



## REGIONAL REPORT

### The regional context

The German federal state North Rhine-Westphalia (NRW) is situated in the western part of the Federal Republic of Germany, the capital city is Düsseldorf. With about 18 million inhabitants North Rhine-Westphalia is the most populous state of Germany. It takes up a land area of 34.000 square kilometers and so it is the fourth largest German federal state. With a population of some 10 million inhabitants the region is one of the 30 largest metropolitan regions in the world.

In the past, the Ruhr area was characterized by coal mining and steel industry. Since the 1960s the Ruhr area has undergone a structural change that is taking place to this day. With a Gross Domestic Product (GDP) about 541 billion Euro in 2008, NRW is the most economically powerful federal state of Germany and further more an economic centre of worldwide importance. NRW contributes 22% to the German economic performance.



Figure 1 Situation of NRW in Germany  
Source: [www.wikipedia.de](http://www.wikipedia.de)

### Current Solar Thermal Market Development

The lack of information on process heat demand in manufacturing industry requires the use of general national information. According to the declaration of the *AG Energiebilanzen e.V.* the consumption of process heat of the manufacturing industry in Germany in 2007 was 1.633 PJ. This corresponds to a rate of process heat of 66,8 % of the common consumption of end-use energy in manufacturing industries.<sup>1</sup> The manufacturing industry in NRW consumed an amount of 888.404 TJ final energy, in the same year (2007).<sup>2</sup>

<sup>1</sup> AG Energiebilanzen e.V. (2009): Energieverbrauch in Deutschland – Stand 2007: Daten, Fakten, Kommentare. S. 10

<sup>2</sup> Information und Technik Nordrhein-Westfalen, Geschäftsbereich Statistik (2009): Energiebilanz und CO2-Bilanz in Nordrhein-Westfalen 2007. S. 23

Assuming that the pattern of final energy consumption in NRW corresponds to the national patterns, the process heat consumption in NRW (2007) can be derived. In view of the foregoing, the process heat demand for the manufacturing industry in NRW can be estimated at about 593.454 TJ in 2007.

According to the calculations of the *Research Center in Energy Economics*, 10 % of the German processing industry requirements have been allotted to processes heat up to 100 °C.<sup>3</sup> On condition that the structure of the processing industry in NRW is matching the national structure and that also 10% of the heat consumption is needed for temperatures up to 100 °C, NRW had a process heat demand of 59.345 TJ in 2007.

An investigation in 2004 revealed that approx. 34 % of the Austrian industrial heat demand up to 100 °C could be covered by solar thermal.<sup>4</sup> If the process heat consumption of the processing industry in NRW is adjusted based on the same condition, an accessible solar thermal process heat demand about 20.177 TJ is obtained.

Assuming that this available solar thermal process heat is covered annually up to 40 % by solar thermal at the average<sup>5</sup>, there is a calculational potential for solar process heat in processing industry in NRW of approx. 8.000 TJ in 2007. This corresponds to 1,3 % of the total amount of process heat consumption of the processing industry in NRW.

The calculation of required solar collector areas is based on the following values:

- 970 kWh/(m<sup>2</sup>a) average annual global radiation in NRW<sup>6</sup>
- 40% performance ratio for solar collector plants (388 kWh/(m<sup>2</sup>a))

Presuming that the process heat demand will stagnate on the current level till 2020<sup>7</sup>, a constantly high potential for solar process heat in NRW with about 5.727.000 m<sup>2</sup> collector area until 2020 could be assumed. Granted that by a constant development until 2010, 10 % of this potential could be developed, it is assumed that the annual demand of solar collector area for process heat will reach about 573.000 m<sup>2</sup> in NRW. As mentioned this value is based on several assumptions consequently so it is tainted with a certain uncertainty.

