² was installed which is the first solar process heat installation in the region. Investment costs were about 5,500 Euro, the annual solar fraction is calculated to be 70 %.

**Hustert Galvanik: Solar process heat for electroplating, Germany**

Hustert Galvanik in Rahden is specialised in surface treatment and electroplating (galvanizing). The company had an interest in stabilising its energy costs and reducing its dependency on the international energy markets. A solar thermal installation with 221 m² (vacuum tubes) was installed which supports the heating process of the industrial
baths which require 80 °C. The solar fraction is expected to be about 40 %. Total investment costs were about 160,000 Euro.

Asamer: Solar and biomass for process heat, Upper Austria

Asamer operates a gravel and concrete plant at their site in Ohlsdorf which is also the company headquarter. In the framework of a comprehensive renovation - which also included a thermal retrofitting of the office building - a heat distribution grid supplied by biomass and a solar thermal system (167 m² flat plate collectors) and 2 buffer storage tanks were installed. During the summer months, the solar installation is calculated to cover all heat needs at the company site.

Vaporizados Palencia: Truck vessels washing, Spain

Vaporizados Palencia, located in Villamuriel de Cerrato, is specialised in washing truck vessels which offers its services to transporters of different products, such as chemicals, food, industrial oils etc. Each washing process is different, depending on the materials transported. The average need of water is about 300 litre/truck, with 20 trucks washed per day. A solar thermal system of 140 m² was installed with two buffer tanks of 5,000 liters each. The investment was 85,000 Euro, due to a regional subsidy, pay-back time of 7 years can be achieved.
In addition to the pilot projects, partners also summarised the following case studies on existing SO-PRO installations:

<table>
<thead>
<tr>
<th>Partner</th>
<th>Company name, location</th>
<th>Business sector</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESV</td>
<td>Leitl Beton, Hörsching, A</td>
<td>pre-fabricated concrete ceilings and components</td>
</tr>
<tr>
<td></td>
<td>Eisvogel, Molin, A</td>
<td>fish production and trade</td>
</tr>
<tr>
<td>ESCAN</td>
<td>Nissan, Avila, E</td>
<td>automobile industry</td>
</tr>
<tr>
<td></td>
<td>Fasa, Valladolid, E</td>
<td>automobile industry</td>
</tr>
<tr>
<td>ECCB</td>
<td>Cider house, Hostětín, CZ</td>
<td>apple cider production</td>
</tr>
<tr>
<td></td>
<td>Feifer, Holice, CZ</td>
<td>metalworking</td>
</tr>
<tr>
<td>GERTEC</td>
<td>Edmund Merl GmbH, Brühl, D</td>
<td>specialty food</td>
</tr>
<tr>
<td></td>
<td>Schulte, Meppen, D</td>
<td>painting</td>
</tr>
<tr>
<td>SAENA</td>
<td>Lackiererei Vogel, Zwickau, D</td>
<td>painting</td>
</tr>
<tr>
<td>ISE</td>
<td>Laguna, Marburg/Lahn, D</td>
<td>washing of clothes</td>
</tr>
<tr>
<td></td>
<td>Hofmühl-Brauerei, Eichstädt, D</td>
<td>brewery</td>
</tr>
</tbody>
</table>

**Examples of SO-PRO case studies**

**Solar process heat installation in a concrete factory in Upper Austria**

In its new company building in Upper Austria, an industrial company produces pre-fabricated concrete elements for walls and ceilings. The decision was taken to install a solar process heat system instead of a conventional oil system. The installation is in operation since December 2009 and consists of 315 m² large solar thermal collector plant and 3 buffer storages (12,000 liter each).
The total heat demand to be covered (production and space heating) is about 530,000 kWh/a. In addition to the solar thermal plant, a 200 kW wood chip boiler provides heat. About 30% of the heat needed for the production and for heating the production facility comes from the solar thermal system.

