SDH
solar district heating

SDHp2m

… from policy to market

Advanced policies and market support measures for mobilizing solar district heating investments in European target regions and countries

Solar District Heating Outlook: Best-practises on market support instruments and implementation outcomes in European regions.

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1. INTRODUCTION

1.1. Welcome Address by Werner Lutsch, President of Euroheat & Power

Solar District Heating is bringing down the walls of the industry helping our district heating networks to become even more greener and efficient. From being a niche technology in the past, it has now become one of the key elements for cities that consider embracing Europe's energy transition. With a market growth of over 35% annually over the last 5 years and heat production that will grow to 1TWh during 2018, Solar District Heating delivers. It contributes to the overall decarbonization of the heat sector by reducing costs, increasing regional economies and creating jobs locally.

The advantages Solar District Heating brings to our industry come from the fact that this technology is 100% renewable, emission-free and is available everywhere, as long as the areas are available for its implementation. It is important to underline that Solar District Heating is a mature technology ready for market uptake, with capacity to power up to 100MW with a solar fraction up to 50% when seasonal storage is in place.

Denmark is the world leader in the development of this innovative technology but countries such as Sweden, Germany and Austria are already following closely in its steps. However, Solar District Heating is not only present in northern Europe as new markets with immense potential are opening in southern Europe, in countries such as France and Italy.

Looking forward to 2050, it is expected that Solar District Heating will cover 240TWh out of 1600TWh in District Heating networks. As you can see there are opportunities everywhere from Veneto in Italy to Västra Götaland in Sweden!

I invite you to read closely the best practices and the lessons learnt from the nine regions involved in the SDHp2m project. There is no better way to learn than by experience. Who knows - maybe your region will be next one to jump on board the DHC revolution!

1.2. Regions background

The SDHp2m project (Solar District Heating from policy to market) began in early 2016 and its overall aim is to change the framework conditions and barriers to Solar District Heating. This is done from a regional perspective, where the 3 A-regions (Thuringia (DE), Styria (AT) and Auvergne-Rhône-Alpes (FR)) have had the role as forerunners in a process that should lead to a systematic roll-out of SDH. There are also 6 B-regions (Hamburg (DE), Västra Götaland (SE), Valle d´Aosta and Veneto (IT), Varna (BG) and Masovian, (PL)) following the steps of the A-regions.

The organisational setup for the regions stands on a regional stakeholder advisory group which is supported by a regional based consultancy company. The regional advisory groups consist of 10-15 members representing key stakeholders, policy makers, DHC operators and planners, energy cooperatives and initiatives, municipalities, city planners, heat planning experts, financing institutions and consumers.

Some of the highlighted regional activities developed during the project have been, amongst others, a survey of the regional and national framework for SDH and planning of transnational transfer and coaching (8 experienced European consultancy companies participated in a transnational coaching group supporting the regions) and other related activities in the field of "Implementation of framework improvements" and "Mobilization of projects and investments"

In this summary report, the region's best practice activities in 'implementation of framework improvements' and 'mobilization of projects and investments' have been reported. Furthermore, the regions have reported, in their national languages, a more detailed version of their respective regional activities.

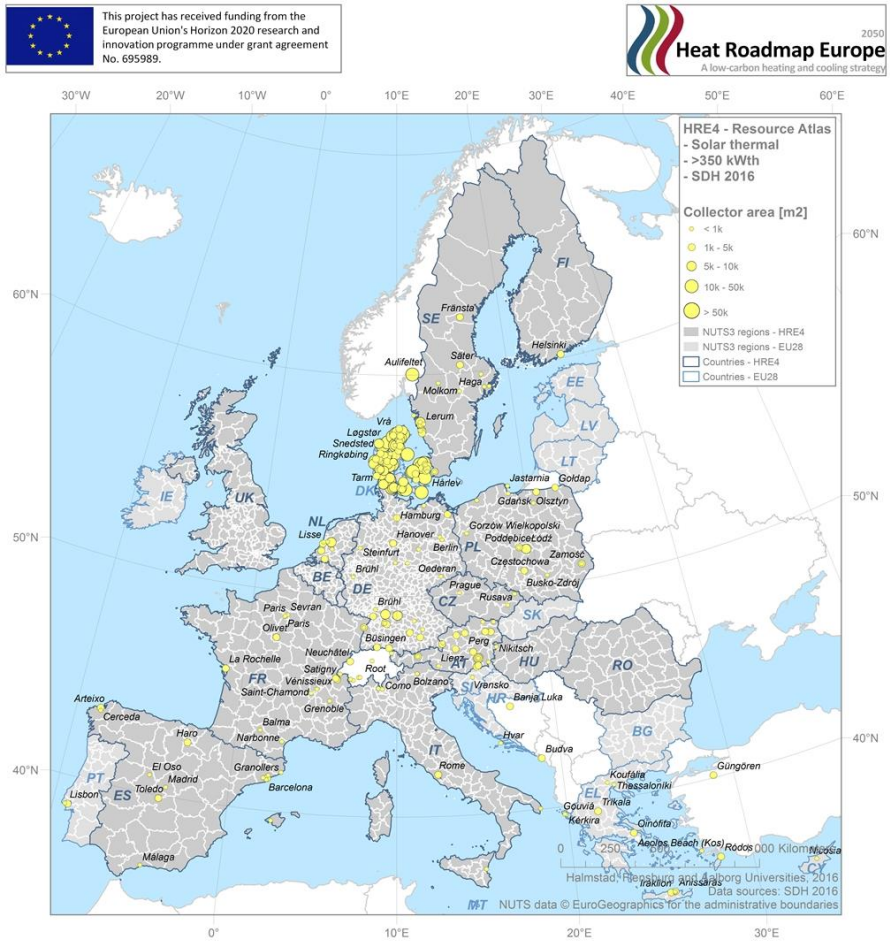
2. SDH MARKET UPTAKE

The largest amount of solar systems worldwide is implemented in China. However, Europe is a technological leader particularly in the integration of solar thermal energy systems in district heating networks.

Hotspots here for further development of SDH are: Germany, Austria and, especially Denmark, where the implementation of SDH networks based on good general conditions is exemplary. Building on its blueprint, Denmark built the world´s largest solar thermal plant for district heating in Silkeborg, with an installed capacity of 110 MWth (157,000 m² flat plate collectors).

More and more large-scale solar plants for district heating are being built in combination with large heat storages, which allow seasonal heat storage from summer to winter. The further development of heat storage based on environmental measures, as practiced in Denmark, will enable the future expansion of solar thermal systems for district heating networks.

The economic situation is difficult for renewable solar district heating in comparison with cheap fossil fuels such as coal, gas and oil, as these are compensated by investment subsidies (generally granted by national states). Most of these subsidies are granted by central federal offices, while regions support consulting and planning.



Solar district heating systems in Europe (Source: Halmstad University, SWE)

3. REGIONAL ACTIVITIES TO PROMOTE SDH

3.1. Regional best-practices

3.1.1. A- Regions

The three A-regions have been the forerunners of the SDHp2m project to achieve the market roll-out of SDH. The regional authorities of these regions are members of the project's consortium.

AUVERGNE-RHÔNE-ALPES REGION, FRANCE

TRAINING FOR POSITIVE ENERGY TERRITORY SCHEMES (TEPOS)

The aim of these activities was to offer training and a framework to regulators and stakeholders. It was fundamental to rely on the active network of the energy territories (more than thirty) to create a better understanding of the SDH technology and, as a result, facilitate the implementation of the technology in the Auvergne-Rhône-Alpes Region.