<sup>3</sup> Forschungsstelle für Energiewirtschaft e.V. (2009): Energiezukunft 2050 - Teil 1 Methodik und IST-Zustand. S. 101

<sup>4</sup> Bundesministerium für Verkehr, Innovation und Technologie (2004): Produzieren mit Sonnenenergie. Potenzialstudie zur thermischen Solarenergienutzung in österreichischen Gewerbe- und Industriebetrieben S. 151

<sup>5</sup> Bundesministerium für Verkehr, Innovation und Technologie (2004): Produzieren mit Sonnenenergie. Potenzialstudie zur thermischen Solarenergienutzung in österreichischen Gewerbe- und Industriebetrieben S. 151

<sup>6</sup> Energieagentur NRW (ohne Jahr): Solaratlas für Nordrhein-Westfalen. S. 8

<sup>7</sup> AEE - Institute for Sustainable Technologies (2009): Potential of Solar Thermal in Europe. S. 48

## Costs for large scale solar thermal installations

Component	Price
Collector	350 – 400 € per m <sup>2</sup>
Material costs like valves, pump, isolation, pipes, sub construction, ...	180 € per m <sup>2</sup>
Buffer storage	750 – 500 € per m <sup>3</sup>
Heat exchanger	17 – 20 € per kW
Manpower instalation	170 € per m <sup>2</sup>

## Competing energy sources and prices

Energy source	Price	Unit
Oil	0,050	EUR/kWh
Gas	0,053	EUR/kWh
District Heating	0,040	EUR/kWh
Electricity	0,120	EUR/kWh

## Financial support programmes which could be used for SO-PRO projects

The support programmes can be distinguished in these, which offer a financial grant and those which offer a loan with a below-market rate of interest. There are subsidies offered by the German Federal Government as well as by the Federal State Government of NRW. The different support programmes could be combined.

### Federal Government Support Programmes

#### KfW Mittelstandsbank – Energy efficiency advice

Under the programme “energy efficiency consulting” the KfW-Mittelstandsbank provides grants for qualified independent energy consulting in industrial companies. There are two awarded grants for an initial consultation and for a detailed consultation.

For an initial consultation (one or two days) a subsidy of up to 80 % of the maximum eligible daily fee is implemented and for detailed consultation a subsidy of up to 60 % of the maximum eligible daily fee can be granted.

#### KfW Mittelstandsbank - ERP environmental and energy efficiency program

The ERP environmental and energy efficiency programme is used to finance energy efficiency measures in small- and medium-sized companies. Low-interest loans can be granted for investments in building and energy technology, including heating, cooling, lighting,

ventilation, hot water and in process heat. Both, replacement investments and new investments which are leading to an energy saving of at least 20% and 15% will be supported. The loan is 100% of the eligible costs but not more than 10 million Euro.

### KfW Mittelstandsbank – KfW programme „renewables” (premium aid)

The KfW promotes the construction and expansion of large solar collectors (more than 40 m<sup>2</sup> collector area) and large heat stores (more than 20 m<sup>3</sup>), fed by renewable energies, in small and medium-sized companies.

The ‘premium aid’ consists of the provision of long-term, low-interest loans with redemption-free start-up years and a repayment grant. The loan will be granted for 100 % of eligible net investment, but not more than 10 million Euro. The repayment subsidy for solar collectors will be awarded at a rate of 30 % of eligible net investment. For large heat stores the repayment subsidy will be awarded at 250 Euro per m<sup>3</sup> storage volume, at a maximum of 30 % of the net investment and a maximum of 300.000 Euro.

### Federal Office of Economics and Export Control – Promotion of solar collectors

The Federal Office of Economics and Export Control (BAFA) promote the use of solar collectors in companies. The support is divided into *basic-, bonus- and innovation support*. The *basic subsidy* is paid for solar collectors used for water heating, for combined water heating and heating assistance, and for generation of process heat and solar cooling.

The initial installation of solar collectors will be promoted up to 40 m<sup>2</sup> gross collector area. The subsidy per m<sup>2</sup> gross collector area is 60 Euro for water heating and 105 Euro for the combined water heating, heating assistance and process heat supply. The subsidy for the extension of existing solar installations by up to 40 m<sup>2</sup> collector area is 45 Euro per additional installed m<sup>2</sup> gross collector area.

In addition to the basic subsidy a bonus can be paid for exceptionally innovative and effective applications of solar collectors.

### Federal State Government support programmes

#### progres.nrw

Under the program “progres.nrw”, the federal state North Rhine-Westphalia promotes the use of efficient solar collectors in industry. The subsidy covers expenses for the construction, reactivation and the extension of solar collectors, for both water heating and solar process heat. The subsidy may only be granted for projects, which have not been commenced at the time of application.

