



## SO-PRO - Work Package 2

### D2.3 - REGIONAL REPORT ON THE SELECTION OF PRIORITY APPLICATIONS

Project Partner: SAENA

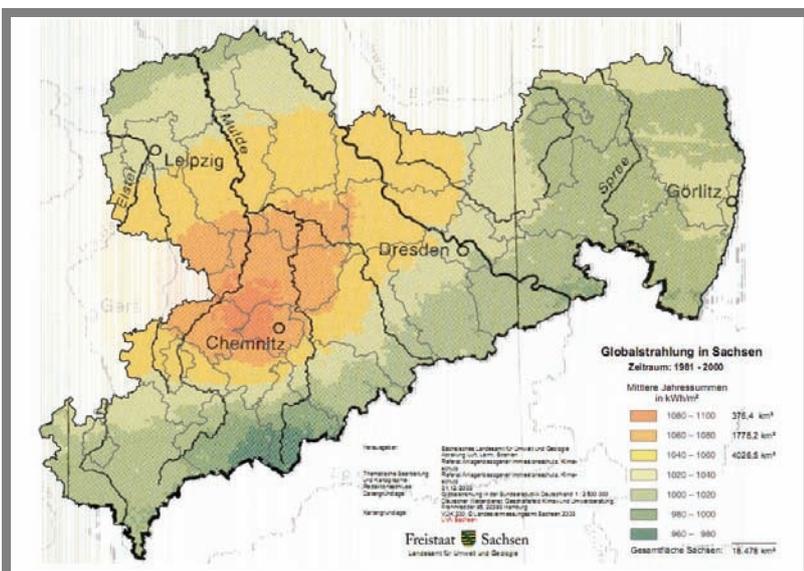
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#### The regional context

The Free State of Saxony is the most eastern state of Germany, bordering Poland in the east and the Czech Republic in the south. Saxony has an area of 18,415 km<sup>2</sup> and about 4,183,404 inhabitants (Dec. 2008). The population density is 227 inhabitants per km<sup>2</sup>. Saxony's state capital is Dresden with 508,398 inhabitants (Dec. 2008).

Saxony has a long tradition as business location. 2000 - 2008 Saxons economy grew about 15,7%. The industry density is 70 employees subjected to social insurance contribution per 1.000 inhabitants (Dec. 2008). The investment rate has been 12,9% in 2008.

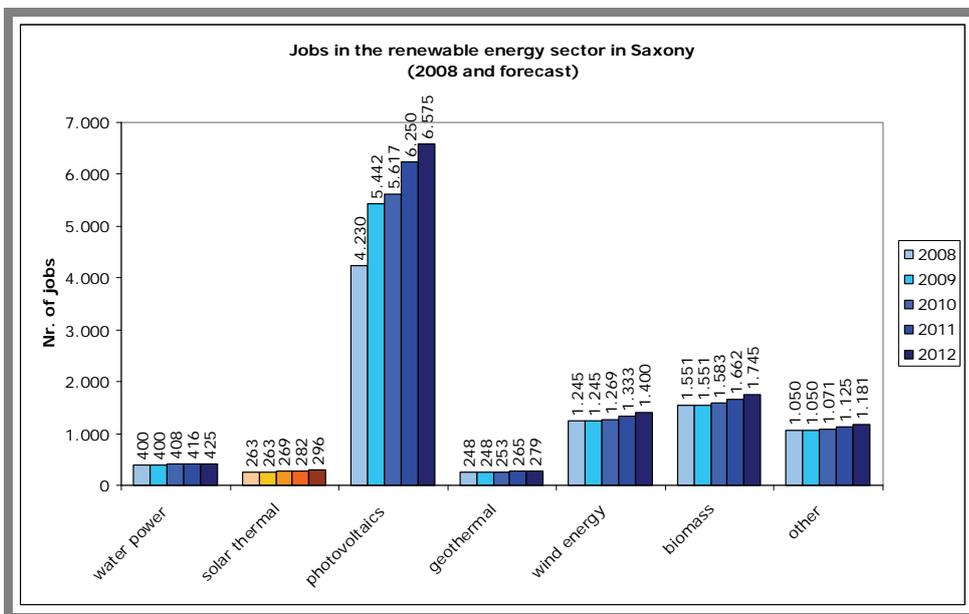


Concerning the solar radiation Saxony has good conditions for the use of solar energy. Because of the mountain ranges high solar radiations of up to 1,100 kWh/(m<sup>2</sup>a) occur especially in the middle west of the region. This "solar island" covers round about 1/3 of the region.

