SOLAR DISTRICT HEATING IN BADEN-WÜRTTEMBERG – OVERCOMING BARRIERS AND MARKET INTRODUCTION WITHIN THE PROJECT SOLNETBW

Dipl.-Ing. Oliver Miedaner
Solites – Steinbeis Research Institute for Solar and Sustainable Thermal Energy Systems,
Meitnerstr. 8, 70563 Stuttgart, Germany, +49 711 673 2000 80, miedaner@solites.de

Dipl.-Ing. Helmut Böhnisch
KEA Klimaschutz- und Energieagentur Baden-Württemberg GmbH,
Kaiserstr. 94a, 76133 Karlsruhe, Germany, +49 721 98471 13, helmut.boehnisch@kea-bw.de

Abstract – Within the project SolnetBW measures for solar district heating (SDH) market introduction have been elaborated with the aim to initialize new plants in Baden-Württemberg. With focus on the 'barriers': land areas, economics and necessary market actors (e.g. planners), a systematic screening of potential implementation municipalities was undertaken followed by an accompaniment of first steps. In parallel many information events, workshops, etc. have been organized to address the different stakeholders. Based on the experiences recommendations have been prepared for interested replicators and the Ministry of the Environment Baden-Württemberg.

1. INTRODUCTION

In Baden-Württemberg since the 1990s SDH systems have been realized in pilot projects supported by the state of Baden-Württemberg and the federal government. In the meantime on international level solar district heating systems are realized with sizes up to 100 MW_{th} at feasible heat costs. Thus the question occurs what can be done to improve the market situation in Baden-Württemberg and to allow also there commercial implementation of solar district heating systems? This issue has been examined also regarding political, legal and economic conditions within the project SolnetBW. Further goals of the project have been measures for SDH market introduction and initialization of new plants in Baden-Württemberg.

The project has been supported by the Ministry of the Environment in Baden-Württemberg from November 2013 until June 2016. The project partners are Steinbeis Research Institute Solites, Climate Protection and Energy Agency Baden-Württemberg (KEA), German Energy Efficiency Association for District Heating, Cooling and CHP (AGFW), Hamburg Institute Research (HIR) and Institute for Energy Economics and the Rational Use of Energy (IER).

2. MARKET ACTIVITIES

2.1 Action plan

The basis for the selection of the activities to be undertaken within the project SolnetBW was determined in the study 'Solare Wärmenetze für Baden-Württemberg – Grundlagen, Potenziale, Strategien' (SolnetBW, 2015). Within this document the project partners dealt with the question: What can be done to improve the market situation for solar district heating systems regarding political, legal and economic conditions? The aim was to support also in Baden-Württemberg the commercial implementation of SDH systems.

Another part of the study includs an analysis of the potentials of integrating solar thermal energy in district heating systems in Baden-Württemberg. The outcome of the analysis is: According to current technical and economic frame conditions about 15 % of the heat fed in district heating systems could be provided by solar thermal collectors. To increase and reach this solar thermal share of the district heating supply, the awareness and knowledge about the technology has to be improved in municipalities and utilities. Also the confidence in this heat generation technology has to be strengthened by realisation of further projects.

To tackle these and other important barriers a six-point action plan was elaborated:

1. Information and consulting activities for SDH in Baden-Württemberg
2. Initiating concrete projects for new SDH plants
3. Initiating concrete projects to integrate solar heat in existing district heating networks
4. Removing barriers through strengthening the public participation
5. Development of business models for SDH
6. Improving the legal framework and funding situation for SDH

2.2 Focus activities

Within the project SolnetBW the SDH market introduction activities focused on systems with a high replication potential and feasible heat costs. Therefore on the one hand new and already existing small district heating systems that can be extended by solar thermal systems were chosen and on the other hand large-scale district heating systems in cities.

The focus of the activities of KEA and Solites was on new and already existing small district heating systems that can be extended by solar thermal systems. The chosen workflow for initiating new projects is described in the following chapter.

2.3 Workflow for initiating new SDH projects

In the following the workflow chosen by KEA and Solites for initiating new projects in new and already existing small DH systems is described. Main steps are:

- Screening of municipalities in Baden-Württemberg according to different criteria: Municipalities were selected that have (1) less than 20.000 inhabitants and (2) at least some districts without natural gas supply. Thereby 142 municipalities were chosen to be contacted. The order was set according to already existing contacts and chances of success to come to an initial advise (see Fig. 1);
- Direct addressing of potential implementation groups by writing letters to mayors and telephone calls;
- An initial advise and check of the situation, followed by first rough calculations based on the available data (solar yield, solar heat cost, etc.) and preparation of a short study;
- Further support when needed (helping to find a planner, make contact with manufacturers to receive offers for an installation, etc.).

