



SDHp2m project
Solar District Heating: From Policy to Market

www.solar-district-heating.eu

**Strategies and actions
towards Solar District Heating (SDH)
for 9 European Regions**



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Work Package 2 – Strategy and action planning

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Solar district heating: The role of Regions

The EC Directive 2012/27/EU on energy efficiency, by introducing the concept of efficient district heating and cooling, calls for a much wider use of renewable energy sources in the existing and future grids. Especially in central and north European countries, the use of solar thermal for providing thermal energy to heat grids (Solar District Heating) is gaining a new momentum, allowing the final users to benefit of a clean source and a stable heat price, independent of fossil fuel trends.

The SDHp2m project (Solar District Heating and actions from Policy to Market), supported within the framework of the Horizon 2020 programme, addresses market uptake challenges for a wider use of district heating and cooling systems with high shares of renewables, specifically focusing on solar thermal.

The key approach is to develop, improve and implement advanced policies and support measures for SDH in 9 areas: 3 focus Regions (Thuringia for Germany, Styria for Austria and Rhone-Alpes for France) and 6 follower Regions in Bulgaria, Germany, Italy, Poland and Sweden. The project activities aim at a direct mobilization of investments in SDH and hence a significant market rollout.

The project process include 1) strategy and action planning based on a survey, best practices and stakeholder consultation 2) an implementation phase and 3) efficient dissemination of the project results at national and international level.

This document reports the results of the first step showing, for each Region, the initial survey carried out highlighting barriers and opportunities for SDH, as well as the strategic approach and the planned actions for developing a self-sustainable SDH market in the regional territory.

This English summary of the results is complemented by the more detailed reports available for all Regions in the specific national language and downloadable from the project website: www.solar-district-heating.eu

Abbreviations used in the document

RES: Renewable Energy Sources

DH: District Heating

DHC: District Heating and Cooling

SDH: Solar District Heating

SDHp2m: Solar District Heating – From Policy to Market

ST: Solar Thermal

EU: European

Austria – Styria Region

Current status: Barriers and opportunities



The Fernheizkraftwerk Puchstraße SDH plant in Graz

District heating is quite a common technical solution in Austria and today around 24% of flats are heated by DH. Furthermore, Austria is the European leader in the diffusion per capita of solar thermal technology, with a total of over 5 million square meters, mainly installed in small systems, with an area lower than 20 m².

District heating is mainly “on-bill” financed (i.e. by user fees) and partly by different federal subsidies (up to 30% of the investment costs).

As far as solar thermal is concerned, different subsidies are available for small and large systems (>100 m²). The larger systems, which could be used in integration with district heating grids, can receive federal subsidies in the range from 10% (small systems) up to 40% of the additional investment costs compared to a fossil plant (for innovative solution with area >100 m²).

Regarding the legislative framework, first of all the DH sector is not regulated like the electricity or gas branches. DH is generally considered as efficient and clean and there is no minimum mandatory share for the use of renewables or waste heat in DH production. However, 85% of DH in Austria comes from renewables or recycled heat (CHP, waste incineration, industrial waste heat).

There are currently no information campaigns for solar district heating or large scale solar thermal plants, also thanks to the fact that both DH and solar thermal have quite a positive image in Austria.

Anyway, the DH association “Fachverband der Gas- und Wärmeversorgungsunternehmen – FGW” recently planned a specific campaign for highlighting the benefits of district heating.

Regarding training, Austrian DH companies usually attend professional courses of German association AGFW. Furthermore, there are no specific courses on SDH in Austria.



Participants of the 1st Styrian SDH stakeholder group meeting

The biggest opportunity for renewable DH in Austria comes from the ever growing phenomenon of the shutdown of fossil fuel fired CHPs due to low electricity tariffs. An additional positive framework condition is the available subsidy for innovative solar thermal systems up to 10.000 m².

On the other hand, the toughest challenges for SDH in Austria seem to be the low gas price and the availability of affordable land areas for collector placing.