The installation of a wood chip and a solar thermal system could be done economically: compared to heat provision with oil, 25,000 Euro annually can be saved. The benefits for the environment are also substantial: 422 t CO₂ emissions annually are saved. The investment, compared to an oil heating system, was about 135,000 Euro higher of which were partly covered by a public programme.

Laguna (textile industry), Marburg/Germany

Laguna is a medium-sized laundry situated at a commercial area in Marburg, Germany. Two gas-fired steam boilers (300 kW each) generate steam which is distributed to the different processes by a steam network. A significant share of the steam is consumed directly. The condensate from the steam which is not directly used returns to the feed water tank. Working time is from 7:30 am to 15:30 pm, the plant is not operated at weekends and usually there are no company holidays.

In July 2010, a solar thermal system with 57 m² aperture area (40 kW) and 3.3 m³ buffer storage volume was installed. The solar thermal system supports the partly open steam network of the laundry by pre-heating of demineralised make-up water (20°C – 90°C). Also solar pre-heating of feed water (90 °C up to max. 120°C) is demonstrated. On the process level, soft water for the washing machines is heated (20°C – 80°C). The collector field works at temperatures up to 125°C.
Steinbach & Vollmann, Germany

The metal processing company Steinbach & Vollmann produces locks, fittings and hinges for more than 125 years. By installing a new heating system in 2004, the company reduced its gas consumption by 29%. In 2008 a solar thermal system with 400 m² (280 kW) vacuum-tube collectors and 9 m³ solar buffer storage was installed.

The system (pre-)heats 16 galvanic baths (all together 21 m³) and also the conventional heating and domestic hot water system, both via return flow boost. The baths act to a certain extent as additional buffer. The required temperatures of the baths range from 60°C to 80°C. The total investment costs were 240,000 Euro. From the regional government the company received subsidies of 300 Euro / m² (120,000 Euro). The solar thermal system reduced gas demand by further 30 to 35%. An amortisation time of 7 years is expected (subsidies included).

Lammsbräu, Neumarkt/Germany

The Neumarkter Lammsbräu Gebr. Ehrenspurger e.K. is a brewery and malt house in Neumarkt, Germany with a very long tradition. Since 1987, all the ingredients of the beer originate from organic farming. In the year 2000, a 72 m² (50 kW) field of single-glazed air collectors was installed.

The air-collector system is pre-heating ambient air for the drying process in the malt house. Because the ambient air is used directly, no buffer storage is required and the utilizable temperature is very favourable. The process requires temperatures up to 60°C.
Conclusions

• triggering pilot projects was the most challenging part of the project
• the economic crises impacted and delayed the projects:
  industrial companies had "other" problems (were certainly not in "green technologies" during this period), for solar companies, there were two main impacts:
  on the positive side they were less busy, on the negative side, several solar companies struggled with survival
• pilot projects are strongly depending on the national/regional funding framework
• the main effort of the project partners went into the decision making process, significantly less in the technical aspects once the principle decision had been taken. The focus was on identifying industrial companies where solar process heat could be economically feasible, on interesting the management and the engineers in the topic and in providing arguments in order to convince them to do it.
• in addition to the screenings/checklists/stakeholder networks, several of the partners were able to use reports from energy advice/audit programmes which their organisations run
• it is very important that a thorough analysis of the process supplied is carried out to make sure that the solar energy produced can be optimally used
• monitoring of the plants is essential to ensure an optimal operation
3.7. Solar contracting

What is solar thermal contracting?

One approach to overcome the challenge of high upfront investments (compared to lower operation costs) of renewable energy installations is the instrument of energy contracting. Here an ESCO (energy service company) invests in and operates a renewable energy installation located within the premises of a company or a public body and sells energy (heat, including process heat, and possibly also electricity and cooling) to the owners/users of the buildings at an agreed price.

The basis of a solar thermal contracting project is a contract between the ESCO and the client which defines the main conditions and rules for a longer-lasting partnership. Contract duration can be 5-15 years (for solar thermal, possibly on the longer side).