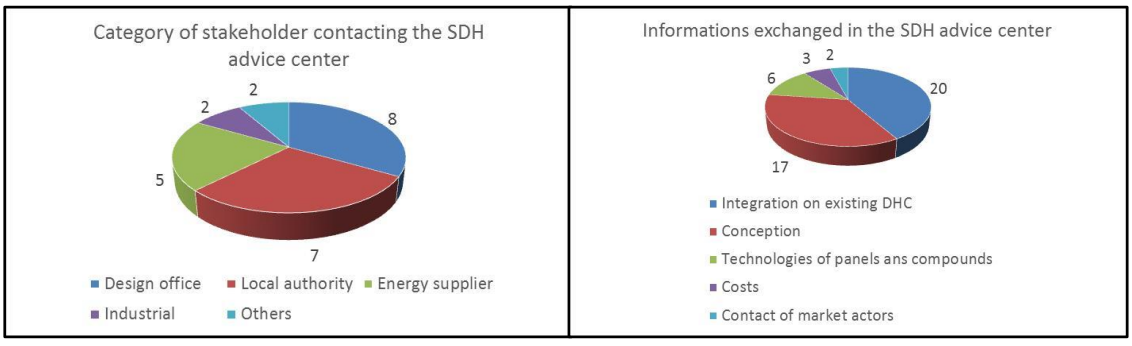
The objectives of these practices were, firstly, to disseminate widely to local authorities the relevant information about Solar District Heating and secondly, support the development of related projects by the end of 2018 on these territories.

Due to the implementation of these activities, 5 new local authorities under the TEPOS are involved in the project, participating actively in regional meetings and case studies. Furthermore, it was also possible to achieve a greater dissemination of the project and its technology through the TEPOS network. Thanks to these efforts, there are 4 new SDH projects foreseen on TEPOS territories.

IMPLEMENTATION OF A MARKET ROLL-OUT TOOLBOX

The toolbox is being created following two objectives: improve the capacity of the market actors and prove that SDH is technically and economically feasible. It does not only include the documents and data gathered from the projects developed under SDHp2m, but also other documents collected from different French research programs. Relevant stakeholders, such as local authorities and municipalities, have already shown their interest on the development process of this toolbox.

The preliminary results are promising as seen in the graphics below. Additionally, 33 participants attended the 1st SDH training for market actors and 31 contacts were made from the SDH advice centre. The toolbox is available in French.



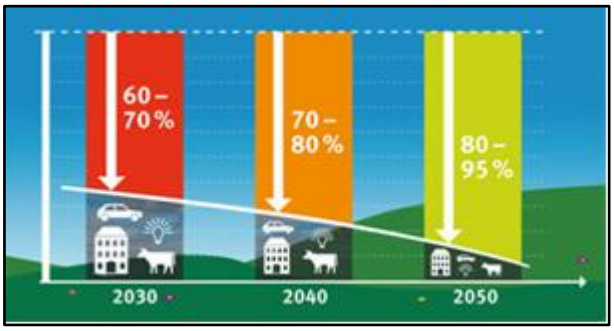
Toolbox's preliminary results (Source: Auvergne-Rhône-Alpes Region)

THURINGIA REGION, GERMANY

THURINGIAN CLIMATE LAW DRAFT

In 2017 the Thuringian Ministry of Environment, Energy and Nature Conservation (TMUEN) developed a draft of the Thuringian Climate Law. It was accepted by the State Government after two interdepartmental coordination processes and it was finally sent to the State Parliament for further discussion and voting in January 2018. Amongst other things, the Draft Law pinpoints a greenhouse gas (GHG) emission reduction target corridor. The base year of these targets is 1990. (Figure below).

To reach these targets, the GHG emission reduction potential of the heating sector should be tapped through cooperation with regional stakeholders such as municipalities, operators of district heating networks and building owners. Following the success of the Draft Law, municipalities would be required to develop heat analysis and heat consumption concepts. Administrative districts and municipalities too would be required to create or update existing climate protection concepts, which could contain aspects of heat analysis and heat consumption concepts. Under the same logic, operators of district heating networks would have to develop also concepts for their local heat supply systems.



Thuringia's Draft Law greenhouse gas (GHG) emission reduction target corridor (Source: TMUEN)

The development of these concepts implies the creation of specific implementation steps that need to be updated at least every ten years. Other features contained in the Draft Law are the obligation of district heating network operators to publish product information for consumers (share of renewable energy sources (RES)) as well as information about the environmental impact (carbon dioxide emissions and primary energy factors) of their heat supply system. Regarding economic conditions, builder owners would have to ensure that the heat demand of their buildings is covered to a minimum of 25% by RES by 2030. This specific target aims to reach a climate neutral consumption in existing buildings. In Thuringia, this target might be reached through a connection to a DH network providing more than 25% heat from RES.

The Integrated Energy and Climate Strategy, which will collect concrete measures to help reach the climate protection targets set by the Draft Law, is proposed within a broad public discussion. Its field of action under the 'energy supply system' contains several SDH-relevant measures, such as the development of concepts for a CO2-neutral heat supply system for public district heating systems and transparent product information, the support for the expansion of local heating grids with RES or the realization of pilot projects for the transition of a district heating system from high temperatures to low temperatures. If accepted by the State Parliament, these measures for an Integrated Energy and Climate Strategy will need to be implemented in the near future.

These actions should lead not only to energy savings and increasing energy efficiency within the heat supply system but also, to an increasing share of renewable energy sources. Furthermore, both the Draft Law and the Strategy could likely build a strong regulatory framework and lead to an increased awareness concerning renewable district heating.

FINANCING AND FUNDING PROGRAMMES

In Thuringia three funding programs currently exist that complement the national funding programs concerning solar district heating directly and indirectly. These funding programs (GreenInvest, KlimaInvest and SolarInvest) are addressed to different target groups due to different focusses.

Communities can receive funding within the KlimaInvest program amongst others as a non-repayable grant for:

- Development of greenhouse gas emission reduction, climate protection concepts, heat concepts with up to 40%
- Advice services and professional trainings can be promoted with up to 80%
- 100% funding for a 7500 € climate protection-starter package, such as initial advice services

SME/Companies can receive funding within the GreenInvest program amongst other as a non-repayable grant with up to 80% for:

- advice services concerning energy efficiency, feasibility studies
- exemplary investments in projects with renewable energies and energy efficient technologies targeting at a greenhouse gas emission reduction and
- feasibility studies concerning such investments.

Within the SolarInvest program for example municipalities, companies (SME), housing cooperatives and citizen cooperatives can receive funding as a non-repayable grant amongst others for investments in thermal energy storages, while a solar fraction of 60% is mandatory. Funding is up to 25% and 40% for cooperatives.

Under the GreenInvest program, companies can receive funding for advisory services, feasibility studies and exemplary investments in projects with RES and energy efficient technologies that are targeted at the reduction of GHG emissions up to 80%. This is a mandatory condition of the GreenInvest program.

With the KlimaInvest program, municipalities receive funding for the development of greenhouse gas emission reduction or heat concepts with up to 40% of expenditure. Advisory services and professional training can be promoted for up to 80%. Furthermore, municipalities can receive 100% funding for a €7500 climate protection-starter package, such as initial advice services.

Finally, the SolarInvest program operates with municipalities, companies, housing cooperatives and citizen cooperatives etc. These can receive funding for investments in heat storage systems and correlating advice services and feasibility studies, amongst others. Citizen cooperatives can receive funding for investments in heat storage systems up to 40%. All other target groups can receive funding up to 20%. Advice services are supported financially up to 80%.

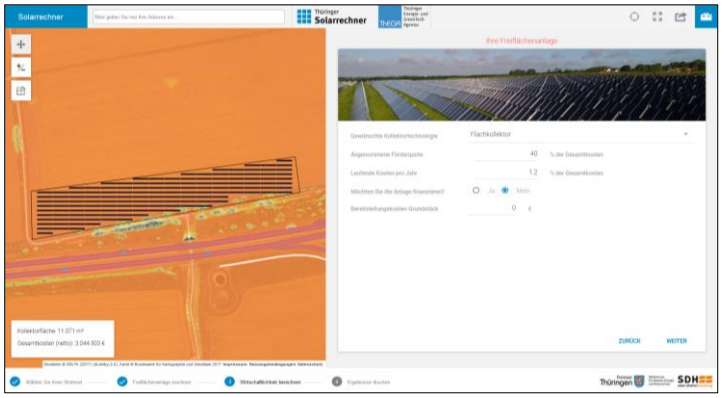
With the aim of informing regional stakeholders about SDH financing and these funding possibilities, the TMUEN held a content-related workshop in January 2017 for district heating operators, cooperatives and other market actors.

