



REGIONAL INVENTORY DOCUMENT

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% of the German economic performance.



Figure 1 Situation of NRW in Germany
Source: www.wikipedia.de

Current Solar Thermal Market Development

At present, neither for NRW nor for Germany current or prospective declarations for solar thermal capabilities in the manufacturing industries are available. However, it is very important for companies and for policy makers to be able to evaluate the market potential.

Within the framework of the SO-PRO project, although with bounded funds, will be made an effort to close this information gap for NRW with an assessment of the current and the future potentials of solar process heat. The approach and the deliverables of this assessment will be presented in the following.

To make an evaluation of the potential of solar energy recovery in the manufacturing business it is important to know the process heat demand in the manufacturing sectors in NRW. The rate of the total heat demand as well as the required temperature levels have to be investigated. The last one is important, because only those processes with a heat demand up to 100 °C will be considered within this project. Not all processes with a heat demand below 100 °C are suited for solar thermal - yet another step is it to exclude those processes which are not able.

After all, with the help of the average annual global radiation in NRW and the average performance ratio of solar collectors, a simple estimation of the current potential of solar thermal for the provision of solar process heat in industry in NRW can be carried out.

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.¹ The manufacturing industry in NRW consumed an amount of 888.404 TJ end-use energy, in the same year (2007).²

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.

The manufacturing industry uses process heat in different levels of temperature (from below 100°C up to more than 1.400°C), so it has to be calculated the process heat demand up to the temperature level of 100°C. Because of the unknown general information for the industry in NRW in this part as well, it has to be reverted to national average values. 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.³ 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 about 59.345 TJ in 2007.

Though it is possible to generate heat for this temperature level via commercial flat-plate collector plants and evacuated tube collector plants, it has to be considered that there are a few process structures (independent of the temperature level) which are not available for solar process heat. For example in cases in which process heat can not be applied by a heat exchanger or if the process heat is required strongly fluctuating. An investigation in 2004 revealed that approx. 34 % of the Australian industrial heat demand up to 100 °C could be covered by solar thermal.⁴ If the process heat consumption of the processing industry in NRW is adjusted based on this 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 average⁵, 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. Covering this heat demand by solar thermal systems requires an adequate availability of area. The verification of the availability of areas is not part of this calculation.

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

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

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

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

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

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

- 970 kWh/(m²a) average annual global radiation in NRW⁶
- 40% performance ratio for solar collector plants (388 kWh/(m²a))

Concerning the calculational potential for solar thermal heat in processing industry in 2007 the demand for solar thermal systems in NRW is about 5.727.000 m². It can be assumed that the major part of this potential is currently not yet developed, given that end of 2007 there has been only six solar thermal plants registered in Germany allocating process heat in the manufacturing industry.⁷

Presuming that the process heat demand will stagnate on the current level till 2020⁸, a constantly high potential for solar process heat in NRW with about 5.727.000 m² 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 m² in NRW. As mentioned this value is based on several assumptions consequently so it is tainted with a certain uncertainty.

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	Pioneer Industries:	Cofely Deutschland GmbH
Business Development	Paradigma Deutschland GmbH	surface treatment	Fernwärmeverorgung Niederrhein GmbH
Chamber of Industry and Commerce	BOSCH-Solarthermie GmbH	food industry	Imtech Deutschland GmbH & Co. KG
Efficiency Agency NRW	Sotec-Solar		MVV Energiedienstleistungen GmbH West
Energy Agency NRW			NGT Neue Gebäudetechnik GmbH
Industrial Associations			Proenergy Contracting GmbH & Co. KG

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

⁷ Solar Heating and Cooling Executive Committee of the International Energy Agency (2008): Potential for Solar Heat in Industrial Processes. S. 3

⁸ 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 ²
Material costs like valves, pump, isolation, pipes, sub construction, ...	180 € per m ²
Buffer storage	750 – 500 € per m ³
Heat exchanger	17 – 20 € per kW
Manpower installation	170 € per m ²

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 those, which offer an allowance 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 Programs

KfW Mittelstandsbank – Energy efficiency advice

Under the program “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.

Grants are awarded only for counseling service by a consultant approved by the KfW. To finance the recommended energy efficiency measures, the KfW provides investment credit under the “ERP environmental and energy efficiency programme”. There is also a financing of solar collectors as part of the KfW programme “renewables” possible.

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.

The interest rates on the financing of solar collectors depend on duration of the loan, duration of fixed interest rate, size and creditworthiness of the company. The effective interest rates are currently in a range from 1,21% to 5,88 %. For a period of ten years including two redemption-free start-up years, the current average effective interest rate is 2,93 % for a small business. For medium-sized businesses, the effective interest rate is usually higher by 0,25 %.