The principle split of tasks and responsibilities is the following:

The ESCO:
- plans, installs, maintains and finances the solar thermal plant
- guarantees a certain heat price over the contract period

The client:
- provides the (roof) area for the solar thermal collectors and space for the buffer storage
- buys heat (for hot water, space heating, process heat) and/or cold (for cooling) from the ESCO

Solar contracting market development

Attractive as this in theory, there are (practically) no countries in Europe that have managed to set up fully functioning markets for solar contracting.

In some countries, markets for energy efficiency contracting, CHP biomass, biomass heating have successfully developed. Also, in some countries, a large number of PV contracting projects were realised. PV contracting can be economically attractive if an appropriate feed-in tariff (or investment subsidy) for the plant is granted.
Even in countries that have developed contracting markets and implemented a number of contract projects, solar thermal contracting projects are very rare.

The market development levels for different forms of contracting vary between the project regions: for example, Upper Austria and North-Rhine Westphalia have well developed markets for contracting whereas in South-Bohemia and the Podravje region, no contracting market was established yet.

**Main barriers for solar process heat contracting**

Solar contracting for industrial process heat has to overcome the combined market barriers for solar thermal process heat, for contracting in general and specifically for solar thermal contracting. Therefore, market introduction of this instrument represent a real challenge, even in countries with well-developed solar markets as well as contracting markets. However, it seems worthwhile at least to try it.

One main barrier is the "chicken-and-egg" problem: as contracting is often relatively unknown, there is no demand for it from potential customers, and as there is no demand, not many are interested in offering the services, especially as a lot of general promotion of the instrument is required before any business can be done. Also, specific skills and access to capital are necessary for the ESCOs.

Therefore, in many countries the number of ESCOs is low.

Discussions with the stakeholders in the project regions made it clear that there are also specific barriers in industry for solar thermal installations:

- it often is a “new technology” for planners active in industry and therefore, they lack the know-how about subsidies, solar systems/technologies, pilot projects.
- potential customers do not believe that the simulated (projected) solar results will be realised
- both planners and customers have doubts about system and installation quality and they fear that the integration of a solar thermal system in the existing heat supply might interfere with the existing heat distribution system and possibly even with the industrial process itself
- often very low prices for fossil fuels, electricity in industry
Important technical aspects (relating to quality and measurement)

Solar Keymark
Especially in industry and in contracting, only quality solar systems should be used. That can for example be ensured by agreeing in the contract that only solar collectors with the quality label of "Solar Keymark" are to be installed.

Solar Keymark is the first internationally recognised quality mark for solar thermal products. It is based on three aspects:

- initial type testing to EN 12975 or 12976
- an implemented manufacturing Quality Management System
- annual review of QMS and bi-annual product inspection

By obtaining the Solar Keymark, a consistent production quality of solar collectors can be demonstrated. The Solar Keymark can only be issued by an accredited "certification body" after the product has been tested by an accredited testing laboratory. In an increasing number of regions and countries, the Solar Keymark has become a programme requirement for regulatory and financial incentive schemes.

Solar heat meters
Solar heat meters are an essential component in any solar thermal systems in order to measure its output. Solar heat meters consist of the following components:

- flow meter (water is used almost exclusively as heat transfer medium)
- temperature sensors (to measure the temperature difference)
- processor (often also called integrator)
- for larger installations, generally, a remote reading service (M-bus and modem / radio) will usually be added.

For most meters, the accuracy is defined for a period of time. To keep this guaranteed, accuracy calibration is necessary every 3-6 years.
Recommendations for a solar contracting agreement

A solar contracting agreement defines roles and responsibilities of ESCOs and clients. As each project is unique and the partners need to arrive at a joint understanding of their respective obligations, "standard contracts" which are just copied have not proven to be the right approach.