Global radiation in Saxony; Source: Free state of Saxony

Actually the main focus of the solar thermal business activities in Saxony lays on solar thermal installations for heating and warm water supply of buildings and district heating systems. The market for solar thermal process heat systems in Saxony is not developed yet. There is little interest within the companies that could use solar process heat, because of long pay back periods, the big effort for the integration of solar systems and a lag of know how. The interest within the solar industry is much higher. But up to now the existing activities are not linked yet.

The total installation of solar thermal systems between 01/2001 and 05/2009 in Saxony is about 303.000m<sup>2</sup> (in Germany about 9.3 Mio. m<sup>2</sup>). These installations are mainly hot water and heating systems for buildings. Data from the Federal Office of Economics and Export Control (BAFA) show zero solar process heat installations out of more than 20,000 solar installations between January 2002 and May 2009. Only 610 out of 23,745 installations are found in other sectors than the private household sector. Currently there are no installations that use solar contracting and only 11 installations in the industry sector. In Saxony realised solar thermal process heat applications are detected for example in a paint shop and a car wash.



Currently the photovoltaic marked is the most promising renewable energy marked in Saxony, with the highest employment rate and highest annual turnover. For the solar thermal marked 296 jobs and an annual turnover of 47 Mio. Euros are expected till 2012 under the current conditions.

Jobs in the renewable energy sector in Saxony (2008 and forecast);

Source: SAENA GmbH

One of the most important players for solar process heat in Saxony is NARVA Trade Solartechnik GmbH. Founded in 2007, but with 40 years experience in manufacturing of fluorescent light tubes NARVA is now producing around 1 million high efficient evacuated tubes for collectors per shift and year. Those tube collectors are very suitable for collecting solar energy for systems with high temperature demand because of their very low negative temperature gradient. NARVA developed a new and highly robust glass-metal connection for the vacuum tube. By designing a glass-metal connection that is not under any tensile load, the new glass-metal connection resists strong axial and shear forces.

Other relevant solar companies in Saxony are STI Solar-Technologie-International GmbH (standard collectors) and Solarhybrid AG (standard collectors and "hybrid-collectors", mixing

photovoltaic and solar thermal usage). Beside regional companies some nationwide operating companies like Paradigma Germany GmbH and SMP Solartechnology have local offices in Saxony. There are also some Saxon companies specialised on big storage systems (heat and cold) and engineering companies and planners with experience in large scale solar systems, but mainly for non process applications. All together more than 40 solar companies have been detected.

Scientific work is done by universities as well as by institutes like the Fraunhofer Institute for Machine Tools and Forming Technology IWU (Fraunhofer Institut für Werkzeugmaschinen und Umformtechnik IWU) from Chemnitz or the ILK Dresden (Institut für Luft- und Kältetechnik Gemeinnützige Gesellschaft mbH). The Fraunhofer IWU developed a new production method for forming processes by the use of over pressure. It can be used to produce optimised flat plate solar thermal collectors or connecting elements of solar thermal systems. The ILK Dresden developed a new storage material for high temperature latent heat storage.