In sum about 50 initial consultations have been done. In 8 cases next steps followed, e.g. feasibility studies were assigned and done. In a few cases concrete planning activities of SDH systems were started. Furthermore two planners were advised that now accompany realisations of SDH systems.

3. EXPERIENCED BARRIERS

During the above described market introduction activities and at information events, workshops, etc. that have been organized in parallel all around the state, the following topics and barriers emerged regularly: Market actors (e.g. planners), economics and land areas. These are described in the following chapters.

3.1 Market actors, e.g. planners

One outcome of the study was that the awareness and knowledge of the SDH technology have to be improved in municipalities and utilities (SolnetBW, 2015). For this reason municipalities have to be addressed on events and workshops with specific information.

Therefore on 11./12.05.2016 the 'Forum Solare Wärmenetze' was organized. More than 140 persons participated at the Forum and the small exhibition of suppliers and collector manufacturers on 11.05.2016. The current state of solar district heating and its application possibilities was presented and explained. An exchange of knowledge and transfer of know-how to planners and utilities took place during the different thematic presentations, workshops and discussions.

On 12.05.2016 two site visits were organized with more than 50 persons taking part at: Possible replicators were brought to the plants in Crailsheim and Büsingen and learnt from the operators Stadtwerke Crailsheim and Solarcomplex about their experiences of SDH. Advantages as well as challenges were discussed.

Such events can trigger stakeholders of municipalities, cooperatives and utilities to think about implementing a SDH system. Furthermore the activities for initiating new projects (see chapter 2.3) showed that a SDH system has much more chances to be realized when a person that is locally, well-respected with a certain power or influence on the people, e.g. mayor, chairman of important association, etc., promotes the project.

Another crucial step is to find an experienced planner. Unfortunately at the moment there is still a lack of knowledge among planners. Only a few planners work on renewable district heating systems and even less have experiences with large-scale solar thermal systems. Here especially the suppliers of solar thermal systems have to support during the planning phase. Therefore special training courses and materials are planned for the possible follow up project (see chapter 4).

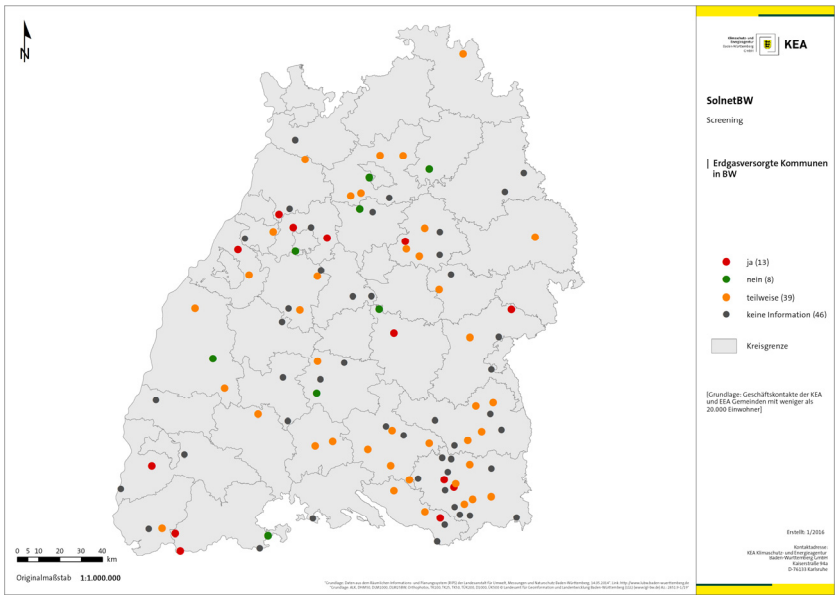

Fig. 1: Screening of municipalities in Baden-Württemberg according to different criteria (Source: KEA)

3.2 Economics and incentives

When a SDH system is realised several details have to be decided and clarified. Depending on the chosen system type the corresponding heat cost can vary. Therefore in each case the importance of defining the specific aims has to be highlighted and communicated to the involved stakeholders: high solar fraction, low heat costs, independency from fossil fuels, etc.