However, the following list of minimum content of a solar contracting agreement can provide guidance in the process of developing the agreement (especially not to forget an important aspect). The list was developed by the project partners based on their own experiences with contracting project and discussed with the stakeholders in their regions:

- scope of services provided by the ESCO
- contract duration
- delivery guarantee (xy MWh/year)
- price, price structure, price index
- invoicing and payment schedule
- minimum consumption by the client
- compensation if heat is not delivered
- main technical features of the solar installation
- right to install solar system and access to the site
- ownership during and after the contract
- measurement method and point
- maintenance measures (extent, frequency, costs), technical auditing
- liability, insurance and warranties in case of damages
- provisions in case of bankruptcy and/or change of ownership of the ESCO or the client
- subcontracting
- confidentiality issues, conflicts of interest
- reasons to terminate the contract, settlement of disputes
- appendix: technical part, scope of supply and services

Critical aspects that are to be taken into account in the case of solar contracting are among others:

- how to calculate the solar gains?
- how to guarantee solar earnings?
• not only solar yields metered in kWh are important, but it is necessary to take temperature levels and amounts of heat needed into account
• exact definition of properties - which parts of the solar installation are owned by the contractor and which are owned by the clients (e.g. who owns pumps?)
• exact definition of the time when the property passes on to the client
• financing costs and insurance issues

Strategies to overcome the barriers and to trigger market development

The following activities could be useful in achieving this goal:

• information and awareness raising for contracting:
  very often contracting is not known and therefore not considered as an option to implement and finance solar thermal systems. Information and awareness raising is therefore crucial.

• promoting existing projects:
  Existing (and well-functioning) installations can help to make the instrument known and to establish confidence, both by the clients and the ESCOs.

• identifying companies that could become "Solar ESCOs". These could be, for example:
  - existing, active ESCOs which add this technology to their current portfolio
  - large solar thermal companies which develop solar contracting as a new business field
  - larger maintenance and facility management companies that are active in industry

• training:
  Very often the lack of qualified ESCOs hampers further market penetration of solar thermal contracting. A training programme can help to inform about solar thermal contracting and to make the topic more attractive for ESCOs.

• FAQ – List of frequently asked questions:
  Very often similar questions are asked concerning contracting projects. A list of frequently asked questions with answers can clarify first uncertainties.
The project partners developed roadmaps which included - among others - the following activities to increase visibility of solar contracting, to encourage ESCOs to consider solar thermal and to support the development of projects:

- FAQs on solar contracting:
  FAQs were developed by the project partners and disseminated, taking into account stakeholder inputs
- include information on solar thermal contracting on existing websites on contracting managed by some of the partners
- give advice and technical support to all projects identified as potential pilot projects: contracting as option was included in all activities related to pilot projects
- include the solar contracting option in business advice activities:
  those partners which manage business advice programmes in the field of energy informed their advisers of the findings relating to solar thermal contracting
- inform relevant ESCOs about potential contracting projects.

Results from stakeholder feedback process & conclusions

In all project regions, stakeholders from the solar, the industry and ESCO sectors met for the first time to discuss solar process heat and in all regions, the level of knowledge about solar process heat both in the solar sector and in the industry was even lower than expected. Also, market for solar contracting proven to be either non-existent or in their infancies in the project regions.

Building up markets for solar process heat contracting in the partner regions (and beyond) will need more time and efforts than can be provided in the framework of the So-Pro project. The most likely candidates for a successful development are regions which:

- manage to develop a sustainable and stable market for solar process heat in the framework of which "solar process heat contracting" can find its niche.
- have an active contracting market and therefore experienced ESCOs which can be interested in this business field
3.8. Policy recommendation

The benefits of using solar thermal process heat for industrial processes are manifold

- supporting the energy, climate and environmental goals of the European Union, the Member States, the regions and cities
- supporting companies in long-term cost stability of their hot water provision and thereby contributing to their competitiveness
- contributing to the European leadership in sustainable energy solutions

However, in order to use the potentials and to deliver these benefits, the significant existing market barriers for solar process heat must be overcome. The two main barriers are:

- the economic viability of solar process heat installations which is - among other reasons - due to often very low prices for fossil fuel in industry and the short pay back periods for investments expected in many industrial companies. Also, in an early phase of a market development, costs for planning and set up tend to be high due to the lack of experience of the companies involved.