*Optimized structures with forming process by the use of over pressure;*

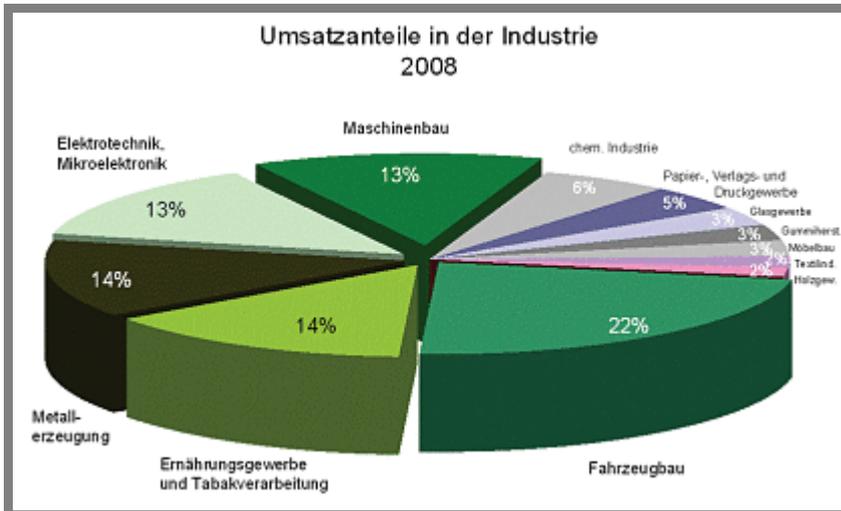
*Source: Fraunhofer-Institut für Werkzeugmaschinen und Umformtechnik IWU*

The price for solar process heat applications vary significantly, because different collector systems, different buffer storage strategies and different costs for implementation must be considered as well as different sizes of the system. Average prices for "high end" collectors for big solar thermal applications vary around 300-400 Euro/m<sup>2</sup>, costs for large buffer storage systems amount around 800-1.000 Euro/m<sup>3</sup>. The typical price for natural gas for industrial customers (1,000,000kWh/a) in 2009 was 3 ct/kWh (excl. VAT). The typical price for electricity for industrial customers (100,000kWh/a) in 2009 was 8-10 ct/kWh. For small enterprises energy costs are significantly higher.

In Germany solar thermal installations are promoted by the Federal Office of Economics and Export Control (BAFA) and KfW Bank Group (KfW Bankengruppe). Within the BAFA programme solar thermal process heat is promoted with 105€ per new installed m<sup>2</sup> collector area up to 40m<sup>2</sup> gross collector area. Large solar fields with more than 40 m<sup>2</sup> of gross collector area are promoted within the KfW programme in terms of long-term, low-interest loans with several grace years and up to 30% grant for repayment.