Within the project SolnetBW the solar heat cost (Euro per MWh) and system costs (Euro per m² collector area) for seven different types of SDH systems have been calculated: Quarters, villages and urban DH systems with central and decentralised solar feed-in as well as low and high solar fraction. Fig. 2 shows the results of these exemplary calculations. The red and blue bars show the possible cost range for the different systems: The upper end of the coloured bars indicate higher costs for not so favourable conditions and the lower end shows lower costs that can be reached at better conditions (conditions to be considered are e.g.: temperature level in DH network, system size, solar fraction, etc.). The results show that from an economic point of view it is recommended to go for a SDH system that is:

- big enough (> 1 MW_{th}),
- simple enough (ground-mounted collectors),
- with low network temperatures and moderate solar fraction (< 20 %).

This assures in most cases heat production cost of about 50 €/MWh. In addition funding is available that even lowers the heat cost. The different available funding schemes have to be communicated to the potential investors, too. Currently, there are programs for financial support of SDH systems on national and state level.

The Federal Ministry for Economic Affairs and Energy (BMWi) funds solar thermal systems that primarily feed their heat in a district heating network by a loan with a repayment bonus of up to 40 % of the investment costs. Alternatively, the funding is assessed on the heat output of the collectors, which is mostly financially more attractive. This variant offers a repayment bonus of 45 cents per kWh of the annual certified collector output. Mostly, this leads to very high funding rates that are limited by the subsidy regulations of the European Union to a maximum of 65 % of the investment costs!

In addition to funding on national level in Baden-Württemberg in February 2016 a new funding scheme has been introduced with the aim to increase the quality and efficiency of renewable DH systems. This new subsidy program ‘Energieeffiziente Wärmenetze’ of the Ministry of the Environment Baden-Württemberg funds (1) concepts, (2) regional initiatives that promote RES DH and give advice e.g. to municipalities and (3) investments linked to advanced quality criteria related to energy efficient and renewable district heating networks. Within this program investment costs are funded with up to 20 % of the eligible costs and can sum to a maximum of 200,000 Euros. By additional bonuses, e.g. the use of solar thermal energy, the amount can increase to a maximum of 400,000 Euros per investment project.

A guide on financing and funding of solar thermal collectors that feed-in district heating systems was prepared within the project. The aim is to give potential replicators an overview on invest and operational costs as well as on funding and financing possibilities (Sandrock, 2016).