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

The KfW promote the construction and expansion of large solar collectors (more than 40 m² collector area) and large heat stores (more than 20 m³), fed by renewable energies, in small and medium-sized companies.

The ‘premium aid’ consists of the provision of long-term, low-interest loan 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 m³ 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 for the generation of process heat and solar cooling.

The initial installation of solar collectors will be promoted up to 40 m² gross collector area. The subsidy per m² 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 m² collector area is 45 Euro per additional installed m² 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 “progre.nrw”, the federal state North Rhine-Westphalia promotes the use of efficient solar collectors in companies. The subsidy covers expenses for the construction, reactivation and the extension of solar collectors, for both water heating and for solar process heat. The subsidy may only be granted for projects, which have not been commenced at the time of application.

The subsidy is 200 Euro per m² solar collector area. The support funding for solar collectors, which generate solar process heat, are 300 Euro per m² solar collector area. The maximum subsidy amount corresponds to 30 % of 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 m² consists 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 to this, the solar plant is used 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 m² collector area, this installation is one of the biggest of this 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 m² of the roof area. The water will be heated up to 60°C - totally about 30.000 liters. The warm water will be used in the hole 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 North Rhine-Westphalia is the Chemical Industry, Metal Production and - Processing as well as Mechanical Engineering. However, the change of structure wears on: in 2008 the service sector has generated 70 % of the gross value creation in NRW - the industrial share only engaged 30 %.

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.⁹

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.

⁹ 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 for the beer industry. In relation to other federal states NRW is in the fore. Five of the breweries with the major outlet in Germany are arranged in NRW.¹⁰

However, not only breweries, but also the hole beverage industry is high represented in NRW.. Because of 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 in 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 is distributed like this in NRW:

Clusterindex
Herstellung Metallserzeugnisse
(Bundesdurchschnitt 21,5)

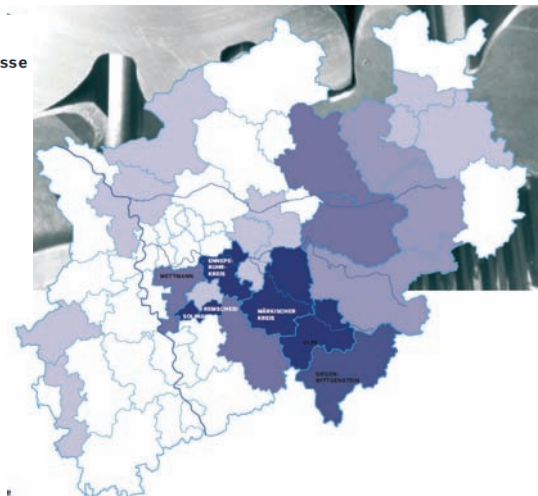
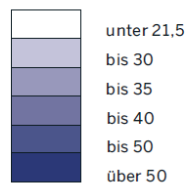