THURINGIAN SOLAR CALCULATOR

Since May 2018 the Thuringian Solar Calculator, a web-based software application tool, is available. This tool aims to increase the generation of heat and power from solar energy in Thuringia generally. It will support different user groups such as house owners, planners, municipalities and companies, so that they can exploit the power of solar energy by identifying potential areas for installing solar thermal collectors or photovoltaic modules on any roof or open area in Thuringia. Identification of areas for the exploitation of the potential of solar energy contains calculations of the yield and the economics of possible solar energy plants in Thuringia. Regarding solar district heating, roof areas or any open area in Thuringia can be chosen for calculations by marking a certain polygon-shaped area manually.

The Thuringian Solar Calculator is linked to the Solar Service Centre at the Thuringian Energy and GreenTech Agency (ThEGA). This service offers stakeholders (e.g. municipalities, citizen and companies) practically oriented consulting concerning the identification of potential areas for implementing solar thermal and photovoltaic plants, correlating business models and subsidy possibilities.

Already during their implementation phase, the Solar Calculator and the Solar Service Center have been presented within SDH-Workshops and other events to regional stakeholders. And still, since its publishing in May 2018 the Solar Calculator is an essential element for SDH-communication, for example presented at fairs or within a workshop for housing cooperatives.



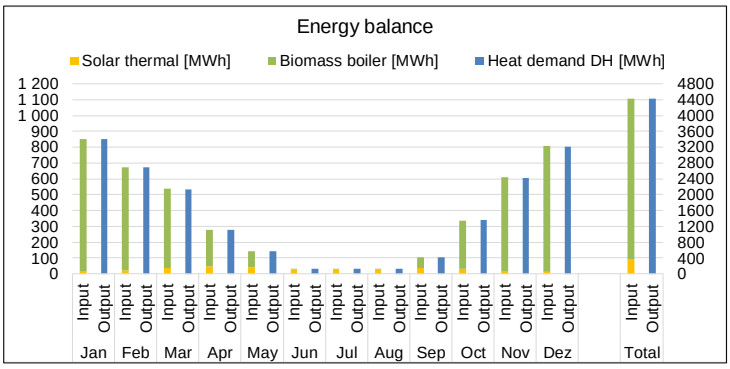
Screenshot of the Thuringian Solar Calculator (Source: TMUEN)

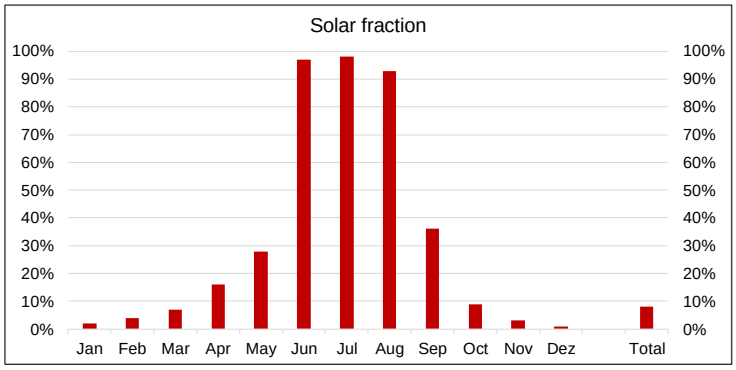
STYRIA REGION, AUSTRIA

FUNDING OF FEASIBILITY STUDIES FOR SDH

The Province of Styria has an extensive database of about 600 district heating plants in the region. Using the data from a questionnaire sent to 200 plant operators, managed by the SDHp2m project, they identified those operators who plan an extension of their district heating network or an integration of renewables. Firstly, this target group is consulted on the integration of a solar thermal system in their district heating network. The selected plant operators are then offered a further consultation on the possible integration of solar thermal systems.

To overcome the initial inhibition threshold, advice for district heating operators is offered free-of-charge. This advice is supported with €1,650 from the EU project SDHp2m and with € 550 from the province of Styria. An initial analysis of district heating networks has shown that both an adaption to the state of the technology, as well as an efficient operation optimization, are required for long-term sustainable plant operation. Therefore, a quick-check analysis is prepared to illustrate the potential for solar thermal integration into their district heating network. In addition, the plant operators receive first a feasibility study of their district heating network. This study contains technical and economic estimations as well as different possibilities regarding financing supports. As part of the feasibility studies, 12 district heating networks are currently being considered. The average solar collector area is about 200 m².





Schematic results of energy balance and solar fraction of SDH Fehring (source: AEE INTEC)

SYMPOSIUM FOR REGULATORS AND FRAMEWORK STAKEHOLDERS

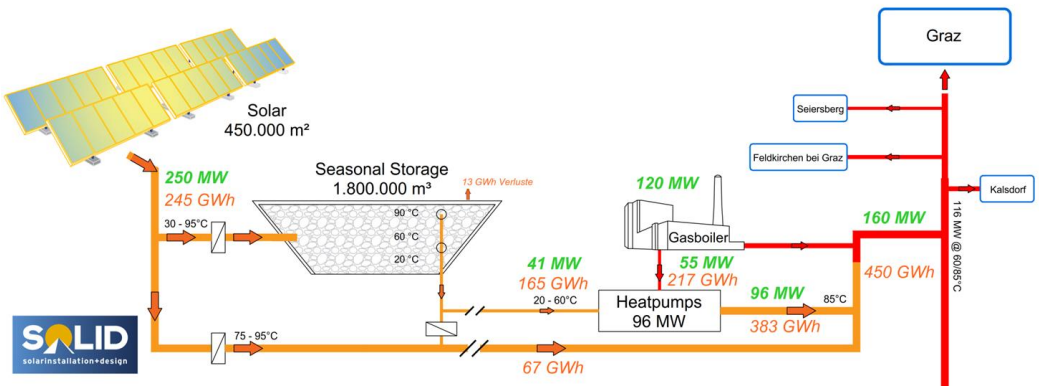
A range of events and excursions have been organized for planners and plant operators to increase their awareness and develop their competence.

A 2-day event, the symposium on "Diversification of local and district heating supply" took place in June 2018. There were 88 participants including planners, industries, energy suppliers, and municipalities. Topics included funding operator reports for practical examples, innovative solutions and news on BIG-SOLAR concepts and alternative energy sources for district heating networks. Another part dealt with large-scale heat storage concepts for useful integration of alternative heat sources. During the event representatives of the municipal utilities of Amstetten, Wörgl and Mürzzuschlag, as well as research representatives of PlanEnergi (Denmark) and Solites (Germany), reported on the future developments in solar district heating. A trip to the green brewery in Goess rounded off the symposium. The Austrian brewery Goess integrates a large solar thermal system with a gross collector area of 1,500m² and is connected to a 200m³ energy storage tank.

Symposium "Diversification of local and district heating supply" (source: AEE INTEC)

BIG SOLAR GRAZ – NEW INVESTMENTS IN SDH

The "BIG SOLAR GRAZ" concept was developed for the city of Graz. This concept foresees a maximum solar fraction with a competitive heat price compared to heat from gas boilers for the DH network of Graz. The figure below gives an overview of what the concept would look like. However, it must be noted that the size of the collector field, the pit storage and the absorption heat pumps (AHPs) are simulated between a certain range in order to find a system optimum for dimensioning each component. AHPs play a key role in this concept, leading to an essential yield improvement of the specific net solar heat production.



Scheme of BIG SOLAR GRAZ (source: SOLID)

In 2018 an area for a solar system of 220,000 m² with seasonal storage was secured. Thus, more than 10% of Graz district heating can be provided from this in the future. The value of this achievement is unprecedented for a big city like Graz with around 300.000 inhabitants.

3.1.2. B- Regions

The 6 B-regions have been involved in the project under a voluntary agreement through their regional authorities.

HAMBURG REGION, GERMANY

"SOLAR NEIGHBOURHOOD GREENHOUSES"

Large scale solar thermal installations generate cost-efficient renewable district heating. Nevertheless, this realization often fails due to problems in finding suitable building sites. Solar Neighborhood Greenhouses are a concept developed by the Hamburg Institut and they enable a multifunctional use of urban open spaces: for solar thermal energy and urban gardening. These provide neighborhoods with renewable heat and healthy food, encourage community building, and promote public acceptance.