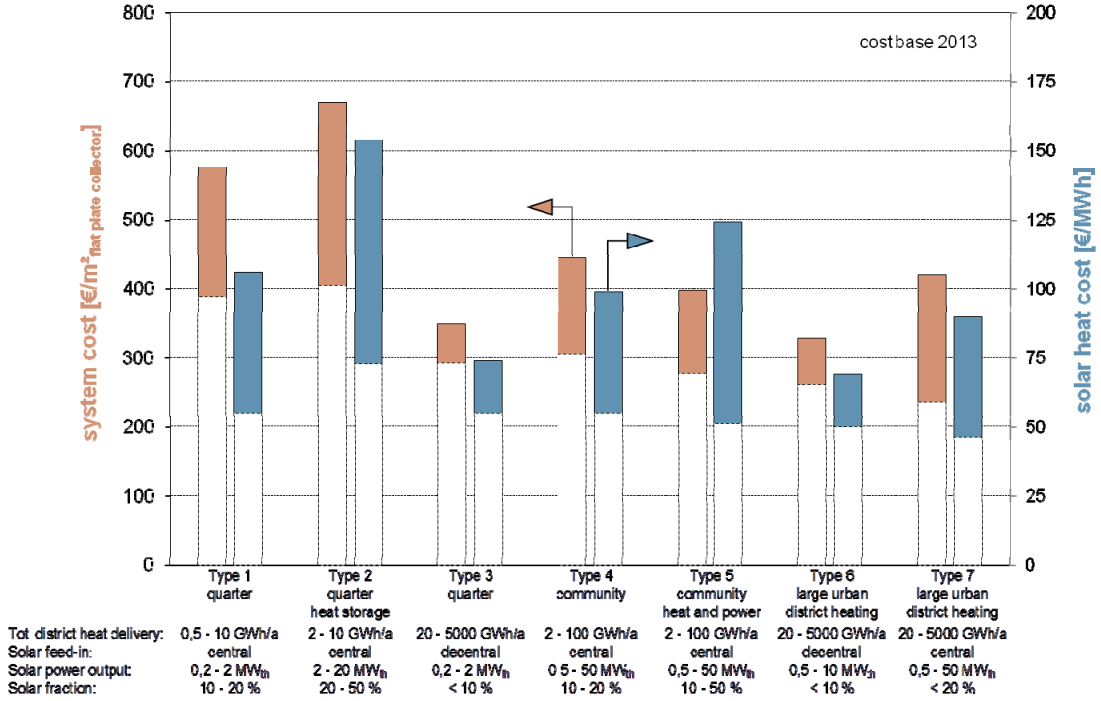

Fig. 2: Solar heat cost (Euro per MWh) and system costs (Euro per m² collector area) calculated for different types of SDH systems (Quarters: type 1, 2 and 3; Villages: type 4 and 5; Urban DH systems: type 6 and 7) (Source: Solites)

3.3 Land areas

An advantage of solar thermal systems is that they can be used anywhere in Germany. However, suitable and affordable land areas must be found, preferably close to the district heating system or the heating plant. In general ground-mounted systems lead to cheaper heat production costs than collectors on building roofs. For this reason a systematic land search and development plays a key role for realisation of SDH systems. In this context the following steps have proven effective:

- A systematic screening of the land areas based on economic, political and legal criteria should be done already at the start of the project.
- An early involvement of the authorities, citizens and stakeholders is recommended.
- The development of an ecological utilization concept for the land area on which the solar collectors are installed helps to get permission from the authority. Main reason is that enabling primary wildlife around the solar collectors can compensate for sealed surface areas at other places in the municipality.

Furthermore in discussions with stakeholders it is important to explain that also the use of alternative renewable heat sources requires a certain demand of space. Often the comparison with biomass is drawn. Here the use of solar thermal heat shows clear advantages as the production of heat from solar thermal collectors is very area efficient. In numbers solar heat is about 40 to 60 times more area efficient than heat from biomass. This is shown with an exemplary calculation of a 100 % renewable heat supply concept of a village in Baden-Württemberg: On the one hand with heat from local biomass and on the other hand with solar heat (see Fig. 3).

Anyhow there is still need for clarification on the issue ‘land areas’. Therefore on April 11th 2016 a workshop at the Ministry of the Environment Baden-Württemberg was organized to discuss land quality issues, acceptance among stakeholders and also to clarify technical, ecological and legal aspects.

The Ministry of the Environment and the Ministry of Agriculture participated at the workshop as well as collector manufactures, conservationists, legal experts and a utility/municipality reporting about their problems of finding appropriate land areas for ‘heat production’. Main results of the workshop are:

- The important topic ‘land areas’ was brought on the agenda of the ministries and discussed with different relevant stakeholders.
- A process has been started to improve, amongst others the planning and approval procedure, for solar thermal and other installations based on renewable energy sources in urban areas.
- Possible concrete solutions and incentives could be:
  - Privilege solar thermal systems in zoning law
  - Tax incentives for farmers to face land sales
  - ‘Eco points’ (e.g. for a high-quality eco concept)
  - Backing for dealing with local authorities (e.g. official supporting document)

A guide on planning and authorization of ground-mounted solar thermal collectors was prepared within the project. It gives advice on planning, building and environmental law and particularly supports project developers, municipalities and authorization authorities regarding projects with large-scale ground-mounted solar thermal systems (Maaß, 2016).