The support funding for solar collectors, which generate solar process heat, are 300 Euro per m<sup>2</sup> solar collector area. The maximum subsidy amount corresponds to 30 % of the eligible expenses.

## Existing solar process heat installations in the region

There are just a few existing solar process heat installations in NRW at this moment:

In October 2003 the Schiffer GmbH & Co. KG realised a solar process heat installation. The company is an electroplating shop in Menden. The vacuum-tube-collector-installations with an area of about 100 m<sup>2</sup> consist of 518 vacuum-tubes. The plant covers part of the heat demand, needed for electroplating baths in which metal and plastics parts are nickel plated, gold-plated, chrome-plated, electroplated or tin-plated. The temperatures required for the electroplating baths are in the range of 40 to 70°C.

Another realised installation of solar process heat is the plant of the Steinbach & Vollmann Company (STUV) in Heiligenhausen near Velbert, a producer of locking and fitting systems. A solar thermal plant for heating the electroplating baths was brought on line in January 2008. In addition, the solar plant is used for room heating in the washing rooms. A solar energy based process heat system in this dimension is a novelty in the range of electroplating. With a size of 400 m<sup>2</sup> collector area, this installation is one of the biggest of its kind in Germany. The system has a power output of 210 kilowatt and reduces the gas consumption at a rate of about 35 to 40 %.

The delicatessen producer Edmund Merl GmbH in Brühl is realizing at the moment a solar process heat installation. In August 2009 the Merl Company has received a subsidy payment of 90.000 Euro from the Federal State Government of NRW. The total amount of investment is 297.000 Euro. The collector area of this installation will cover circa 568 m<sup>2</sup> of the roof area. The water will be heated up to 60°C – in total about 30.000 liters. The warm water will be used in the whole production process, e.g. in the filling machine where it will be used during and after the daily production for cleaning and flushing.

## Industrial sectors of special interest

The key sector in the North Rhine-Westphalia region is the Chemical Industry, Metal Production and -Processing as well as Mechanical Engineering.

The industrial and technological sectors which offer an especial capability for growth in NRW are: Health, Science of Nutrition, Logistic, New Material, Nano-, Micro-. Biotechnology, Chemistry, Environmental Engineering, Energy, Information and Communication Technologies, Media and Cultural Studies.<sup>8</sup>

The nutrition industry in NRW holds a prominent position, compared with other German federal states. With more than 93.000 employees and approx. 1.000 companies, the sector is an important economic factor and employer. Measured by turnover, the food production industry is the fifth largest sector in NRW. Most significant is the high number of powerful medium sized businesses.

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<sup>8</sup> [www.wirtschaft.nrw.de/branchen/index/php](http://www.wirtschaft.nrw.de/branchen/index/php)

The most important processes in the range of metal processing, for using solar thermal systems, are surface finishing processes. Especially refinement baths, in which metal components are submerged in. Those are heated up to 60 – 100 °C.

In the sector of nutrition especially the beverage industry, the meat processing industry and the production of dairy products are relevant for solar thermal systems. NRW, the most populated federal state in Germany, with the metropolitan area of Rhein-Ruhr, is the most important market in Germany for the beer industry.<sup>9</sup>

However, not only breweries, but also the whole beverage industry is well represented in NRW. Due to the necessary production- and cleaning processes (mainly the cleaning of empties) this sector is relevant for solar process heat.

Both, the production of dairy products and the meat processing industry need great quantities of hot water for cleaning machines and equipments.

The geographical hot spots of industries suited for solar thermal are distributed like this in NRW:

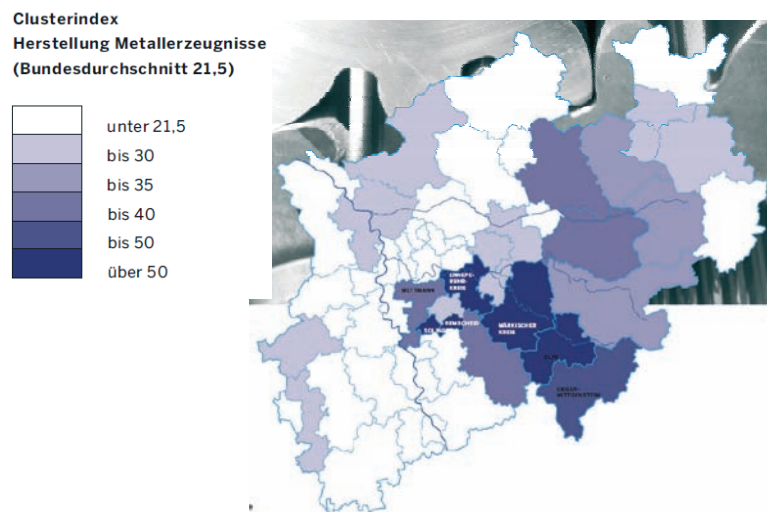


Figure 2 Industrial concentration manufacture of metal products in NRW

Source: NRW.INVEST GmbH, Econom.Development Agency of the Fed. State of NRW

<sup>9</sup> Pott, W.; [www.welt.de/print-wams/article614389/Nrw\\_Brauereien\\_cor\\_dem\\_Ausferkauf.html](http://www.welt.de/print-wams/article614389/Nrw_Brauereien_cor_dem_Ausferkauf.html); 26.08.2001

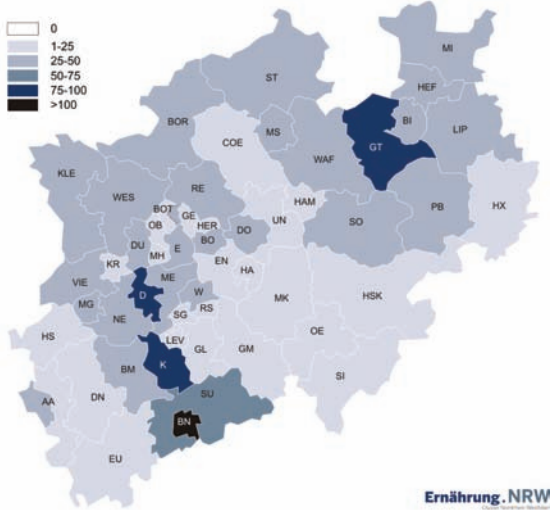


Figure 3 Regional distribution of the food industry in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

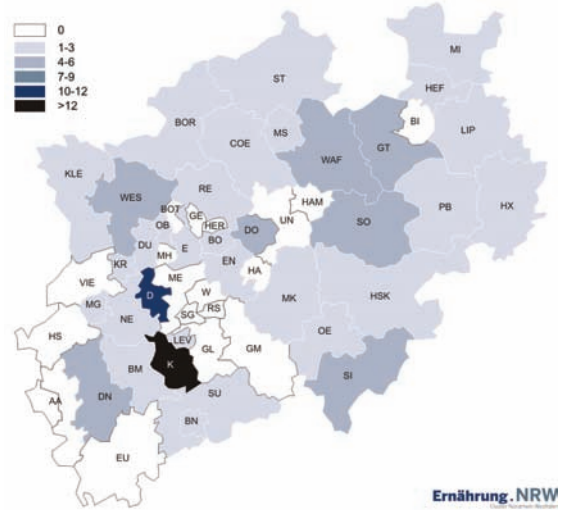


Figure 4 Regional distribution of the non-alcoholic beverage industry in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

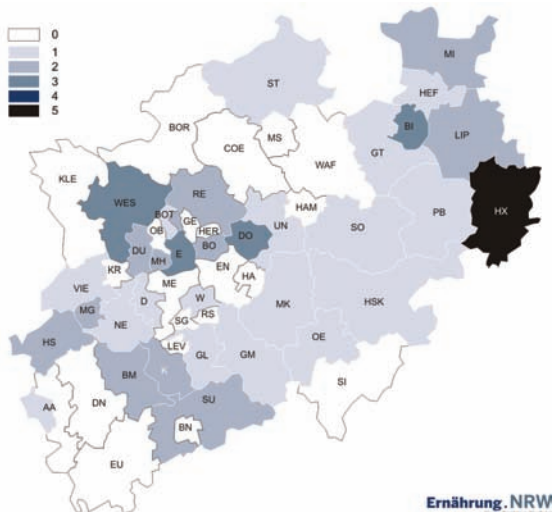


Figure 5 Regional distribution of the alcoholic beverage industry in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