The case study in the framework of the SDHp2m project gave a first technological, economic and legal analysis of the Solar Neighborhood Greenhouses concept. Connections to relevant stakeholders were made, as well as evaluations of two possible site locations in the City of Hamburg for such a project. The case study shows that stakeholders from different fields are open towards new solutions in the competition for land use in the urban environment.

A project of this kind takes an integrated approach that must involve all parties from the beginning: urban gardening initiatives, heat suppliers, housing companies and decision makers. Even more so than in other energy projects, only an open and community-driven process can lead to the successful realisation of a project of this kind. Furthermore, the conditions and goals differ at every location, and in every group of 'urban gardeners', so there cannot be one kind of "Solar Neighbourhood Greenhouses" for all projects but unique solutions that all follow the same idea.

Finally, it became clear in the discussions with the stakeholders from the agricultural sector and greenhouse constructors that the combination between solar thermal collectors and greenhouses is very promising in the urban gardening context. For professional farmers additional economic benefits would be needed in order to make up for potential lost revenue due to possible shades in the greenhouse.

The results of the case study will serve as the basis to approach potential partners like the City of Hamburg, heat suppliers, housing companies and many others.

Pilot picture of "Solar Neighbourhood Greenhouses"
(Source: Hamburg Institut)

BEST PRACTICE GUIDE MULTI CODED AREA

SDH is a simple, proven, and cost-efficient option to integrate RES in DH if large areas are available and “plug and play” solutions can be realized. This approach has been very successful in Denmark. Transferring this approach to other central European countries has so far only succeeded in a few cases. The experiences of the last few years show that scarcity of sites for panel installation is a major barrier to implement SDH, particularly in urbanized areas.

To overcome these barriers, policy instruments are needed to facilitate the usage of urban areas for SDH – in the best case for simple, large and cost-efficient solutions.

However, it will also be necessary to find other solutions that will enable SDH in areas where it would operate alongside other land usages. We must re-think our perspective and our understanding of monovalent land use and develop multi-coded areas. At first glance these solutions might be complicated, more experimental and possibly more expensive, but the transformation of the heating sector, especially in the urban regions, might only be successful in cooperation-models with other land usages.

Examples from different regions in the EU show that solutions for SDH land development and for parallel land use through SDH and other purposes can be done and gives us a motivating push.

Categories for multi-coded areas for SDH include:

- agricultural production (e.g. so called “Solar Neighbourhood Greenhouse”)
- nature preservation and water protection areas
- polluted, contaminated or industrial areas (e.g. former landfills or sludge hills)
- large infrastructure installations (e.g. parking decks, sewage treatment plants)
- large scale roof areas (existing and new build)
- areas along traffic routes (e.g. noise protection motorway, railway)

The Best Practice Guide should encourage to think more about the topic of double use in a more inclusive and creative way.

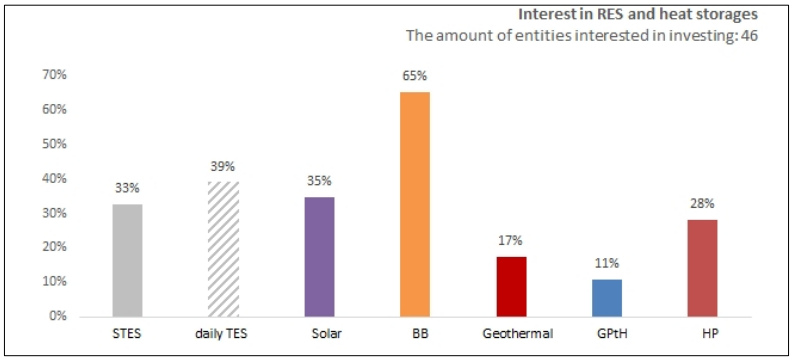
MAZOVIA REGION, POLAND

TRAINING CONFERENCE

On the 17th January 2018, the Institute for Renewable Energy (IEO) organized a training conference titled “Solar District Systems Combined with Renewable Energy Sources and Heat Storages”. Its aim was to start working on the implementation a NFOŚiGW (national environmental fund) program concerning SDH and the exchange of the experiences with RES. Among the over 130 participants were representatives of industry companies, producers of RE devices, institutes and universities. Importantly, the invitees from Sweden and Denmark (SDHp2m project partners) shared their experience in the area of SDH implementation in their countries.

After the conference IEO arranged an in-depth survey amongst the Polish district heating companies (DHC) participating at the conference. Results from 44 entities operating on 49 DH systems were gathered in the survey.

The installed thermal capacity of these DH plants surveyed was equal to 7,440 MW, which constitutes 13,7% of the overall potential installed in the Polish market. These DHC’s sell a total of 42,001 TJ of heat, which is approximately 11% of the market. The trial includes DH systems with an installed capacity ranging from 10 to 2000 MW, which gives an average of 158 MW of installed power per each entity. The answer to the question regarding the interest in RES and heat storages is shown on the graph below.



Interest in RES and heat storages in the region of Mazovia, Poland (Source: IEO)

The energy/heat source that drew the main interest among the surveyed companies was the boiler running on biomass (65%). The reason for such interest is in the fact that biomass boilers may be a basis to produce heat. The further preference of the heat storages and solar collectors shows a change in approach to RES and their meaning to DH systems. Over 35% of DHC networks are interested in solar collectors and over 33% of DHC systems are interested in STES.

Among the polled DHC plants, IEO selected the most typical one which expressed clearly in the questionnaire some ambitious objectives to move from coal to solar with thermal storage and another RES. This is Końskie District Heating Company (DHC Końskie Ltd). The company was established in 1992 by the city of Konskie, in the Świetokrzyskie region (close to the Mazovia region). The scope of its activities cover the generation, transmission and distribution of heat. Additional areas of activity of DHC Końskie are electricity distribution and trade (concessions issued by the naional regulator are valid in both areas). The full stakeholder of DHC Końskie Ltd. is Końskie municipality.

The basic fuel used by DHC Końskie LTD is the hard coal used in the main unit in two main (central) coal boilers (86% of total heat generated). Secondary fuel is natural gas, which is used in four small, decentralised gas boilers for utility hot water preparation (14% of total heat generated). See a detailed structure of the heat generation fleet given in the table below:

Heating plants	Capacity and boilers	Fuel	Heat sold	
The main heating plant	38 MW (15 + 23 MW)	coal	~115 000 GJ/y	86%
Local plant 1	1,75 MW (2x 0,7 + 0,35 MW)	natural gas	~9 500 GJ/y	7%
Local plant 2	1,15 MW (2x 0,575 MW)	natural gas	~1 700 GJ/y	1%
Local plant 3	1,4 MW (2 x 0,7 MW)	natural gas	~7 500 GJ/y	6%
Total	**42,3 MW**		**~133 700 GJ/y**	100%

INNOVATIVE INVESTMENT PLAN

Further IEO work with the company has prepared an innovative investment plan which presents a transition from coal fired boilers to renewable energies in DHC Końskie Ltd. The objective of the plan is to achieve the status of energy efficient district heating system with the share of RES at 50%. As the CAPEX intensive plan

up to 2023 might cost 11 million Euros, the biggest barriers were access the attractive credit financing, supported for the first time (full scale pilot project with first sessional storage in Poland and whether depended renewables and coal as a peak load) with initial subsidy, to reduce the business risk and perception of technical risk. IEO proposed this investment plan as a model for large scale demonstration. The idea was consulted by IEO with the other DHC stakeholders at two conferences and presented to the National Fund for Environmental Protection and Water Management (NFOSiGW). The DHC Końskie works together (as a member) with the Polish Chamber of District Heating for establishing relevant support programme in Poland.

The new subsidy programme for DH systems, devoted to RES and storage, is prepared by National Fund for Environmental Protection and Water Management, so that DH companies might develop more ambitious and more innovative investment plans. With an ambitious development plan based in new technologies, DHC Konskie LTD is looking (partner search stage) for an opportunity in joining new RES DH demonstration projects within the framework of Horizon 2020, the EU RTD programme 2004-2020.