Strategy and action plan

A regional stakeholder advisory group, composed by 15÷20 people and focusing on the integration of ST into DH, preferably based on renewables (mostly biomass in Styria), has been especially set up for the SDHp2m project. This group has already met twice (May and October 2016) and saw the participation of



Participants of the 2nd Styrian SDH stakeholder group meeting

energy suppliers, chambers of different sectors, several departments of the Styrian Regional Authority, Municipalities and energy agencies.

The key topics discussed in the meetings were: The role of DH for the future energy supply (including “KESS”, the Climate and Energy Strategy for Styria 2030), the SDHp2m project and the role of the regional advisory group, available incentives for large-scale SDH systems, spatial planning and energy in the landscape and the main outcomes from the recent SDH conference in Denmark.

The overall concept of the strategy for SDH development arises from the specific regional conditions: The bigger cities in Styria use DH from waste heat and fossil energy whereas rural areas prefer biomass as DH energy source. Especially the latter ones offer a great potential for the additional integration of solar energy.

The high acceptance towards ST, as well as the specific know-how concerning the integration of solar into existing DH grids, appear to be very good framework conditions for a further development of SDH.

Therefore the regional strategy includes the following key objectives:

- Make SDH more popular especially among decision makers.
- Simplify the implementation of SDH plants.
- Develop a funding model which also foresees a public participation model.

Despite such a positive framework, some barriers still need to be overcome:

- Solar thermal plants are widely used for the supply of heat and domestic hot water, but with an increasing competition by other technologies such as heat pumps and photovoltaics. Furthermore ST is affected from growing price pressure and land use problems.
- The existing public subsidies for solar thermal plants range around 20%, lower than the available incentives for other renewable energies (e.g. photovoltaic).

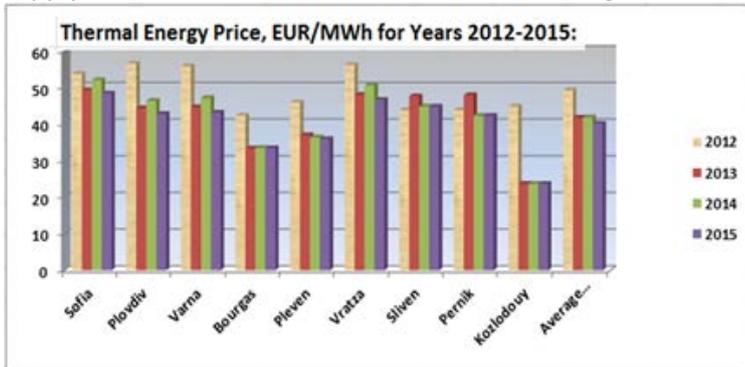


Work during the 2nd Styrian SDH stakeholder group meeting

Bulgaria – Varna Region

Current status: Barriers and opportunities

DH in Bulgaria covers about 13% of the energy production, by using cogeneration units fed on natural gas and, for a very small part, coal. All DH grids use pressurized water with temperatures over 100 °C in the supply line, conditions which are not ideal for integration with solar thermal systems.



The Bulgarian DH market has more than 2 million end users. However, the market for green energy supply through DH systems has not started yet.

The average price of DH heat is around 40 €/MWh (data for 2015).

Heat price for several Bulgarian cities from 2012 to 2015.

Regarding solar thermal, the cumulative installed collector area was 120,000 m² in 2016, mainly for hot water production in new buildings and hotels. Therefore, no experience of SDH plants has even been realised. However, practical experiences were developed by Sofia and Gabrovo DH companies on integration of solar thermal systems with the existing DH substations for district heating in multi-family and public buildings.



Barriers for SDH can be summarized as follows: High VAT (Value Added Tax) for ST (20%) compared to other EU countries (often from 5% to 12%), no specific incentives for solar thermal and no mandatory RES shares for DH companies and, finally, hardly any experience in selling solar thermal energy to existing DH grids.

Example of a solar thermal plant on a Bulgarian building.