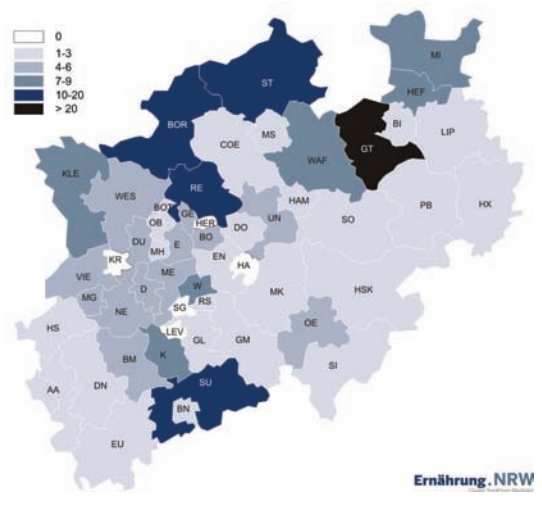
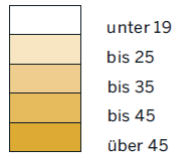


Figure 6 Regional distribution of the meat and cold cut industry in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

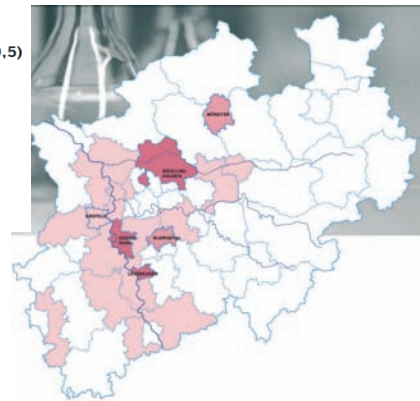
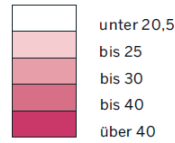
**Clusterindex  
Energieversorgung  
(Bundesdurchschnitt 19)**



**Figure 7** Regional distribution of energy supply organisations in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

**Clusterindex  
Chemische Industrie  
(Bundesdurchschnitt 20,5)**



**Figure 8** Regional distribution of chemical industry in NRW

Source: NRW.INVEST GmbH, Economic Development Agency of the Federal State of North Rhine-Westphalia (NRW)

## Important stakeholders for solar process heat in the region

official and privat organisations	solar companies	industry	ESCOs
Ministry for Economy, Medium Sized Business and Energy of NRW	Wagner & Co. Solartechnik Paradigma Deutschland GmbH	Pioneer Industries: surface treatment	Cofely Deutschland GmbH Fernwärmeversorgung Niederrhein GmbH
Business Development	BOSCH-Solarthermie GmbH	food industry	Imtech Deutschland GmbH & Co. KG
Chamber of Industry and Commerce	Sotec-Solar		MVV Energiedienstleistungen GmbH West NGT Neue Gebäudetechnik GmbH
Efficiency Agency NRW			Proenergy Contracting GmbH & Co. KG
Energy Agency NRW			
Industrial Associations			

## Regional approach to companies, screenings and pilot projects

The regional inventory starts with contacting the LOI-partners and informing them about the contents and objectives of WP 2. The solar companies have been asked for their actual contacts to industrial companies interested in solar thermal heat and for inform them about SO-PRO via mailing. Therefore, a press report has been authored which informs shortly about the contents and all objects of the project SO-PRO.

A profound online search helped to detect industrial sectors with a high heat demand in their processes. With regard to the results of this search, the Chamber of Commerce and Industry in Essen has been asked to compile a list of companies in the detected sectors and to give their opinion on fitting branches.

The Energy Efficiency Agency NRW (EFA) has been used as an uncommitted platform to spread information about the SO-PRO project. Additionally, a press report has been published in the EEA-newsletter which informs briefly about the contents and objects of SO-PRO.

Existing contacts of Gertec to industrial companies have been informed about the SO-PRO project, ESCOs and solar companies have been involved in the search for candidates which are suitable and interested in SO-PRO.