VARNA, BULGARIA

NEW INVESTMENTS IN RES IN DHC AND SDH

A case study for the implementation of the technology in “Kaisieva gradina” district in the city of Varna was prepared. The case study explores the potential of the available urban spaces where solar panels can be installed. Flat roofs are the most suitable for large scale installations. If made an integrated part of a refurbishment – vertical south facades are also suitable for heat production. However, the vertical walls will achieve 2 times less production / per unit investment compared to the roofs. The heat production from the roof panels can cover 38 kWh/m2y of the heating demands while wall panels can cover 22 kWh/m2y, with total 60 kWh/m2y. Finally, 70% of total yearly heat consumption by the end users after refurbishment of the buildings would be covered by the solar panels.

It was calculated that 50% of the heating demands would come from DHW (domestic hot water) which could be covered completely by solar fraction. In addition, it was evaluated that for the district heating network at least 6.0 GWh energy would need to be stored or buffered for seasonal usage in winter. Due to lack of enough space for large water-based seasonal storage in the district, it suggests exploring the possibilities to buffer the surplus energy in larger city’s DH as being the most cost-effective solution. Further calculations and evaluations with the local DH company are planned.

TRAININGS FOR REGULATORS AND FRAMEWORK STAKEHOLDERS

A training seminar on SDH was conducted under the framework of the Black Sea Energy Days on June 21-22, 2017 in Varna, during the EU Sustainable Energy Week. The seminar was attended by more than 40 people – representatives included regional authorities, regional agencies, municipalities, city planners, and heat planners, as well as professors and researchers from the Varna Technical University. Danish and Finnish specialists showed SDH technology and its commercial and environmental aspects and benefits. The strategic development and legal barriers for SDH in Bulgaria were also discussed. IZEB presented two case studies for the implementation of the technology in the “Kaisieva gradina” district – Varna and in a small municipality. As a result, the interested supporters in the seminar were trained and prepared with basic knowledge for future implementation of SDH in the region.

TRAININGS FOR MARKET ACTORS

In the first week of July, a two-day workshop for market actors was conducted with the support of Sofia municipality and the participation of international experts. DH companies, designers, engineers, end users and authorities’ representatives have already expressed their interest in the workshop. The aim is to attract attention to SDH technology - its commercial and environmental aspects and benefits, and to prepare actions for SDH implementation.

VÄSTRA GÖTALAND REGION, SWEDEN

PRE-SET REGIONAL CONDITIONS

The Swedish follower region Västra Götaland has very different conditions compared to other regions involved in the SDHp2m project, A-regions and other follower regions.

First, the legal framework (including financing) for block and district heating is well established as there are present, in principle, in all cities and urban areas. Furthermore, most of these 110+ plants are based on bio-energy i.e. solid bio fuels like wood chips, briquettes and pellets. A survey of bio-energy plants, carried out within the SDH-p2m project, was published in a Master thesis at Chalmers University of Technology and presented in September 2016 at the International Solar District Heating Conference in Billund, Denmark.

Secondly, there are no national or regional policies to support *solar heating* in block and district heating. This is mainly because as there is already a renewable heat supply, there are no strong incentives to reduce the negligible use of fossil fuels. The only support that is available is for demonstration projects.

Market support has therefore focused on knowledge transfer and feasibility studies to show how solar heating can be used to improve the efficiency of solid bio fuel plants, based on existing combined solar and bio fuel heating plants in the region as well as similar applications in other countries. The aim is to be able to build one or several demonstration plants using as a benchmark the existing solar district heating plant in Ellös (≈ 1 000 inhabitants), with 1,000m^2 of ground mounted solar collectors built in 2010.

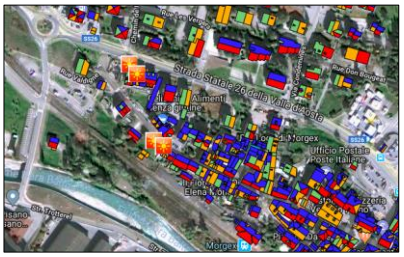
VALLE D'AOSTA REGION, ITALY

PUBLIC ACCEPTANCE FOR SDH: SDH PLANT IN MORGEX

There is already an SDH plant in operation in the Valle d'Aosta Region: the 120 m^2 solar thermal plant located on the roof of a local school is providing heat to the biomass DH network of the small centre of Morgex.

It is therefore of key importance to have this plant as a showcase, a success story of SDH. That is why, within the SDHp2m project, a specific study on how the plant is currently working and on the possible optimization steps was carried out. This study was developed with the help of a local technical partner and always in close collaboration with the city administration and with the district heating utility.

The actors involved have received this initial feedback and can now decide on how to proceed (which will depend on the available economic resources).



Thermal plants in Morgex (source: www.morgexsolare.it)

ROLLOUT - NEW INVESTMENTS IN RES IN DHC AND SDH: DEMO PLANTS

The development of a pilot SDH plant in the regional capital of Aosta will act as a real policy measure to foster the diffusion of SDH solutions as a viable alternative to fossil-fed district heating networks.

To reach such an objective, the barrier of mistrust and scepticism towards the visual impact of solar panels in the landscape, especially in high-quality mountain landscape such as that of the Valle d'Aosta region, must be overcome. This should be done by both finding alternative low-impact solutions for the panel installations and through awareness-raising activities targeting regional and local administrations.

The results of the preliminary evaluation of SDH integration into the DH network of Aosta are quite encouraging Not least having in mind the financing opportunity given by the incentive scheme of 'Conto Termico'. According to the first calculations, this incentive could return more than 50% of the initial investment within a 5-year period.

After this initial screening a detailed site visit was carried out with the support of a technical consultancy company. The consultants performed a detailed simulation of the pilot SDH plant to evaluate its yield and related economic parameters. The DH utility is now evaluating these results to decide its next steps.

Regarding authorisation and visual impact issues, a document summarising the main installation solutions realised all over Europe was developed by Ambiente Italia and is currently being discussed with the regional stakeholders. Furthermore, a first exchange of information too place between Ambiente Italia and Varese Risorse (the utility mentioned above) to collect and exchange information about the successful authorisation procedure used to develop the only SDH plant operating in Italy.

However, the areas involved in the Aosta plant should not produces challenges from this point of view as they are located either on roofs or on the ground but in technical areas generally not affected by visual restrictions. However, a possible barrier is the restricted extension of such areas, which could limit the size of the solar plant to well below the 2,500m^2 threshold the national incentive scheme requires.

One of the roof areas available for placing solar collectors in the DH plant in Aosta (Source: Ambiente Italia)

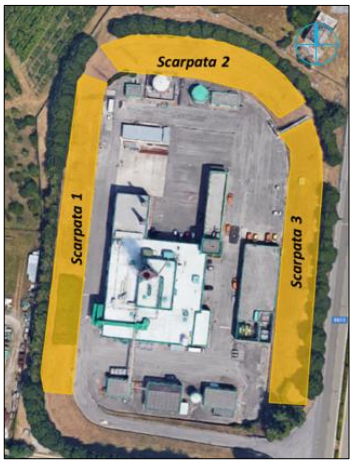
VENETO REGION, ITALY

DEMO PLANTS: SDH IN LARGE CITIES

The region of Veneto contains only two medium to large cities that have a district heating network: Verona and Vicenza. One of the main barriers to a larger diffusion of solar district heating in Veneto (as well as in Italy generally) is the lack of trust in the technology and knowledge about its potential to be integrated in real systems. It is therefore crucial to have showcases in large cities that can demonstrate the viability of this solution.

This is the main reason why the development of pilot SDH plants in these cities should be regarded as a best-practice policy to spread the use of solar thermal in district heating plants. Another relevant fact is that utilities of the size of those operating in Verona and Vicenza usually have the financial capacity to uphold small investment such as the one needed for the implementation of a solar district heating plant.