## Industrial sectors of special interest in the region

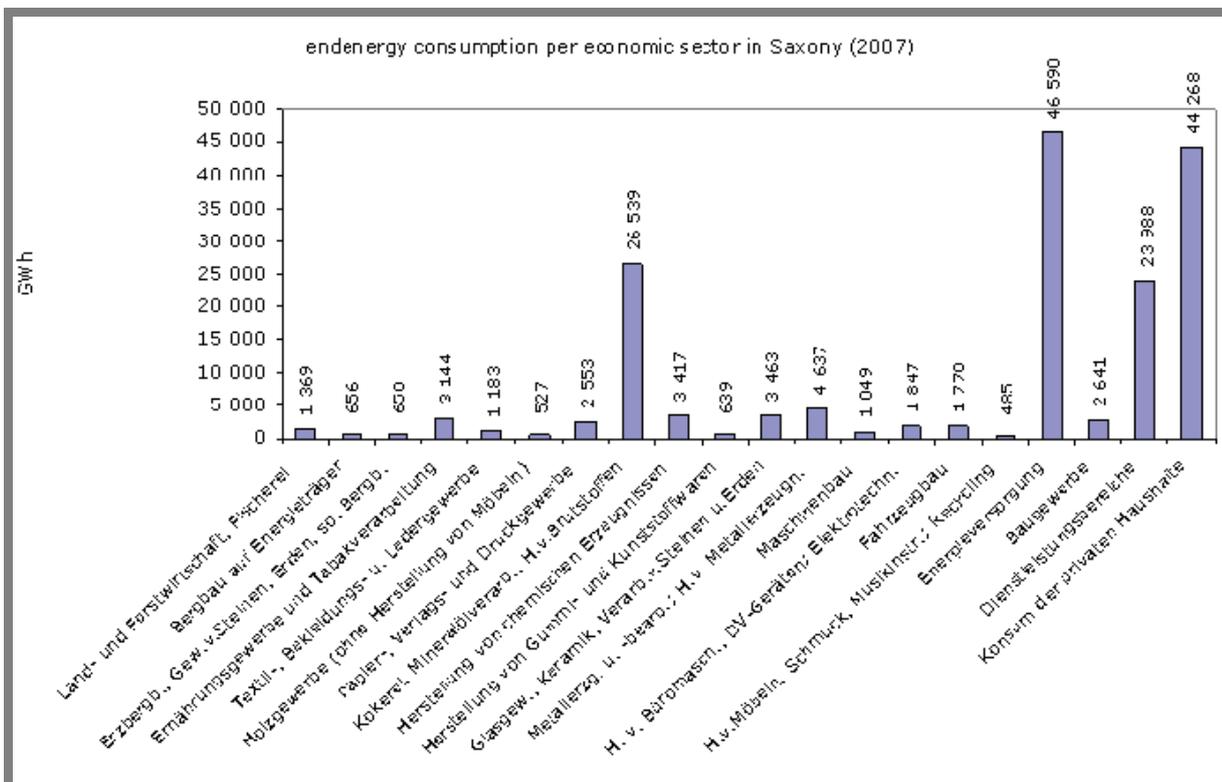
Saxony has a long tradition as location for industry and trade. Especially the textile industry, the coal mining, the mechanical engineering, electrical engineering, vehicle manufacturing, chemical industry, wood-working industry and glass-working industry as well as agriculture have age long tradition in the region. During 2008 and 2009 a significant crisis affected the textile and car industry. New investments and growth are expected in the renewable energy sector.



The biggest share of sales in the Saxon industry sector is done by five branches: car industry, food and textile industry, electrical and mechanical engineering and metal manufacturing industry. Accumulated this branches have a share of 3/4 of the total share of sales in the industry sector. 34,3% of the total sales are made by exports.

Share of sales in the industry in Saxony 2008; Source: SMWA

The main relevant sectors for solar thermal process heat include the chemical industry, metal working and the food industry. These branches have significant energy consumption on the one hand and temperature demand suitable for solar process heat on the other hand.



Energy Consumption per economic sector in Saxony (2007); Source: SAENA GmbH

The chamber of industry and commerce represent the interests of industry and trade companies. In Saxony three chambers are located (IHK Dresden, IHK Leipzig and IHK Chemnitz) and joined in a state-wide work group. Interests of the trade sector are represented by the chamber of crafts, which is divided into three divisions as well (HWK Dresden, HWK Leipzig, HWK Chemnitz). Mechanical engineering companies are represented by VEMAS (Verbundinitiative Maschinenbau Sachsen), the Saxon network of mechanical engineering. Companies of the renewable energy branch are represented within EESA (Industrielles Netzwerk Erneuerbare Energien Sachsen), the industrial network of renewable energies in Saxony.

For the investigation of relevant companies classified web based directories may be used. Beside the yellow pages and others a regional company database is available under [www.firmen.saxony.de](http://www.firmen.saxony.de), published by the Free State of Saxony. The database contains 22,004 datasets. Companies may be investigated by postal code, field of technology, memberships in networks ore Saxon family brands.