On the other hand, looking at opportunities for SDH, it is likely that the increasing requirements towards nearly zero energy buildings will take into account the high productions by fossil fuels in DH, thus fostering the use of solar energy for heat production.

Regarding the main partners for developing SDH system, existing public DH would not be the best choice while privately owned DH grids, when economic viability is demonstrated, could be the key driving actors. Furthermore, politicians with strong green platforms could also act as main drivers for developing pilot projects in their cities.

Solar thermal installation on a flat roof.



Strategy and action plan

A SDH stakeholder group was kicked-off in May 2016 thanks to a first meeting with about 15 representatives from national and regional authorities, financial institutions, industry, professional organisations and NGOs. This group, which will meet every 6 months, will also be intertwined with the activities of the Bulgarian DH Associations and of the Bulgarian Solar Association.

In the first meeting, the technology was presented to the stakeholder groups and possible pilot project opportunities were discussed. Main topic was the certification of the technology according to the national legislation standards and technical incorporation in the existing DH networks.

Smart district heating with large solar fraction is an exotic concept in Bulgaria, far away from the current district heating reality, often characterized also by old infrastructures. The main strategic priority, therefore, is to increase the general knowledge about SDH technology and its ecological, economic and social potentials in the country. It is necessary to overcome the scepticism among professional and investment stakeholder groups by providing sufficient technical and economic details. First steps for introducing the technology should include case studies for real applications, technical support for pilot projects and, at the same time, integration of the SDH concept in the strategic plans for sustainable urban development.



First meeting of the Varna stakeholder group.

The following actions will be carried out to develop the SDH market in Bulgaria:

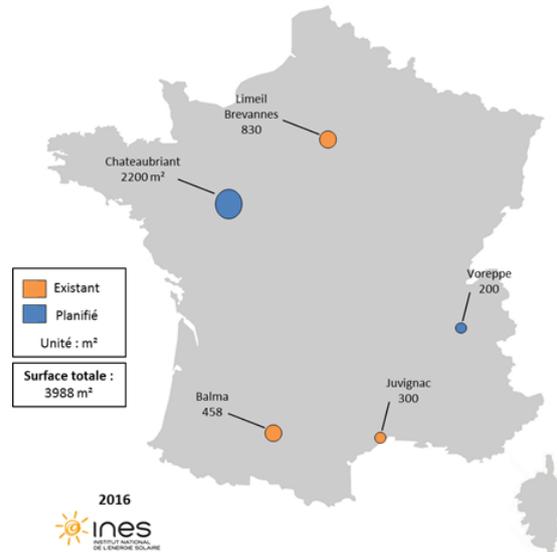
- Through the technical support from international experts, the potential for SDH applications will be analyzed in two different urban areas: A small community with no previous experience and infrastructure in DH (town of Gorna Malina) and a whole district in the city of Varna, with an already existing local DH operator and established infrastructure.
- Improvement of the political awareness by introducing SDH technology as one of the key drivers on the path to zero carbon emission urban development; The integration of smart district heating with large solar fraction, therefore, should be part of 2030 and 2050 strategic plans for the chosen regions.
- Organize capacity building training activities to improve the knowledge about SDH among the main stakeholders.
- Set up a wide dissemination campaign for developing the public image of solar thermal.
- Comparative analysis of heat prices and their relationship with taxes on emissions in Europe and Bulgaria. Analysis of how European environmental policies affect restrictive measures on burning fossil fuels. This analysis will be distributed to the attention of political and government representatives as well as to the public attention through the media.
- Comparative analysis of environmental policies for thermal energy, basing on the analysis of the expectations from the Paris agreement and the possible commitments of Bulgaria in the heating sector. This analysis will be distributed to the attention of political and government representatives as well as to public attention through the media.
- Analysis of financial instruments used for SDH in EU countries and their analogue in Bulgaria, including a consultation with financial institutions and the possible alignment of conditions for access to financial resources for SDH projects.
- Analysis of the available strategic documents on sustainable urban heat planning and preparation of proposal for texts which will be distributed to partner institutions.