After a first interaction, the utility of Verona showed a clear interest in assessing the viability of an SDH plant in its grid, while the one in Vicenza decided not to proceed with an evaluation of this potential. Preliminary investigation revealed the availability of a large area close to the central heat production plant. Despite some shadowing from the plant buildings, the expected yield from SDH in the area was considered satisfactory. A detailed simulation study, with the support of a technical consultant company, was therefore carried out. The results of this study are now being evaluated by the Veronese utility.



Heat production plant and possible areas for solar collections (Source: Ambiente Italia)

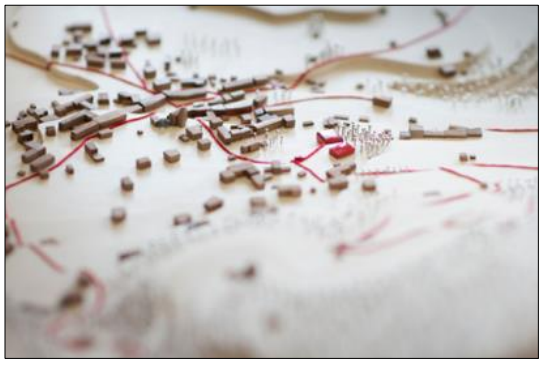
PUBLIC ACCEPTANCE FOR SDH: INCREASING AWARENESS IN MOUNTAIN AREAS

Thanks to a fruitful cooperation with the Italian Wood Energy Association (AIEL), activities are taking place to raise awareness among local authorities, professionals, and citizens, towards the use of renewables in DH networks, including solar thermal and biomass.

These activities are focusing on specific mountain areas such as the 'Dolomiti Bellunesi Park', where issues like authorisation and visual impact or air quality (linked to the use of biomass) are sensitive and crucial points.

The awareness raising activities include:

- Training in SDH of a help desk on energy launched by the Municipality of Feltre (activity carried out on June 7th, 2018).
- Workshop on solar and biomass DH targeting local authorities (including park managers), professionals and citizens (Feltre, June 22nd, 2018).
- Feasibility studies for solar integration into both an existing DH network in Polverara and for a new DH network using solar and biomass in Lamen (Feltre) are ongoing.



Model representing a potential heating plant and network in Lamen (Source: Ambiente Italia)

3.2. Lessons learned: implementation experiences, achieved impact and replicability

LEGAL MEASURES

- The Draft Law of the Thuringian Climate Law was handed over to the State Parliament for further discussion and voting. If accepted, it could build a strong framework for the development of the climate protection and energy supply systems in Thuringia. Furthermore, it is a measure with a long-term impact. However, formulating a Climate Law is a time and labor-intensive measure, which finally rests on the political decisions of the State Parliament. The same is valid for the introduction of the Integrated Energy and Climate Strategy that is currently under development. (Thuringia, Germany)
- During 2017 Thuringia developed a draft for an Integrated Climate and Energy Strategy, as well as a National Climate Protection Act. Both documents are to be passed by the state government or state parliament in 2018. The Integrated Climate and Energy Strategy aims to operationalize the country's climate protection targets in each sector. Among other things, the draft national climate protection law plans to develop a national heat strategy, within which would be a framework for the reduction of heat demand as well as an increased use of renewable heat in Thuringia to be set regarding district heating. (Hamburg, Germany)

PUBLIC AWARENESS

- Furthermore, in 2016 the brochure Future Sun! was published, which contains an SDH-question-answer-catalogue as well as three correlating case studies. Such a measure clearly is recommended since its implementation is relatively simple yet effective and can accompany other measures. (Thuringia, Germany)
- It is essential to show the integration options for solar thermal energy in heating networks at events known to heating plant operators. It is then possible to inform the heating plant operators of best practice examples and other valuable information. It is not necessary to create new events for this topic since existing ones address the relevant stakeholders. (Styria, Austria)
- On 13th June 2017, a delegation of the working group on climate protection and energy of the Hamburg Metropolitan Region visited two SDH sites in Denmark. A group of 25 persons followed the invitation of the Hamburg Institut to visit renewable district heating sites in Gram and Vojens in Denmark. The group consisted mostly of expert staff members from the ministries and municipalities of the region, and all were keen to get first-hand information on SDH plants and seasonal heat storages (Hamburg, Germany)

- More than 15 experts followed the invitation of Hamburg Institut to a multi-stakeholder workshop on 28th March 2018. SDH planners, consultants, farmers association, landscape architects, representatives of the administration's department for renewable energy, nature preservation, agriculture and spatial planning, all discussed very open-minded solutions for the conflict and the competition regarding land use. (Hamburg, Germany)

- On 3rd April 2017, an expert conference was held in Hamburg with around 170 experts on renewable energies in large-scale district heating systems. The conference was arranged by Hamburg Institut carried in cooperation with the AGFW. Strategies and best-practice-examples from international and national pioneer cities showed participants how the transformation of urban heat supply towards renewable energies succeeds, and importantly key role the district heating system can play. (Hamburg, Germany)

- SDH in Italy is regarded as a new technological application and therefore its correct implementation there is of utmost importance. If stakeholders are not informed correctly it will mean non-performing plants, such as in Morgex, threaten to spoil the promotion of SDH in the country. A lesson learned on this issue is not to underestimate the need for surveillance and maintenance of the SDH plants. This is especially important if the plants have not been designed with the state-of-the-art practices. (Valle d'Aosta, Italy)
- Operators of biomass plants do not face an easy situation in Italy given the pressures on the air quality issue. Doubts on the sustainability of the biomass chain are gaining notice and this momentum complicates the situation for SDH. The alliance with solar therefore can improve its image by offering a way to reduce biomass consumption, especially in the summer period when boiler efficiency is usually lower. Lastly, an important lesson regarding awareness of SDH is that the most relevant stakeholders, especially when discussing authorization issues and visual impact of the plants, often are not aware of the real area needs for installing the plant. They usually tend to automatically connect SDH with photovoltaic plants, giving the image of large amount of agricultural areas occupied by SDH plants. Therefore, it is important to show them the actual land mass required, viable alternative solutions for placing collectors, and finally satellite photos in which the occupied area can be compared to the extension of the centre fed by the DH network. (Veneto, Italy)
- It appeared that SDH is a “hot” topic here and there is a strong desire from local stakeholders to increase their knowledge in the field. There is also an interest in implementation of an SDH project in the city of Varna. We found a friendly attitude both from the local heating company and the municipality, although SDH still remains an exotic topic for non-granted investment. (Varna, Bulgaria)

PUBLIC ACCEPTANCE

- Regarding public acceptance, an additional lesson learned is that there is a general negative attitude from local actors (especially public administrations and citizens) towards ground-mounted solar panels. This is due to bad experiences with large-scale photovoltaic plants in the recent past. It is therefore crucial to explain the differences in this as against solar thermal - above all in terms of size of the plants to be installed.

  Finally, proposing new DH networks using solar thermal is complicated by the public view on biomass. Any new installation of DH solar thermal would also have an implied burning of biomass, which is regarded as a detriment to air quality. (Valle d'Aosta, Italy)
- Regarding the integration of solar thermal energy in the city of Aosta, the information gained is the positive attitude of the utility towards this technological solution. The positive attitude owes to several different drivers: 1) The future extension of the network and therefore the need for increasing the heat production; 2) The push towards more efficient networks to adhere to the provisions in the EU Directive on efficient DH; 3) The interest in providing a ‘greener image’ of the utility and of DH more in general. (Valle d'Aosta, Italy)
- The first links made with TEPOS territories show great interest in the topic. This is primarily because solar thermal is an essential RES to reach their goal (a share of 100% RES in energy consumption by 2050). The challenge is to maintain this interest and to be able to assist those local authorities in the implementation of new projects on a technical (case studies) and economic (incentives) basis against low gas prices. (Auvergne-Rhône-Alpes, France)

ECONOMIC DEVELOPMENT

- The poor economic situation of heating plant operators, variably due to market trends, low fuel prices and market developments; reduce operator willingness to invest in SDH. As such it becomes difficult to accelerate the advantages of integrating solar thermal energy into heating networks from a technical and economic point of view. (Styria, Austria)