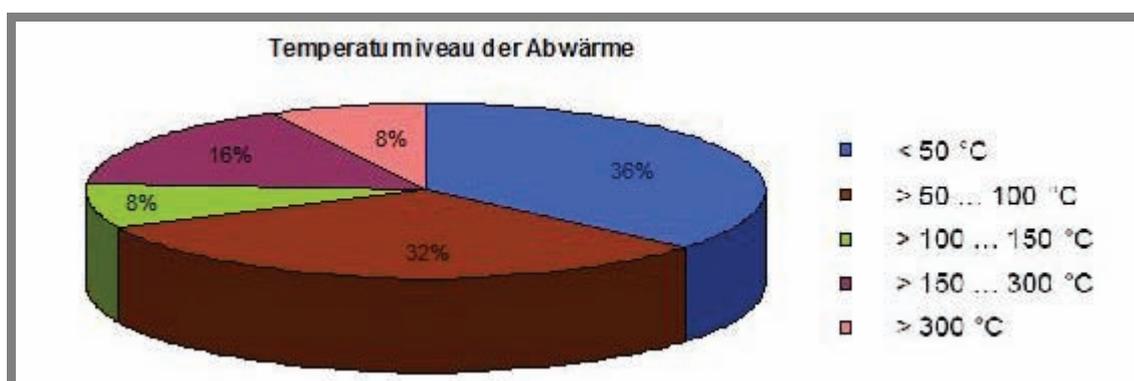
Under the lead management of SAENA the Saxon Energy Certificate for Enterprises (SäGEP, Sächsischer Gewerbeenergiepass) has been developed in the passed years. Experienced energy consultants with assistance of skilled company members analyse, consult, benchmark and certify companies regarding their electricity and heat supply.

Under the lead management of SAENA industrial companies have been interviewed regarding their waste heat sources and the current use of available waste heat.

The interviews have been done in the following branches:

- Food industry
- Textile industry
- Wood, paper, paperboard
- Chemical industry
- Glass, Ceramics
- Plastic industry
- Paint shops, surface treatment
- Foundry, hardening shop
- Metal working industry
- Steel working industry
- Microelectronics
- Electrical engineering
- Energy supply
- Waste management
- Service sector

The interviews detected waste heat sources at the following temperature levels:



Waste heat temperature levels in industrial companies in Saxony; Source: SAENA GmbH

About 50% of the waste heat occurs from production plants. 75% of the waste heat is available as hot air and hot water, in most cases all year long and thereby likely for further usage. And 60% of the total waste heat potential is used already. About 30% of the available waste heat is used for internal process optimisation and more than 60% is used for heating and warm water supply for production halls and company buildings.

The SO-PRO energy screenings are short analyses of the technical and economic viability of industrial processes for solar thermal heat supply. For the acquisition of screening candidates the first contact to industrial companies is mainly done by phone/phone interviews. For more information on the project a 10 page abstract of the work programme in the regional language is handed out and main project information are published on the regional project area website: [http://www.saena.de/Saena/Unternehmen/Solare\\_Prozesswaerme.html](http://www.saena.de/Saena/Unternehmen/Solare_Prozesswaerme.html). Screening candidates receive a 2 page pre-checklist for the preparations of the energy screening.

To motivate industrial companies with process heat demand to participate in energy screenings and pilot project the following aspects are communicated:

1. promotion "innovative company" > demonstration as best practise on regional and European level (internet platform, brochures, campaign etc.)
2. energy screening free of charge
3. possibility of a following detailed energy consulting with existing instruments (SäGEP, KfW "Sonderfonds Energieeffizienz")
4. experience from existing model projects or out of the project results
5. know how transfer
6. financial support for pilot projects via promotion directives

Screening candidates are selected by the following criteria:

- process heat demand with temperatures around 100°C or cooling demand
- interest in the project / in the use of solar thermal
- diversity of sectors
- availability of waste heat from other process steps
- processes with direct heat input, not only per electricity
- availability of roofs without shading

## **Results from the screenings and reasons for the selection of priority applications**

In order to analyse the technical and economic viability of industrial processes for solar thermal heat supply the main relevant processes with focus on processes with temperature levels up to 100°C have been inspected. Beside the technical process parameters and the work flow, the current heat supply, the availability and current use of waste heat, the availability of space for solar thermal system components and areas for the collector installation with visible range to the relevant processes have been analysed. Furthermore general aspects of the company like accepted changes and the overall economical conditions have been taken into account. Altogether 15 energy screenings have been carried out and the first interested companies for the upcoming self-assessing SO-PRO checklist have been detected.