- the "no interest - no know-how - no market" problem - there is a great lack of information across the value chain:
  - solar companies often lack an understanding of the complexity of industrial processes and system integration as well as the skills for successful marketing to industrial companies
  - specialists in industrial energy systems know generally very little about solar thermal technologies, they tend to overestimate the costs and underestimate the energy production and have therefore no experience in system integration
  - management in industrial companies is not aware of the possibility of using solar thermal for industrial process and therefore do not ask planners to include this option in their offers
  - there is a lack of standardised solutions and communication among these groups
  - policy makers on European, national and regional levels are generally not aware of solar process heat.
The information and promotion activities carried out within the So-Pro project made it very clear that a faster market uptake of solar process heat needs dedicated policies and programmes, otherwise, there is a risk that the market will continue to be small and very fragmented and that the development will be too slow to allow for the learning curves and to bringing down costs through larger numbers.

In technical and practical terms, solar process heat is more linked to energy efficiency measures in an industrial process than to the generation of renewable electricity. Therefore, policy support to solar process heat can also be taken in connection to other measures that support energy efficiency in industry, and not only in the context of general renewable support instruments. For this reason, the following text makes reference to a range of energy efficiency policy measures.

**Policy approach**

In principle, the following policy instruments to support solar process heat could be for example considered:

- solar thermal policy targets (e.g. in quantitative terms) and action plans with a concrete emphasis on solar process heat
- support to solar process heat R & D as well as demonstration programmes (e.g. the first 100, the first 1000 installations)
- financial support through general or dedicated funding programmes, either through subsidies or tax incentives, also any measure that supports the consideration of life cycle costs in industrial investment decisions instead of very short pay-back periods
- support to promotional measures (e.g. training, information campaigns, publications, information exchange, networking etc.)
- legal requirements, e.g. solar/renewable obligations for new sites
- standardisation and quality instruments (e.g. requirements to met certain quality criteria)

In all support measures, the option of using solar thermal contracting should be taken into consideration: with this instrument, not the industrial company itself but an ESCO (energy service company) invests in and operates the solar thermal installation at the site of the industrial company and sells the heat to the industrial company at an agreed price.
In order to be effective, the promotion and support of solar process heat should be embedded on different policy levels:

The European level

Policy measures to promote solar process heat could be included in a range of policy fields, for example energy, climate, environment, innovation and R & D, regional, tax policies etc. The instruments could in principle encompass directives, funding through different European programmes or standardisation measures.

The approaches on European level could, for example, included the following:

- considering solar process in the analysis of National Renewable Action Plans and the feedback to Member States
- including solar process heat in the energy audit schemes for enterprises foreseen in Article 7 of the Proposal for the “Energy Efficiency Directive”, currently under preparation
- quantitative targets for solar thermal on European level which could also include a specific target for solar process heat
- continued support for targeted R & D activities of the research framework programmes (considering the recommendations of the European Solar Thermal Technology Platform)
- specific support for the financing of large-scale process heat installations through European financing institutions (such as the EIB)
- support to information exchange, networking and training on European level, e.g. through the CIP programme and its successor programmes
- bringing solar process heat to the attention of European policy makers, including those in the industrial and research field, and systematically include it in all future relevant policy documents (e.g. on low carbon technologies, on emission trading etc.)

National and regional levels

Depending of the political structure in each Member State, the following measures could be taken on national/regional levels:
including solar process heat in national/regional energy action plans, setting specific targets for solar thermal and solar thermal process heat

considering solar process as an option in all programmes which support energy efficiency in industry

R & D programmes

demonstration programmes which include scientific support, monitoring and dissemination of results

financial support, either in the form of investment subsidies or tax incentives

making financing solutions (e.g. dedicated funds) available for energy efficiency and renewables in industrial companies

support to information exchange, networking, training on national and regional levels

energy advice/energy audit programmes which motivate and support industrial companies in economic energy efficiency and renewable energy investment decisions.