FINANCING and FUNDING

- The main lesson learned from this activity concerns the different attitude among Italian utilities towards the economic performance of SDH with respect to what is happening in other countries, for instance in Denmark.
- Payback times of about 20 years for investments in SDH are generally considered appealing by Danish utilities assessing SDH. This is not least because they often are co-operative companies (representing their consumers) and as such are more interested in the long-term heat price stability, rather than the short-term return of investment and high profitability.
- Inversely, this is generally not the case for Italian utility companies. In most cases public/private companies in Italy will have a much shorter time horizon, or view, than the Danish co-operatives. To develop SDH it is therefore crucial to find utilities which are interested not only in fast payback times but also in the strategic character of the solar choice in creating more efficient networks. (Veneto, Italy)
- The information gathered in the survey may be of excellent value for the future program of the National Fund for Environmental Protection and Water Management. Based on the results, the DH sector in Poland can be characterised. Knowing its advantages and drawbacks, it is clear how to approach the upcoming changes and prepare the fund. In general, the sector is interested in investments in RES mainly due to emissions reduction. The DHCs are aware of problems with advanced age of their equipment and the necessity to modernize the systems is a motivation to invest in RES. A well-prepared program of subsidies may accelerate the development of RES in the DH sector and this is crucial to comply with the regulations imposed by the directives.

  The biggest barriers were the access to attractive credit financing, supported for the first time (full scale pilot project with first seasonal storage in Poland and whether depended renewables and coal as a peak load) with an initial subsidy to reduce business risk and the perception of technical risk. Finally, the new subsidy programme for DH systems, devoted to RES and storage, is prepared by National Fund for Environmental Protection and Water Management. This means DH companies can develop more ambitious and more innovative investment plans. (Mazovia, Poland)
- A free consultation offers heating plant operators to raise the potential of solar thermal integration into existing district heating networks. A first survey on technical, economic and financial feasibility is considered. It is important to recognize the needs of operators and to show them the benefits of investing in solar thermal energy for their district heating network. (Styria, Austria)

TOOLS

- Stakeholders show a real interest in SDH. The toolbox must be implemented with new tools, experience from study cases and existing SDH. (Auvergne-Rhône-Alpes, France)
- The feedback from stakeholders regarding the Thuringian Solar Calculator at SDHp2m-events was all positive. This tool can support market actors in developing SDH-projects and raise public awareness on SDH in general. Further information events such as workshops and presentations will follow. (Thuringia, Germany)

COACHING

- As part of the SDHp2m project, the Hamburg Institute was asked to provide coaching on the question of how the statutory national heat strategy could be designed to support the desired transformation of the heat sector as effectively as possible. In this coaching process it explored which steps should be operationally implemented in the currently envisaged Integrated Climate and Energy Strategy and which steps should only be enshrined procedurally and implemented in the following years (Hamburg, Germany)

BEST PRACTICE

- Another finding is that the things are going slowly, and the absence of a pilot project is the most obstructive factor to start the implementation of SDH. (Varna, Bulgaria)
- The main result is that the interest for solar heating is fairly low as there are no (technical or economic) problems to running the plants, along with the lack of incentives to cover the risk of implementing solar heating. (Västra Götaland, Sweden)

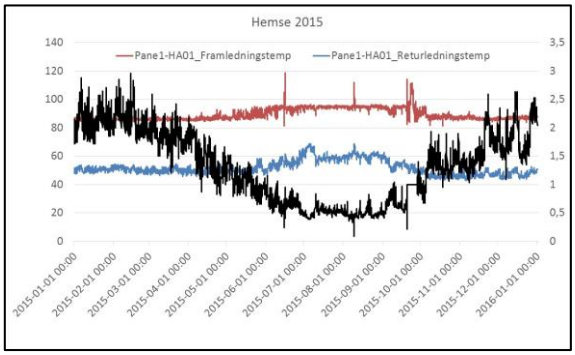
AREAS

- Another lesson learned concerns the tendency of the utilities to be over-optimistic with respect to the areas available for the installation of solar collectors: A site inspection usually reveals that roof coverings are already occupied with other technical equipment, or that the slope is not suitable for collecting solar energy etc. (Valle d'Aosta, Italy)

TECHNICAL IMPROVEMENT

- So far five feasibility studies (three of which were presented at the International Solar District Heating Conference in Graz, Austria, April 2018) have been carried out within the SDH-p2m project. One of the feasibility studies done for Hemse (≈ 2,000 inhabitants) will likely be developed into a demonstration plant to be built in 2019, with the aim of promoting interest in the implementation of SDH. The design heat load in Hemse is of the order of 4 MW and the summer load is about 500 kW i.e. around 10% of the design load. However, the plant is equipped with an old and over large wood chip boiler (7 MW) and two oil boilers for back-up.
  The over large wood chip boiler is difficult to operate at low loads. Supply and return temperatures, as well as thermal power, during 2015 are shown in Figure 2. The supply temperature is above 80°C during the winter and it increases to 90°C during the summer. The return temperature is lowest during the winter and goes above 60 °C during the summer months. The increased temperatures in summer mainly relate to the wood chip boiler, which means there are great opportunities for improvements in a new boiler combined with a solar heating plant.
  The Hemse plant is owned by Gotlands Energi (GEAB) and the plan is to replace the old wood chip boiler with a smaller but newer wood chip boiler, update one of the oil boilers, and complement these with a solar heating plant (as of above) together with an electric boiler to be used during low load periods.
  The results of the feasibility study for Hemse were for a solar heating plant of 3,000 m^2 ground mounted collectors (requiring an area of 10,000 m^2) and a buffer storage with 300 m^3 volume, connected to an existing heating plant supplying 11,500 MWh/a. The budget cost for the plant amounts to 1.2 million Euro and the yield is estimated to 1 200 MWh/a, resulting in a solar heat cost of 50 Euro/MWh (annuity factor 0.05). (Västra, Götaland, Sweden)

Bird eye view of the existing heating plant in Hemse with surroundings. (Source: Gotlands Energi)



Supply (red) and return (blue) temperatures and power (MW, black line) in Hemse 2015. (Source: Gotlands Energi)

4. OUTLOOK

4.1. SDH future development

4.1.1. A-Regions Future SDH Development

AUVERGNE-RHÔNE-ALPES REGION, FRANCE

SHORT TERM ACTIONS:

- The SDH toolbox will be updated frequently on the SDH website. For the moment, AURA-EE will do the update but in the medium term a national actor could update the website.
- The SDH training for dimensioning, conception and exploitation is now institutionalized by ADEME (Energy National Agency).

MEDIUM TERM ACTIONS:

- The CEA INES is developing a French simulation tool for SDH, including long term storage.
- The organisation of a visit of the future regional SDH.

LONG TERM ACTIONS:

- Specific actions could be implemented with Public Energy Distribution Service Operator and Local Energy Company to develop new models in the region. For instance, an SDH model using small DHC in a rural area with a biomass boiler, aiming to substitute the fossil part during summer.
- Regarding the legal framework at a national level, the Ministry for the Ecological and Inclusive Transition organised a national workshop (June 2018) to develop solar energy. Solar thermal energy featured widely in this workshop and indeed some proposals have been made by the stakeholders to develop solar thermal energy. SDH and large-scale plants have been described as a satisfactory solution to develop solar thermal energy. The conclusions of this national workshop will give a national action plan.

THURINGIA REGION, GERMANY

SHORT TERM ACTIONS:

- In winter 2018 the last meeting of the regional SDHp2m stakeholder group should focus on the SDH future development by discussing the project work and its outcomes intensely.

MEDIUM TO LONG TERM ACTIONS:

- The Draft Law of the Thuringian Climate Law, as well as the Integrated Energy and Climate Strategy, needs to be accepted in the political process by the State Parliament, which has the legislative power. Following this the measures of the Integrated Energy and Climate Strategy dealing with renewable district heating also need to get implemented by the State Government.
- Following the successful establishment of the Thuringian Solar Calculator and the Solar Service Centre, both will also be available for regional market actors after the finalization of the SDHp2m-project. The Solar Service Centre at the ThEGA will build a point-of-contact, offer advice and spread the developed information materials concerning solar energy.