Within the SO-PRO energy screenings the following branches have been analysed in Saxony:

Screening no	Branch
1, 11	laundry (textile cleaning industry)
2, 4	plastic manufacturing and processing
3	textile processing industry
5	printing industry
6, 12	beverage industry, brewery
7, 9, 14, 15	food industry
8	galvanic industry/electroplating
10	paint shop
13	railway vehicle manufacturing

*Branches of the SO-PRO energy screenings; Source: SAENA GmbH*

Due the project approach the following branches have been detected as likely for solar thermal process heat: plastic manufacturing and processing industry (pre-heating of plastic mixtures, cooling down of extrusion profiles in water bathes, shape forming processes, drying of glue bonds and acclimatisation of production halls), paint shops (painting and drying process), textile cleaning and textile manufacturing industries (diverse washing and drying processes), as well as the food and beverage industry (diverse washing, sterilisation and substrate heating or cooling processes), galvanic industry (galvanic bathes) and metal working industry (washing processes).

Summarising the following branches are potential users for solar thermal systems:

- food industry
- beverage industry, brewery
- textile manufacturing industry
- textile cleaning industry
- plastic manufacturing and processing industry
- paint shops
- galvanic industry/electroplating
- chemical industry
- metal working industry

The following processes have been detected as priority fields of application:

- washing and cleaning processes
- drying processes
- tempering of bathes/vessels

These applications are considered as priority because of good technical and economical conditions and its appearance in several industrial branches. The temperature levels of these processes range between 20-100 °C. The processes have good possibilities of technical integration because of likely heat carrier and appropriate technical systems, which allow solar thermal inputs.

Further findings:

### **Paint shop (Lackiererei)**

- main products: painting/vanishing of cars/car bodies
- painting process: in a painting cabin, temperature around 20°C
- drying process: in a painting cabin, 60°C or more required
- technical integration possible by preheating feed water or preheating air
- technical integration not possible in case of electrical heating used for small vanishes

### **Textile cleaning - Laundry (Wäscherei)**

- main products: drapery, table clothes
- in washing process hot water with temperatures up to 60°-90°C required – pre-heating of the hot water by solar thermal is possible, technical integration of solar thermal would be easily possible into a central heating system for hot water
- due the ironing process temperature levels up to 180°C required – technical integration of solar thermal not possible in existing systems in case of gas fired or electrical machines
- often small companies with low budget for investments but high interest because of rising energy prices for fossil energy sources

### **Textile manufacturing (Textilherstellung)**

- main products: drapery
- in washing processes with a temperature level of 50-98°C heated up by steam solar thermal is likely for pre-heating of the washing water
- drying processes (temperature up to 210°C) and printing processes (temperature up to 180°C) are done by gas fired machines, which excludes the integration of solar thermal

### **Plastic manufacturing and processing (Kunststoffherstellung und -verarbeitung)**

- main products: plastic mixtures, extrusion profiles
- plastic manufacturing: Pre-heating of plasticizer before mixing it with other synthetic materials (50-60°C) – solar thermal could be used to reduce electric heating in a mixer
- water bed cooling of finished extrusion profiles (8-14°C) - solar process heat in combination with absorption refrigeration could be used instead of a natural free cooling tower combined with electricity in a compression refrigeration machine
- waste heat only available at very low temperature level (20-30°C) and in the case of the screened company with a far distance to the other heat consuming processes

### **Plastic manufacturing and processing (Kunststoffherstellung und -verarbeitung)**

- main products: interior car bodies
- the laminating process includes several process steps done within a laminating plant: flame impingement, adhesive application, drying, activation
- drying process with temperature demand of 45-62°C, supplied by electrical heater or via gas fired boiler - integration of solar thermal in drying processes with boilers are possible
- the production halls need stabile climate conditions (20-25°C), but in summer temperatures are rising up to 30-40°C because of free waste heat, depending on the process area > air conditioning could be suitable for solar thermal cooling