France – Auvergne-Rhône-Alpes Region

Current status: Barriers and opportunities

Heat is a relevant item in the French total energy consumption, representing half of the overall demand. Regarding DHC, 800 systems are currently in operation, with a RES share of 15% and a higher percentage of 25% for waste heat. The average heat price resulting for the final consumer is around 70 €/MWh.

As far as SDH is concerned, 3 plants have been installed in the country and 2 more are in the pipeline, for a total area of about 4,000 m². Future goals foresee a gradual increase of the production by solar thermal: +20% by 2018 and a range from +60% to +260% by 2023. By 2030, 800,000 m² of SDH plants are expected, as well as an increase by a factor 5 on the use RES in DHC, which means going from the current value of 0.7 Mtoe to 3.4 Mtoe.



Existing (orange) and planned (blue) SDH plants in France.

At national level, the main actions and tools for developing the use of RES in DHC are the following:

- Set a higher carbon dioxide tax: This tax is too low at the moment (22 €/t CO₂) to make RES DHC systems economically viable.
- Change the concept for national subsidies: They are currently based on a comparison with natural gas price. Therefore, with a low fossil fuel price, subsidies cannot make RES DHC profitable due to a cap on the incentive.
- Foresee a better integration of DHC into the heat regulation law for buildings.
- Simplify administrative issues which now require many energy planning documents at different scale (national, regional, district, association of local authorities, municipal) to develop RES DHC.

The initial analysis carried out highlighted the typical strength of solar thermal (free resource and no-emission “fuel”) as well as its opportunities, in line with the current developments in the district heating sector, which are low temperature systems, long-term storages and energy efficiency in the DH grid.

On the negative side, the main weaknesses are the land occupation factor, which affects both the authorization procedures and the total investment cost, and the heat regulation for buildings which has not been yet extended to include SDH contribution.

Finally, main threat is the competition with many different thermal energy sources such as other renewables, cheap waste heat and fossil fuels (especially natural gas, with its quite low prices between 15 and 20 €/MWh).

Strategy and action plan

A regional advisory group, specifically focusing on SDH, was created in the Auvergne-Rhône-Alpes region and had its first meeting in April 2016, when 22 participants gathered to discuss strategic approaches to develop SDH. The meeting saw the participation of several stakeholder categories, such as associations and single actors of DHC and ST sectors, policy makers, DHC operators and planners, energy cooperatives and initiatives, city planners, heat planning experts, financing institutions, national authorities, suppliers and service providers.

The group, endorsed by the Director of the climate and the environment at the Auvergne-Rhône-Alpes Regional Council, will meet with a 6-months frequency and will most probably grow since other stakeholders showed interested towards the activities.

Furthermore, already existing regional groups on DHC and on ST will be invited to join the SDH initiative.



1st regional stakeholder meeting in Auvergne-Rhône-Alpes

The regional strategy set up by the advisory group rests on the following three key axes:

1. Energy planning: The survey carried out shows that solar thermal energy is not sufficiently taken into account in the national energy plan. To give an example, the solar thermal production in the DHC sector is expected to be less than 0.5 % by 2030. Energy planning actions foreseen in the strategy are at both national and regional scale. Standard documents, as consultation documents for feasibility studies, will be developed at national level. At regional level, the recent reform of the regional council policy gives new energy planning studies for the energy management and one of the barriers identified is that solar thermal energy is not considered in the early stages of DHC projects.
2. Technical and economic issues: First of all, DHC technical departments do not have a good specific knowledge on the integration of solar thermal energy in DHC. Secondly, there is a lack of detailed economic data on the existing SDH. Finally, there is a need for specific technical and economic data on the SDH model implemented in the French framework conditions.
3. Communication and dissemination: Communication is a key point of the strategy since the lack of information among stakeholders is a huge barrier for the development of solar thermal energy in DHC. Right from the beginning, with the involvement of local authorities in integrating SDH in their energy planning, to the end consumer, all the stakeholders have to be informed and convinced of the social, economic and environmental benefits which could be brought by the use of this renewable energy source.