STYRIA REGION, AUSTRIA

SHORT TO MEDIUM TERM ACTIONS:

- The use of areas for solar thermal should be specifically considered in the planning and expansion of district heating networks. As a result, the available areas would be integrated in the regional urban energy planning concept and reserved for use for energy supply. In addition, a future project of the "exemplary region of energy" will be focused in detail on the spatial energy planning and push the topic in Styria and Austria.
- The refurbishment guideline for technical optimization of district heating networks will be extended with different integration possibilities of solar thermal systems. The guideline will show the technical advantages and efficiency potentials of implementing a solar thermal system in district heating networks. Therefore, decentral and central integration of solar thermal systems will be technically analyzed and compared from an economic point of view.

LONG TERM ACTIONS:

- One highlight is the realization of a new large-scale solar plant with a 5,000m² collector area, which feeds into the district heating network Mürzzuschlag in Styria. This is an essential component of a climate-friendly future for the region.

  Short facts of SDH Mürzzuschlag

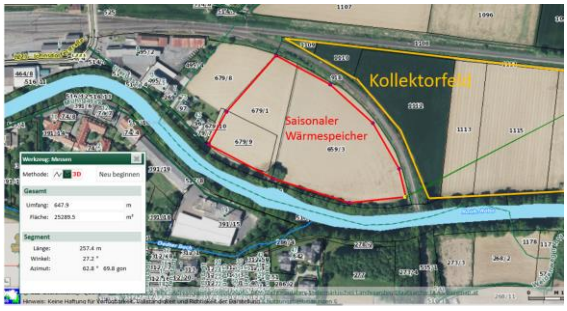
  - Heat demand: 24,8 GWh
  - Solar collector area: 5,000 m²
  - Energy storage: 260 m³
  - Solar yield: 2,450 MWh/a

Solar collector area DH Mürzzuschlag (source: SOLID)

- A similar BIG SOLAR concept was developed for the district town of Feldbach in the south-east of Styria (13,000 inhabitants). There, the network temperatures are much lower than in large cities such as Graz. With a collector area of approx. 50,000 m² and a seasonal energy storage with a solar fraction of around 50% for the district heating network.

  Short facts of BIG SOLAR Feldbach

  - Heat demand: 32 GWh
  - Solar collector area: 55,000 m²
  - Energy storage: 77,000 m³
  - Solar fraction: approx. 50 %



Land availability of BIG SOLAR Feldbach (source: SOLID)

- The exchange between the municipality, funding agencies, industry, interest representatives and research institutions should be pursued, and the advisory group "Solare Fernwärme Styria" should remain in existence even after completion of the project.

4.1.2. B-Regions lessons learned

HAMBURG REGION, GERMANY

SHORT-TERM

- Working group AREA for SDH with the administration
  After the workshop on “Multi-coded areas for SDH” in March 2018, initiated and organised by Hamburg Institut within the framework of SDHp2m, the administration will start an integrated and cross-sectoral working group on the topic,
- Preparing the next conference 2019 in Hamburg. With the positive experience of the conference "Renewable district heating in large cities" in April 2017 within the framework of SDHp2m, Hamburg Institut plan to organise a follow-up conference in 2019

MEDIUM-TERM TO LONG TERM ACTIONS

- Further project development in SDH on a harbour sludge dump site in Hamburg.

- Further project development of SDH covering the water treatment basins on a sewage water treatment plant in Hamburg.

- Further project development of SDH as noise protection in Hamburg.
- Growing numbers of SDH in Hamburg.

MAZOVIA REGION, POLAND

SHORT TO LONG TERM ACTIONS:

- Attend as a speaker in conferences and trade fairs regarding district heating in Poland and Europe.
- Further cooperation with the Chamber of Commerce Polish District Heating and the Ministry of Energy in development of RES in DH systems.
- Continued cooperation with National Fund for Environmental Protection and Water Management for improvement of a new subsidy programme for DHCs.
- Assist in the development innovative investment plans polish district heating companies.

VARNA, BULGARIA

SHORT TERM ACTIONS:

- IZEB will continue the fruitful collaboration with Veolia Varna DH for the realisation of a small SDH installation. Furthermore, future implementation of an SDH project will be supported through the capacity building of the relevant actors and through the elaboration of changes and improvements in the regional and national strategic policy and regulations.

SHORT TO LONG TERM ACTIONS:

- Importantly, another big region of Sofia-city expressed interest in SDH technology. After the workshop for market actors our team will continue to develop the work with Sofia municipality and the municipal DH company through meetings, seminars and consultations.
- Also, the cogeneration preferences in Bulgaria are currently being removed so the cost of DHW in the summer will be competitive with the construction of SDH. Then the DH companies in Bulgaria should further increase their interest in SDH. Therefore, a new business plan needs to be formulated in the context of changing regulations and IZEB will be the executant.

VÄSTRA GÖTALAND REGION, SWEDEN

SHORT TERM ACTIONS:

- The result of the feasibility studies will be disseminated (in articles in journals, seminars, etc.) to several target groups e.g. municipalities, heating plant owners etc.

MEDIUM TO LONG TERM ACTIONS:

- The demonstration plant in Hemse will be used to disseminate practical experience from an operational and economics point-of-view, in order to promote further and larger, and thereby more economical demonstration plants.

  However, a large market for solar district heating in combination with solid biofuels will likely require an increased demand for bio fuels (export or other applications) and thereby increased prices for solid biofuels, as at present the prices are low (approx. 20-25 Euro/MWh).

VALLE D'AOSTA REGION, ITALY

SHORT TO LONG TERM ACTIONS:

- Support the regional company Finaosta in streamlining and standardising the authorisation procedures for SDH plants.
- Assist stakeholders interested in assessing the integration of SDH into their existing DH network, or light technical support in the evaluation of the possibility of new small grids including solar.
- Support and assist the utility to complete the SDH plant in Aosta, even if the development of the project should extend beyond the timeframe of the SDHp2m project.
- Summarise the performance and maintenance issues in the plant in Morgex in order to set up requirements that can be included in the technical annex of future public tenders on SDH plants.
- Perform further training and educational activities, made possible thanks to the collaboration established with the Italian Wood Energy Association (AIEL).

VENETO REGION, ITALY

SHORT TO LONG TERM ACTIONS:

- Support of the DH utility in Verona in case of a positive decision regarding the solar integration.
- Possible extension of the study to the DH network in Vicenza.
- In cooperation with AIEL:
    - Mapping the existing biomass DH networks to propose solar integrations.
    - Development of new small DH networks combining solar and biomass.
    - Training for professionals: Solar DH will be included in already established AIEL training courses.

5. CONCLUSION

Since the start of the SDHp2m project in 2016, its main objective has been to change the framework conditions and barriers to Solar District Heating from a regional perspective. As it was seen through the pages of this report, the European regions involved in the project are the reflection of the enormous varieties of conditions in the different European markets while they all share the same goal: promote SDH. Regarding the activities developed by these regions and that have been well-explained through the report , it worth underlining five key areas of action: 1) *Stakeholders involvement* via, among others, the creation of seminars, workshops, coaching, informative materials (i.e. toolbox, solar calculator) and the development of regional networks. 2) *Development of regional law*, fundamental for the successful market uptake of the technology. 3) A*vailability of areas*, as this is a challenging matter when implementing SDH due to the sometimes conflicting use of land by third-parties, location and price. As seen in this document, the SDHp2m regions try to find alternatives to this challenge by, among others, developing innovative urban concepts and multi-coded areas guidelines. 4) *Investment Schemes* that vary from the Nordic preference to have long-term stability and co-operative initiatives to southern options more inclined to short-term profitability. In every market the involvement of DHC operators have proven important above all regarding information about funding possibilities and risks assessments. 5) *Raise awareness* by among others, developing demo-sites to show-case as a best practice-example. All regions have shown interest and developed strategies to, not only continue with the current activities to promote the presence of SDH in their regional markets, but also to continue beyond the finalization of the project. This proves not only the success the project itself but the viability of the technology at a long-term perspective.