### **Galvanic industry/Electroplating (Galvanotechnik)**

- main products: metallic covers
- powder coating
- electroplating
- all year long heat demand

### **Printing industry (Druckerei)**

- main products: labels, sleeves
- pre-heating of feed water (before vaporizing) for drying process
- all year long heat demand
- final temperature above 100°C

### **Beverage industry (Getränkeindustrie)**

- main products: juice, wine
- main processes: heating for pasteurising, cleaning and sterilising, cooling
- Short time heating (KZE – **Kurz-Zeit-Erhitzung**) with temperatures up to 96°C to pasteurise the juice after extracting from fruits before filling in storage tanks, cooling down to 25-30°C after pasteurisation
- solar thermal integration by pre-heating of feed water before vaporizing

### **Brewery (Brauerei)**

- main products: beer
- steam with up to 140°C/180°C needed for cooking the gyle (Würze) > 45% of the total energy demand of a brewery – internal process optimisation by waste heat usage
- cleaning of bottles with warm water > most likely for solar thermal application, all year long demand with peak in summer
- high demand on cooling of beer products
- acclimatisation of production halls

### **Food industry (Lebensmittelindustrie)**

- main products: mushrooms, whole food, dairy products, chocolate
- steam cleaning and sterilisation of production facilities
- acclimatisation of production halls and cooling of food
- washing of food and production facilities

### **Metal converting and handling (Metall Be- und Verarbeitung)**

- not many processes with process head demand around 100°C, but processes with higher head demand (e.g. tempering with 1.150°C)
- likely process would be the cleaning (e.g. band cleaning system with 60-65°C (Bandreinigungsanlage)) but often waste heat (e.g. from a compressor) available

### **Fish farming (Fischzucht)**

- the interviewed fish farms work only with outdoor reservoirs, which don't need to be heated

## Outlook

Solar thermal potentials for process heat have been detected in 9 branches: food industry, beverage industry/brewery, textile manufacturing industry, textile cleaning industry, plastic manufacturing and processing industry, paint shops, galvanic industry, chemical industry, metal working industry. The most manifold range of suitable processes for solar thermal heat supply have been detected especially in the food and beverage industry and the plastic manufacturing and processing industry. For the further marked development of solar thermal process heat these branches are expected to be most promising.

The following processes have been detected as priority applications:

- washing and cleaning processes
- drying processes
- tempering of bathes/vessels

These applications are considered as priority because of good technical and economical conditions and its appearance in several industrial branches. The temperature levels of these processes range mainly between 20-100 °C. The processes have good possibilities of technical integration because of likely heat carrier and appropriate technical systems, which allow solar thermal inputs.

For low temperature levels flat plate collectors are considered to be the most promising technical solution, due to its lower costs regarding evacuated tube collectors. For higher temperature levels vacuum tube collectors are required. Collector manufacturer consider vacuum tubes as likely for temperature levels above 100°C. In order to meet the economical suitability the degree of replaced fossil primary energy input in connection with the energy costs as well as the strategy for heat storage will be crucial. Furthermore companies that take long term investments into account will be likely for solar process heat. Hence the suitability of solar thermal systems for process heat supply is not depending on the temperature level alone, but rather a result of the above mention factors.

Small and medium sized enterprises (SMEs) will be of special interest for the marked development of solar thermal systems. In comparison to big industries SMEs have significant higher energy prices, so they will be very affected by growing prices for fossil fuels. Secondly their range of options for cost reductions is not so manifold. Since most cost reduction potentials, like reduction of employment cost, are done already, reduction in energy cost could make a big effort. Furthermore the interest in an environmental friendly energy supply system and a “green image” is quite big.

The information and dissemination activities of the project SO-PRO will address experiences with solar process heat applications, know how regarding appropriate processes and branches on the one hand and the networking of relevant experts on the other hand. Thereby it provides input for regional energy concepts and supports the regional “Action Plan Climate and Energy”. The project addresses specialist for large scale solar thermal systems, planners, storage experts, energy consultants, energy experts and decision makers from industrial companies and their networks.