The local Environmental Department in the Ruhr area, to which Gertec has good business contacts, has been asked to cooperate in the search for interested companies with an announcement in their newsletters and on their websites. The Environmental Departments established a contact to the Communal Business Development, asking them also for publishing the SO-PRO press report in their media, in their round tables, information meetings for industrial companies and in their staff briefing.

An important multiplier in the NRW-region is the "Ökoprofit" campagne which is supported by the Communal Business Development. It is mainly focused in energy efficiency questions in the industry. In periodic meetings companies are informed about energy saving measures and Ökoprofit helps them to identify and implement measures which have been worked out in the workshops. In one of this meetings the SO-PRO project has been presented to the participating companies.

ESCOs known from former collaborations has been informed about the objective to develop new financing tools like solar contracting for example. Most of them have been very interested in this theme and will support SO-PRO with input in future round tables.

The actual applications for the first regional round table are very heterogenic. There will be participants from all stakeholder groups. The round table presumably will play a key role in the approach to future pilot projects. The feedback from the interested firms and organizations is very positive (more than 30 applications for the first regional round table). Solar process heat seems to be a up-to-date theme for all the stakeholder groups.

## Results from the screenings

In the first phase of the SO-PRO project in autumn 2009 the project partner carried out the solar screenings. In this short energy analysis the project partner visited the companies and analysed their energy consumption referring to the technical and economical feasibility for using solar thermal heat in their production processes.

Companies from the following branches and industrial sectors have been visited by the project partner, because of their theoretical demand of process heat up to 100° C.

- Plastics and synthetics
- Chemical industry
- Metal processing
- Coating and painting
- Textile industry
- Food industry:
  - Meat processing, butchery
  - Brewery and beverages
  - Dairy and milk products

The following table shows the basic data and the interim results of the realized screenings regarding to the basic suitability of solar thermal in the respective processes.

No.	branche	No. empl.	total electr. energy MWh/a	total heat energy MWh/a	max.solar process energy MWh/a	system	heat recovery system Yes/No	suitable for solar energy Yes/No
1	chemie	30	120	470	33	hot water for production	No	Yes
2	meat processing	140	712	1.440	144	hot water for production	Yes	Yes
3	plumbing fixtures	350	3.500	3.000	2.000	hot water for galvanizing	No	No
4	milk	150	12.000	50.000	1.835	pre heating for steam boiler	Yes	No
5	packaging	100	12.000	2.700	11.000	solar cooling	No	No
6	brewery	105	2.800	8.500	1.000	hot water for flushing	Yes	Yes
7	brewery	25	n.n.	1.270	150	hot water for flushing	Yes	No
8	textil	68	1.100	4.000	1.160	hot water for colouring	Yes	Yes
9	beverage	150	7.000	2.600	120	hot water for cleaning (CIP)	Yes	Yes
10	beverage	n.n.	n.n.	n.n.	n.n.	hot water for cleaning (CIP)	Yes	Yes
11	coating	20	240	250	33	hot water for metal pre-treatment	Yes	Yes
12	meat processing	202	1.100	1.600	160	hot water for production	Yes	Yes
13	textil	100	1.500	4.500	1.000	hot water for colouring	Yes	Yes
14	metal processing	200	3.000	2.000	1.500	hot water for galvanizing	No	Yes
15	coating, painting	30	260	290	45	hot water for metal pre-treatment	Yes	Yes

In summary the experience obtained in the screenings the following points can be mentioned:

Solar thermal should be always integrated along with a extensive location dependent energy concept. En general for minimizing costs a technical solution for the Integration of solar thermal into the existing process as simple as possible is needed.

In some cases although technically the integration of solar thermal would be possible, no adequate space is given for storage units. Also the dimension of passes where the components of the solar plant have to be passed through before their installation have to be proved if their geometrical dimensions are sufficient.

The actual financial grant to a maximum of 30% and state funding is essential for forcing the implementation of solar thermal in industry.

The feed back given from the decision makers in the industry let notice an increase of interest and behavior in the ambit of renewable energies. The legal standards and the public perception for the handling of sustainability by a company or producer are the main reasons for this increase of interest.

Small and medium-sized companies are more inclined to become involved with the use of renewable energies because they would rather accept a slower return of invest than large-scale enterprises.