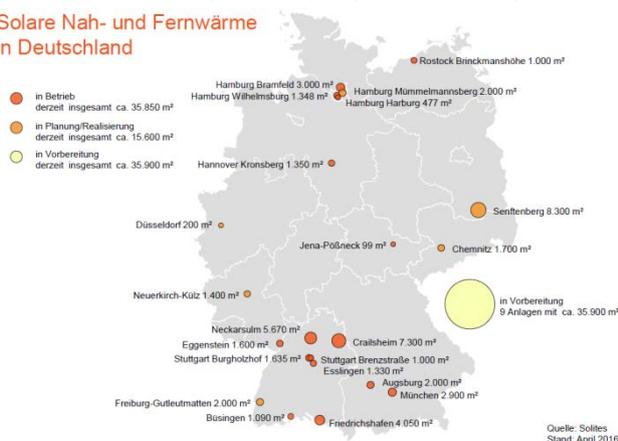
Germany – Metropolregion Hamburg

Current status: Barriers and opportunities

The Hamburg Metropolitan Region has 5 million inhabitants, 1.8 million of which live in the central city of Hamburg. The most important DH grid is the inner city network in Hamburg which is owned by Vattenfall (majority of shares) and the City of Hamburg. It provides 20% of the heat demand of Hamburg and is among the largest DH in Europe. As a result of a referendum in 2013, Hamburg is determined to give the DH ownership back to the Municipality in 2019.

Furthermore, several other DH grids are operating in Hamburg and in the surrounding municipalities in the metropolitan area. Outside the city, then, various DH systems are owned and operated by the municipalities or by municipally owned companies and few DH systems are run by cooperatives.

Solare Nah- und Fernwärme in Deutschland



Though the use of solar thermal energy is less developed than in other German, several SDH have been installed in the city of Hamburg. For instance, in the Solarsiedlung (solar housing estate) Bramfeld, one of the first German SDH networks was built in 1996 with a collector area of 3000 m². Finally, there are ideas for the construction of a new solar thermal plant that could be connected to an existing district heating network in the quarter of Allermöhe and other municipalities have also shown interest for SDH.

ST for block and district heating in Germany (red: In operation; Orange: Under construction; Light yellow: Planned)

Due to the tradition of wind energy and citizen-owned energy suppliers, north of Germany generally has a more positive view on RES than the rest of the country. Nevertheless, because of possible high prices and negative local news coverage, the acceptance of district heating is low in some municipalities.

The main opportunities for SDH in the region may be summarized as follows:

- Successful SDH pilot projects in operation.
- High acceptance for RES in the region.
- Good existing institutional and technical framework for ST.
- Due to the proximity to Denmark, Danish expertise can easily be transferred to the region.
- With the federal funding scheme (Marktanreizprogramm - market incentive programme) and the state and local support schemes, a strong public financial engagement for SDH is in place.
- Good framework for legal provisions promoting SDH in the Hamburg state law.

On the other hand, a number of barriers to be overcome are left:

- DH in the region is still highly dependent on fossil fuels.
- The availability of suitable areas to build ground-mounted solar thermal plants.
- In densely populated municipalities, real estate prices are a problem for the competitiveness of ground-mounted SDH.
- Stakeholders have to be convinced individually as the technology is not yet popular enough.
- Legal incentives for SDH are missing in three of the states of the Metropolitan area.