At present times, solar obligations for industrial companies do not seem to be an appropriate instrument for most European countries for two reasons:

there are still too many significantly more cost-effective measures to be taken in a large number of industrial companies (e.g. use of waste heat, improvements in compressed air systems etc.) which - in case a legal obligation is considered as appropriate and realistic - should take precedence.

in many Member States, the knowledge of market actors on solar process heat is too low which bears the significant risk of faulty installations carried out “just” to fulfil a legal requirement.

Priority measures

Based on the findings of the So-Pro project, the following priority measures are proposed for the coming years to support market take-off which seem to be the most appropriate and also realistic in current political climate:

Solar process heat in national and regional renewable action plans and policies

It would be helpful if some attention were paid to solar process heat by the Member States in their reports on the progress in the promotion and use of energy from renewable sources (foreseen in Article 22 of the Renewable Energy Directive
2009/28/EC) as well as in the analysis of these reports and the feedback given to the Member States by the European Commission. Such reports are due by 31 December 2011 and then every second year until 2021.

R & D support

Continued R & D on European level (research framework programmes) as well as nationally and regionally is necessary. The priorities should include:

- mid & high temperature components (> 100°C)
- integration concepts of solar thermal systems into existing heat supply and consumption systems
- advanced control and operation strategies
- increase in efficiency and cost reduction

Dissemination on European/national/regional level

A lot of further efforts are needed to overcome the significant information gaps on solar process heat among stakeholders.

On European level, such a policy measure could include the support to a project (“So-Pro+)”) which extends So-Pro activities (information dissemination and exchange, the collection and dissemination of best practice examples, the media activities and the transnational learning process) to other European countries as well as to other application areas (e.g. mid-temperature heat applications). Another option (in a next step) could be to support EU companies in exporting this solution to other parts of the world, thereby contributing to European technology leadership and export opportunities.

On national and regional levels, similar actions need to be carried out for the local and regional stakeholders. Here training and the promotion of best practice examples have a key role to play.
Financial support on national and regional levels

The following principle approaches could be possible to overcome the economic barriers for solar process heat:

- investment subsidies for solar process heat installations through dedicated programmes
- including solar process as one of the potential measures to be taken in existing programmes which support energy efficiency measures in industry (which exist in many EU Member States)
- tax incentives which favour solar process heat, e.g. reduced VAT or foreseeing flexible depreciation periods for the investment
- any other measures which supports the consideration of life cycle costs in industrial investment decisions instead of short pay-back periods (a solar thermal systems can provide nearly free hot water for at least 20 years whereas in many industrial companies pay-back periods in excess of 5 years are not considered as acceptable).

When designing a new support initiative, the following aspects should be taken into account:

- minimum support should be 25-30% of the investment costs, experiences shows that otherwise there is an imbalance of bureaucratic requirements and financial advantage (especially for smaller installations)
- subsidised energy advice/consulting programmes for companies have proven to be very effective in directing companies towards energy efficiency and renewable energy investments
- attention should be paid to quality and efficiency levels as well to the dissemination of results:
  - in young markets, the involvement of specialised scientific organisations can be beneficial
  - programmes should require monitoring of installations
  - only installations should be financially supported in which solar systems carrying the “Solar Keymark” are installed. The Solar Keymark is the first internationally recognised quality mark for solar thermal products
  - enough installations need to be funded to create a certain critical mass on the market
- should encourage (and not exclude) projects for which contracting is used
In countries where no or only a very small number of fragmented installations exist, demonstration programmes can be very useful (“the first 10/the first 100 installations”). Such programmes are characterised by higher funding levels, increased requirements for the planning process and for monitoring, for the publicity of results as well as an "organised learning process”.