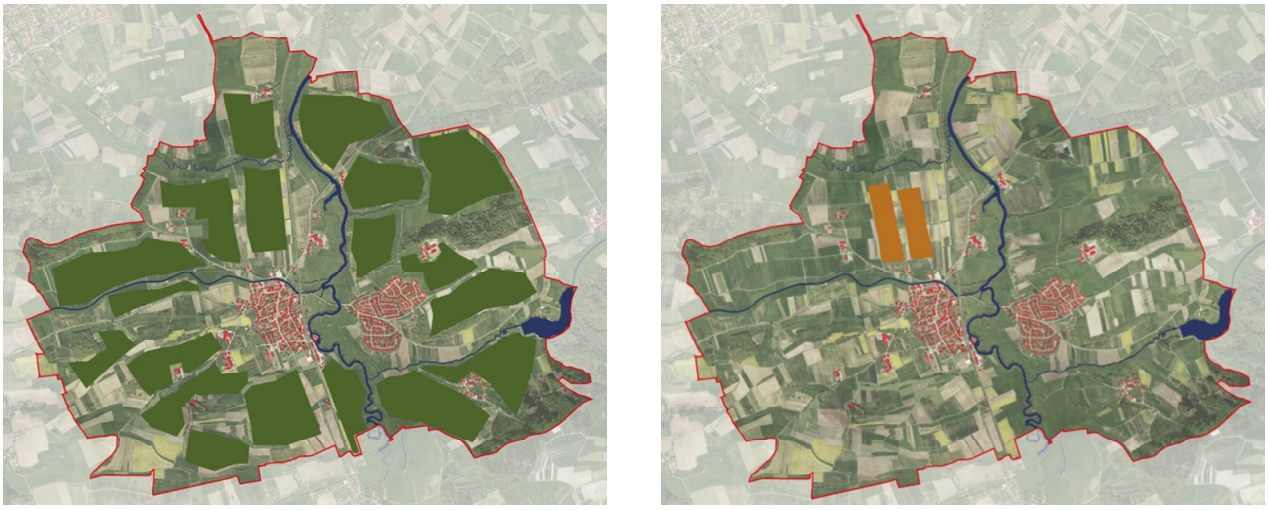

Fig. 3: Comparison of area efficiency for the production of the same amount of heat from biomass (green land areas in left picture) and from solar thermal collectors (yellow land areas in right picture) for a 100 % renewable heat supply concept of a village in Baden-Württemberg (Source: Solites)

4. CURRENT STATUS AND OUTLOOK

So far in Germany 24 large-scale SDH systems were installed. Around two-thirds of the total collector area of 35,600 m² (total installed thermal capacity of 25 MW) is located in Baden-Württemberg. Germany's largest solar thermal plant with a collector area of 7,300 m² (5.1 MW_{th}) is operated in Baden-Württemberg, in the city of Crailsheim.

Currently, many new systems are in preparation and planning by utilities, energy contractors and energy cooperatives nationwide. It indicates that the amount of SDH systems will double within the next years. This current status of SDH plants in Germany and Baden-Württemberg is shown in Fig. 4. There the SDH systems in preparation, planning and operation are marked yellow, orange and red, respectively.

According to the experiences within the project SolnetBW even more plants could be realized. The main barriers preventing a faster development are:

- Lack of knowledge and general caution to invest by utilities and heat suppliers.
- Lengthy project development for new DH systems (e.g. for 'energy villages') and difficult acquisition due to the current low prices of fossil fuels.
- Lack of availability of nearby land areas required for the installation of solar thermal collectors. Additionally a competition of usage of these areas.
- Lack of legal drivers for the market expansion of SDH systems.
- Lack of municipal heat planning or considering of 'energy areas' in spatial planning.

But the mood regarding the use of SDH is still positive in Baden-Württemberg, together with the ongoing funding programs it should be taken up in subsequent activities and initiatives. The project SolnetBW is supplying numerous materials and instruments for the barriers mentioned above.

Furthermore the project partners applied for a follow up project 'SolnetBW II' that wants to find innovative solutions for the following topics:

- Improving the availability of land areas
- Bringing more 'smart' district heating systems with large-scale heat storages in operation
- Analyse influences on economics of SDH systems
- Develop training courses for planners

It is planned to elaborate approaches for these issues and try to implement them in parallel in exemplary regions together with local partners during the project term.