Strategy and action plan

To elaborate and implement a strategy for developing SDH in the region, it was decided to involve, as advisory bodies, two already existing working groups:

- Working Group on Climate and Energy of the Metropolitan Region Hamburg where main stakeholders are state governments and administration of municipalities (“Landkreise” = county level); The membership to the group is limited to these stakeholders. The SDH contribution to this group was kicked-off in May 2016 and regular quarterly meetings are foreseen.
- Forum on heat of the Hamburg Renewable Energy Cluster (EEHH) where key stakeholders are DHC operators and planners, energy cooperatives and initiatives, city planners, heat planning experts, administrations, associations, policy makers. Membership to this group is open to all interested actors. The Cluster manages three forums that meet on a regular basis for sharing experience and networking. This year the forum HEAT has started. The SDH contribution to this group was kicked-off in April 2016 (within HEAT forum), the second meeting was held in July 2016 and additional quarterly meetings are foreseen.



The SDH plant of the Energiebunker Wilhelmsburg in Hamburg

As outlined above, one of the key findings of the regional survey carried out is the barrier represented by the availability of suitable land for installing large-scale solar thermal plant. Therefore the regional strategy and action plan will be mainly focusing on this issue, with the following five primary targets identified:

- Individuation of large-scale roof areas for SDH.
- Individuation of polluted or contaminated areas where SDH can be considered as a recovery option.
- Individuation of areas suitable along traffic routes (for instance noise barriers with solar collectors).
- Individuation of agricultural areas for SDH, not competing with food production.
- Development of ground double use (for nature preservation and for SDH).

In addition to that, several points should be looked at to regard positively the development of SDH on open spaces, such as:

- Energy production always need space and fossil fuels are not an option for the future.
- Heat production must happen close to the final use.
- Energy density for solar thermal is about 40÷50 times higher than for biomass; Therefore, the required land use is much smaller.
- Biodiversity of land where large-scale solar thermal plants are mounted is generally higher than intensively-farmed lands.
- Large-scale plants, thus installed on the ground, make solar competitive with fossil fuels by lowering the specific investment cost.

Germany – Thuringia Region

Current status: Barriers and opportunities

The Free State of Thuringia covers an area of around 16,000 km² and has a population of around 2.2 million inhabitants, including 17 rural and 6 urban districts.

Thuringia's solar collector installed area is 559,100 m², producing 215 million kWh of heat, placing the state in a very low ranking in Germany, thus witnessing the large potential not exploited so far.

Regarding DH, the heat production increased from 4,058 GWh in 2007 to 4,551 GWh in 2010 and the RES share in DH rose from 4.9% in 2003 to 20.3% in 2012, mainly thanks to the use of biomass, a resource which has almost reached its saturation.

In Thuringia 66 district heating grids (not including steam-powered grids), with a line length of 587 km and heat production of 2,243 GWh, are operating, mainly in urban centers. However, some rural communities, such as Pößneck or Hermsdorf, also operate smaller DH grids

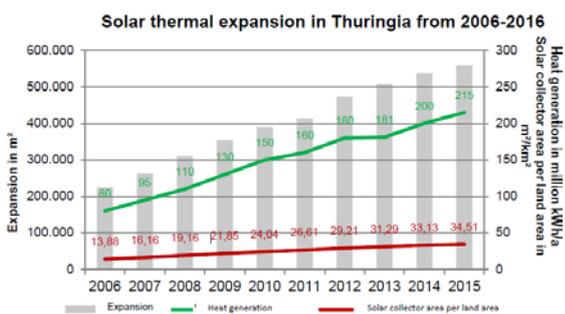
Most of the existing grids were built decades ago: Large grids were installed by the municipal utilities and run by them while smaller local grids are often run directly by local authorities.



The SDH plant providing heat to the DH grid in Jena

As far as SDH initiatives are concerned, two small plants are already operating in Jena and Ilmenau. Additionally, local authorities and utilities from Erfurt, Werther and Gotha are already examining the economic feasibility of realizing SDH plants, in combination with other RES like geothermal or heat pump.

In line with Thuringia's goal of reaching a 35% RES share by 2020, the GreenInvest incentive programme focuses demonstration projects with high replication potential related to RES and energy saving, among which also SDH plants could be supported.