Figure 2 Industrial concentration manufacture of metal products in NRW

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

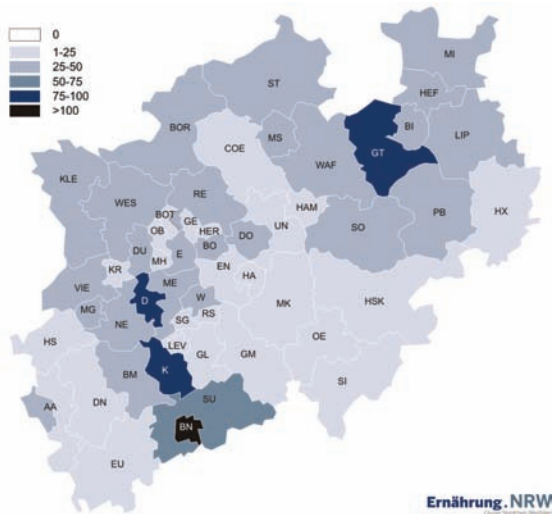


Figure 3 Regional distribution of the food industry in NRW

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

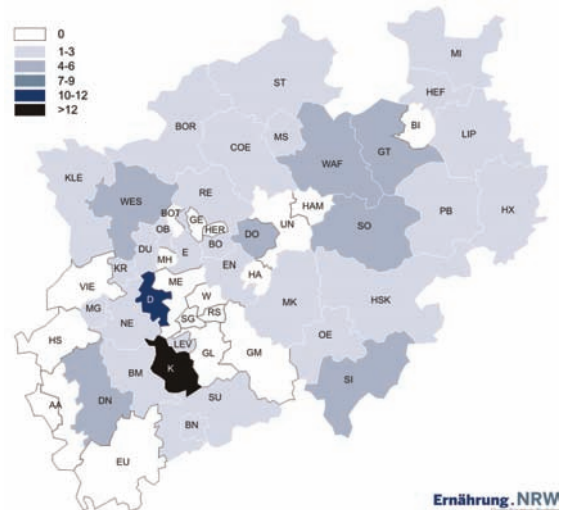


Figure 4 Regional distribution of the non-alcoholic beverage industry in NRW

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

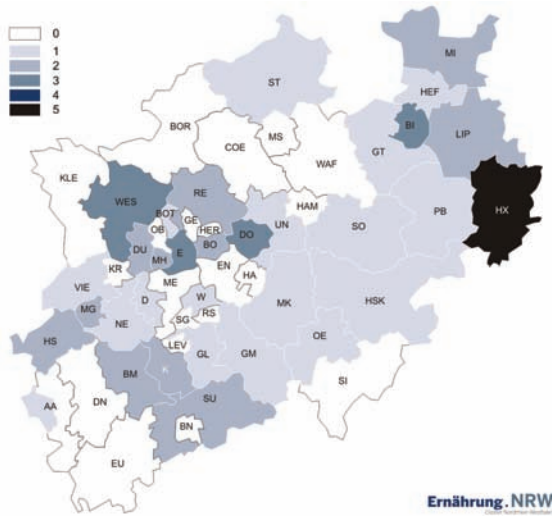


Figure 5 Regional distribution of the alcoholic beverage industry in NRW

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

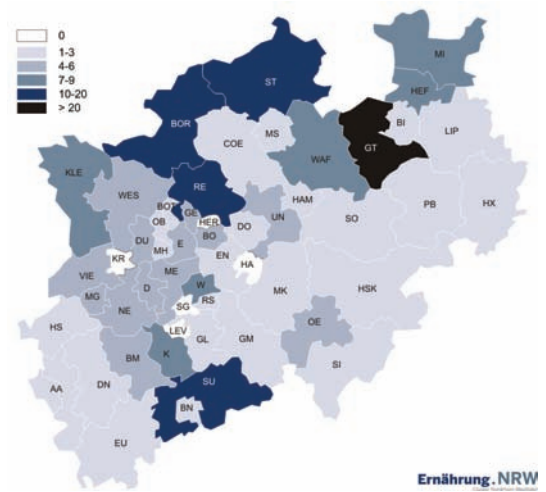


Figure 6 Regional distribution of the meat and cold cut industry in NRW

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

Clusterindex
Energieversorgung
(Bundesdurchschnitt 19)

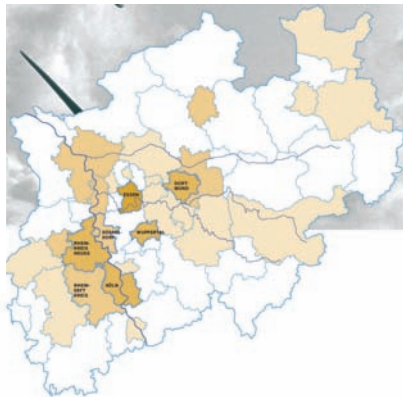
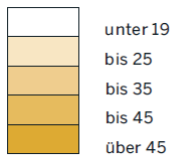


Figure 7 Regional distribution of energy supply organisations in NRW

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

Clusterindex
Chemische Industrie
(Bundesdurchschnitt 20,5)

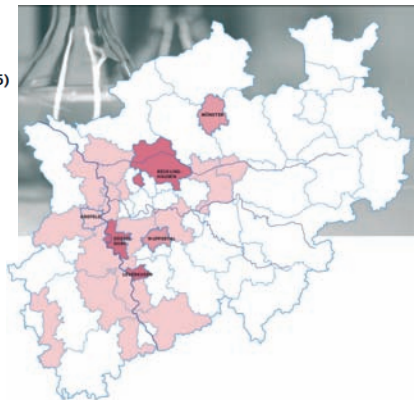
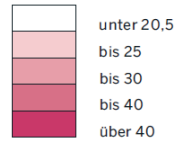


Figure 8 Regional distribution of chemical industry in NRW

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

Regional approach to companies, screenings and pilot projects

The regional inventory starts with contacting the LOI-partners informing them about the contents and objectives of WP 2. The solar companies has 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 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 industry lines.

The Energy Efficiency Agency NRW has been used as an uncommitted platform for 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. This is mainly focused in energy efficiency questions of 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 participant 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.

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 m²/a of collector areas. This means the duplication of the current annual installed collector fields.¹¹

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

¹¹ Ministerium für Wirtschaft, Mittelstand und Energie NRW

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.¹²

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 barrier for a positive market development. With a increase of conventional energy prices the return of invest would be highly shortened. This would be the main decision reason for 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.

¹² J.Z.; Handelsblatt Nr. 244, 16./17./18.12.2005