**Contracting**

Solar contracting for industrial process heat has to overcome the combined market barriers for solar thermal process heat, for contracting in general and specifically for solar thermal contracting. Therefore, market introduction of this instrument represent a real challenge, even in countries with well-developed solar markets as well as contracting markets. However, once these barriers have been overcome, solar contracting could be an attractive instrument to overcome some of the economic barriers for solar process heat, especially the short payback periods accepted: industrial companies often only accept payback periods of up to 5 years and the economic consideration can then not take into consideration the nearly "free" hot water produced by the solar installation for 20 years.

Policy support to solar contracting could include:

- dissemination activities:
  - general information and awareness raising for contracting
  - promoting existing projects
  - identify companies that could be become "Solar ESCOs"
  - training
- dedicated funding programmes for solar contracting or a "bonus" within existing funding programmes if contracting is used
- removing legal and administrative barriers for contracting
4. Conclusions and success stories

4.1. Conclusions

The main conclusions drawn from the project are:

- **Market outlook**
  in principle, project partners are very positive market outlook for solar process heat: in highly developed markets where also dedicated funding programmes are available, already in the coming years, a noticeable market development could take place. In less developed solar thermal markets, this development is expected to take place in the mid-term.

- **Policy support**
  Substantial policy support is needed to allow solar process heat to deliver its full potential in economic and environmental terms, most important instruments are:
  - including solar process heat in national and regional renewable action plans and policies
  - R & D support
  - support to dissemination on European/national/regional levels
  - dedicated financial support on national and regional levels (e.g. subsidies, tax incentives) through well-designed programmes, possibly also programmes that support energy efficiency measures in industry (where solar process heat fits in very well technically)

- **Dissemination**
  Further efforts are needed to overcome the significant information gaps on solar process heat among stakeholders. On European level, such a policy measure could include the support to a project ("So-Pro+") which extends So-Pro activities to other European countries as well as possibly to other application areas (e.g. mid-temperature heat applications). On national and regional levels, similar actions need to be carried out for the local and regional stakeholders. Here training and the promotion of best practice examples have a key role to play.
4.2. Success stories

Response to So-Pro on European level

The interest generated by the project on European level was very satisfactory and the international activities were well received by the target groups: the two international events were well attended and the newsletters and publications were received with interest.

The co-operation with the two major European platforms - ESTIF and Global Solar Thermal - was excellent: they actively supported the dissemination of information about events. In addition to the communication activities foreseen in the work programme, So-Pro was presented at a number of major European conferences, including the ESTEC 2011 conference, the Intersolar 2011 conference and the Solar World Congress 2011.

This will continue beyond the project duration: project partners have already been invited to several further presentations at international conferences, several more articles are expected to be published in the next months.

Through the involvement of ISE, So-Pro results will actively be used in the new IEA Task 49 "Solar Process Heat for Production and Advanced Applications".

The project partners have committed themselves to continue the co-operation and to set up an informal network "Solar Process Heat Europe".

Training courses and their continuation

The regional training courses, developed jointly by the regional partners and with support from the scientific partners, were very effective activities in increasing the knowledge of regional stakeholders, especially solar thermal companies. The aim of the courses was to provide the principle know-how to size and plan installations for solar process heat. 6 training courses were held with 143 participants in total.

Early in the project, project partners established contacts with organisations which could support the continuation of the training courses after the project end. All partners will continue the training courses: ESV in curriculum of the "Energy Academy", ESCAN in
the framework of the EUREM training course, ECCB with its own course programmes, GERTEC in co-operation with Centre for Environment and Energy of the Chamber of Crafts, Energap in co-operation with Viessmann and ISE in the framework of the OTTI seminars as well as their university lectures.

Press echo

The project partners have successfully promoted the project and its activities to the daily and specialised press. They have placed articles on relevant websites, in online newsletters as well as in journals, including among others through press releases, inputs to regional e-mail newsletters, articles in technical press and magazines, interviews, information via online platforms and portals and through cooperation with Chambers, business developments, associations, energy agencies or relevant networks.

In total, 168 articles in press and online media were published in which So-Pro and its activities were mentioned.