The key opportunities for SDH are: Renewable heat should be increased to meet national targets, Local Authorities increasingly regard heat supply as a local remit, integration of large-scale ST in existing DH is less expensive than new construction and projects, the costs of large ground-mounted plants are far lower than those on rooftops and, finally, land use for ST is relatively low compared to other renewables, as the energy yield per m² is higher.

Solar thermal market in Thuringia (source: <https://www.foederal-erneuerbar.de/landesinfo/bundesland/TH/kategorie/solar>).

On the other hand, barriers and obstacles should be taken into account: Need for suitable land space available close to consumers, potential land competition with different uses (e.g. commercial), lack of experience in large ST plant, a subsidy structure for CHP plants which currently hinders the search for alternatives to fossil fuel-driven CHPs.

Strategy and action plan

In order to develop a regional strategy for Thuringia, a stakeholder group focusing on the specific topic of SDH, was established under the lead of the Head of the Department of Energy and Climate of the Regional Authority. The group, which was kicked-off in April 2016 in Erfurt, includes representatives of policy makers, national authorities, ThEGA (the regional energy agency), Municipalities, the Association of Municipal Companies (VKU), regional energy suppliers, Chamber of Industry and Commerce of Thuringia, research institutions, energy cooperatives and initiatives, DHC operators and planners and housing industry. Then a stakeholder meeting was held on the occasion of the 6th Thuringian Renewable Energy Conference in November 2016 in Weimar and the next meeting is planned together with a visit of the largest German SDH plant in the city of Senftenberg/Brandenburg.



Map of Thuringia (source: Wikipedia).

Greenhouse gas emissions in Thuringia should be reduced, compared to the level of 1955, by 50% in 2030 by 70% in 2040 and by 90% in 2050.

This implies relevant requirements for an environmentally friendly energy system: The Free State of Thuringia wants to cover its own energy consumption with a mix of renewable energies until 2040. One important cornerstone is the reduction of greenhouse gas emissions by heat supply from DH networks and their further extension.

Districts and concerned municipalities are advised to develop concepts for climate adaptation. It is foreseen then to offer support for the realization of these concepts.

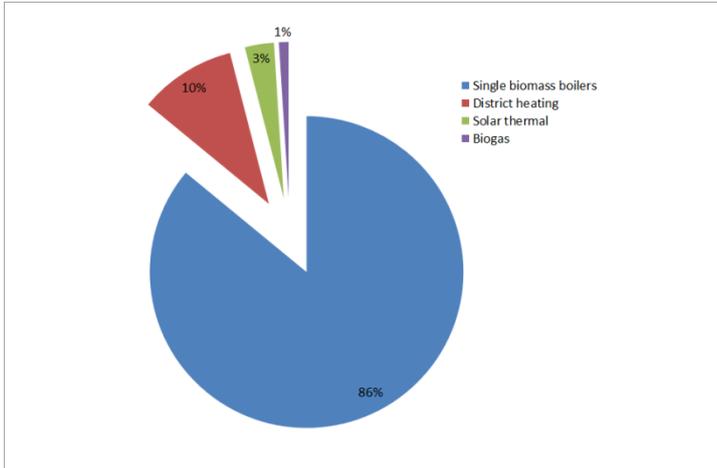
The main focus of the action plan of Thuringia in the framework of the SDHp2m project is to increase the share of renewable DH, basing on an inclusive approach where measures are planned regarding all project phases as shown in the following actions foreseen:

- The creation of a solar cadaster in the framework of a regional renewable energy and resource efficiency portal and the development of an analysis and monitoring platform in correlation with the establishment of a waste heat cadaster based on GIS data.
- The publication of a handout for communities about technical, economical and juridical aspects of the use of ST in DH networks which enables them, thanks to the questions-answers catalogue “solar thermal energy and district heating”, to make firsts steps on their own and to evaluate and compare different solutions.
- The requirement for municipalities to develop heat consumption concepts aiming at energy saving, increasing energy efficiency and the share of renewable energies based on a regulatory framework, which can contribute to the initialization and development of renewable district heating projects.
- Making incentive instruments available for the implementation of energy efficiency measures and the realization of pilot plants for a renewable and sustainable energy production and consumption in enterprises as well as for long-term thermal energy storages in the framework of the directive “Solar Invest”. This measure contributes to eliminating potential investment barriers.
- The targeted renewal of the incentive for district heating networks in rural areas by the responsible authorities represents an important measure for the reduction of the financial risk by the extension or new implementation of SDH projects of smaller scale by communities and/or alternative operators like citizen cooperatives.