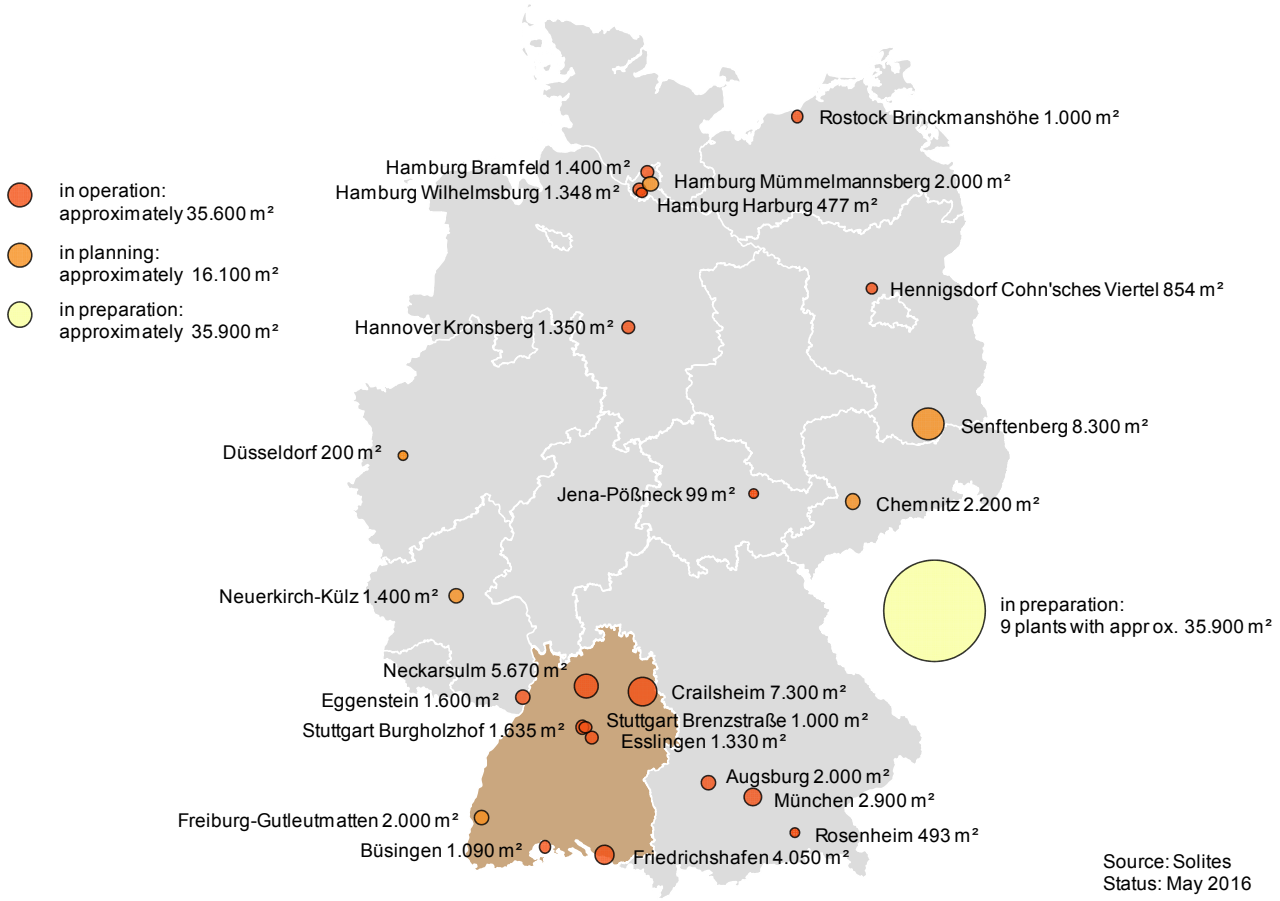

Fig. 4: SDH in Germany and Baden-Württemberg (brown background colour). Plants in preparation are marked yellow (anonymised, accumulated), plants in planning are marked orange and plants in operation are marked red (Source: Solites)

5. CONCLUSIONS

According to the experiences made in Baden-Württemberg within the project SolnetBW the following conclusions and recommendations for a successful initialization of new SDH plants have been drawn. These do not claim to be complete but can give some indications where to focus on:

- Address stakeholders of municipalities, cooperatives and utilities on events and workshops with specific information (experiences from realised plants, rough calculations, etc.) to trigger new solar district heating projects.
- When a concrete project is developed it is important to find a person promoting the project that is locally, well-respected with a certain power or influence on the people, e.g. mayor, chairman of important association, etc.
- Go for SDH systems that are big enough (> 1 MW_{th}), simple enough (ground-mounted collectors), with low network temperatures and moderate solar fraction (< 20 %) to assure heat production cost of less than 50 €/MWh. Additional funding is available.
- Find nearby some piece of land and use good communication skills regarding the district office to get an approval to build the collector field on it. An ecological utilization concept for the used land area can help to get permission.
- Take an experienced planner with know-how in district heating and preferably expert knowledge of solar thermal systems.

ACKNOLEDMENTS

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For more information visit the project website www.solnetbw.de.

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