In general the actual energy price situation is not very favorable for solar thermal. In the most of the screened cases, the energy price for solar thermal is about 30% higher than the price of the competing energy source. So the economical feasibility in most cases is not given today.

## Selection of priority application

Based on the realised energy screenings four applications can be pointed out which enable the integration of solar process heat:

### 1. Pre-heating of water for direct use in the final product

This application type has been found on the one hand in a meat processing company, where pre-heated water is used for the fabrication of sausages and on the other hand in a chemical company, where warm water is used as basic material for product refining. The integration of solar thermal could be realized in both cases directly at the existing boiler unit, e.g. implementing an additional solar storage unit.

### 2. Warm water supply for bottle washing in breweries

The core process in breweries (gyle cooking) requires steam. In many cases the outcome of this is a high heat recovery potential which could be used for the preheating of other process liquids. Is this not possible or is the transport of the recovered heat into other processes, like e.g. bottle washing, aligned with high heat losses, the use of solar thermal could be worthwhile in technical and economical aspects. In doing so, it would make sense to install the solar plant and the thermal storage in immediate distance to the bottle washing plant. For the necessary reheat or the bridging of a spell of bad weather the solar storage can be linked with the heating circulation system of the factory building.

### 3. Plant-cleaning in beverage industry

The plants used for beverage processing have to be cleaned several times a day. Therefore are used so-called CIP-plants (clean-in-process). The cleaning plants are supplied by large tanks filled with tempered water. The warming of the water is carried out by the heating system. The integration of solar thermal into the process is technically possible by installing separate solar storage units or by re-fitting the existing storages with a solar heat exchanger. To avoid heat losses, the installation of the solar plant and of the storage unit in immediate distance to the CIP-plant is favorable.

### 4. Pre-treatment of metals

For surface treatment and for coating, metals need to be cleaned before from fats and oils. The cleaning can be realised by submerging the products into huge baths or by spraying them with cleaning agents in spray chambers. Basic material for the cleaning solution is warm (hot) water. The process water can be provided directly or indirectly by a solar thermal plant. An indirect integration can be carried out by a solar storage

linked with the existing heating system and for a direct integration the heat from the solar circuit can be introduced immediately, e.g. by additional heat coils, into the cleaning bath.

Out of this four uses of warm or hot water in production processes three priority applications for solar thermal has been selected in the region of North Rhine-Westphalia:

- Cleaning and washing,
- Heating of baths and vessels and
- Using warm water as basic ingredient

## Market development - outlook

According to an investigation carried out by the DLR (Deutsche Gesellschaft für Luft und Raumfahrt e.V. in Köln) for a temperature level till 250°C there is a process heat demand about 140 TWh/a in Germany. This is equivalent to about 5 % of the end-energy demand in Germany. The development of 10 % of these capabilities within the next 20 years requires an additional construction of 1,4 million m<sup>2</sup>/a collector area. This means the duplication of the current annual installed collector fields.<sup>10</sup>

Process heat is essentially used in the food- and beverage industry, textile- and chemical industry as well as in washing processes (e.g. car-wash). Solar process heat is mainly used in processes with a temperature between 30°C and 90°C, because these temperature levels can be reached with conventional flat plate collectors. But in the future there will be temperature levels reached and established in ranges between 80°C and 250°C for solar heat. The typical sectors with those temperature levels are the food- and luxury food industry, the chemical industry as well as the paper- and chemical pulp manufacture.<sup>11</sup>

An important factor to encourage positive market development of solar process heat is the reduction of the installation costs. High installation costs in addition to low energy prices are the most important barriers for a positive market development. With an increase of conventional energy prices the return of invest would be highly shortened. This would be the main decision reason pro solar thermal.

Ongoing information campaigns about solar thermal, the costs, the integration possibilities into an industrial process and the possible reduction of costs would contribute to an increasing interest of industrial decision makers in solar thermal. Also the further training of specialists in the solar companies would be positive for a market development. The industrial decision makers will only trust in solar thermal if they trust in the capability of the planer. The lack of confidence in this technology requires further awareness rising.

<sup>10</sup> Ministerium für Wirtschaft, Mittelstand und Energie NRW

<sup>11</sup> J.Z.; Handelsblatt Nr. 244, 16./17./18.12.2005