Italy – Valle d’Aosta Region

Current status: Barriers and opportunities

District heating in Valle d’Aosta shows a heated volume of 1.6 Mm³ (0.5% of the total al national level), 30 kilometers of grid (0.8% of the total) and a ratio between heated volume and inhabitants of 12.4 m³/in.



The use of renewables in the heating sector (not only DH) had, in 2010, the distribution reported in the graph below, where ST covered about 3% and DH (by biomass), had a share of 10%.

In the residential sector, the main heating source is still oil (33%), followed by natural gas (30.5%), biomass (23.4%), LPG (10.9%) and electricity (2.2%).

The main DH grid, operating in the city of Aosta, is managed by a private utility while in the smaller grids (less than ten) there is also a public share.

Renewable heat sources in Valle d’Aosta (source: Regional Energy Plan).

According to the national burden sharing of EU targets, Valle d’Aosta has quite an ambitious target of covering, through renewables, 52.1% of the final consumption by 2020. The measures set up for meeting this target, reported in the Regional Energy Plan, do not foresee a key role for solar thermal and for DH. Given this framework, the main opportunities for SDH can be summarized as follows:

- The continuous growth of thermal consumption, as witnessed in the Regional Energy Plan.
- The relevant extension of the area without natural gas supply: 50 Municipalities out of 74, corresponding to about 29% of the population.
- Due to air quality issues, in areas where a DH grid is operating, biomass plant cannot receive any incentive, thus becoming a potential indirect support to the use of solar thermal as the only exploitable renewable source.



Map of Valle d’Aosta (source: Wikipedia).

At the same time, some specific barriers for solar thermal, especially if used in DH grids, still have to be overcome:

- Low irradiation in the *envers* zone.
- Potential shadowing from mountain contours, which could limit the winter yield of a SDH system.
- Potential visual impact of large-scale ground-mounted SDH plants.
- Gradual increase of the natural gas supply.
- The competition with biomass, an energy source available in large amounts in the region.

Strategy and action plan

Starting from the barriers and opportunities coming out of the initial survey, a first idea of action plan for the development of SDH in Valle d'Aosta has been developed.

As first priority, exploring the introduction of a solar thermal contribution in the main regional grid, the one in Aosta, is one of the key activities and the company managing the grid has already shown its interest in the topic. Solar radiation in Aosta reaches about 1,600 kWh/m² year on an optimally tilted surface and the potential yield of a SDH system could be around 500 kWh/m² year. Assuming a 2,500 m² solar thermal plant, which is the maximum size for applying to the national incentive scheme of "Conto Termico", the investment could be around 1,250,000 €, receiving, in a period of 5 years, a support of 665,000 € from "Conto Termico", about 53% of the investment.

However, two issues are still pending. The first one is how to integrate the solar thermal plant in the production system in order to minimize its operating temperature and, therefore, to increase its



operational efficiency. Secondly, areas where to install the solar collectors should be identified also taking into account that, due to recent issues with large ground-mounted photovoltaic plants, the Regional Authority has forbidden installations on the ground.

Further calculations on this potential SDH system are going to be carried out, also benefitting of the technical coaching of SDHp2m partners from Denmark and Germany.

Example of an Italian SDH plant in Varese using both roof and ground for collector installation.

A second key topic for the regional strategy, linked to the above mentioned issues, is to try and standardize the authorization needs for medium-sized SDH plants mounted on the ground. Since there is just one SDH plant in Italy, no experiences exist on this topic. However, the utility in Varese, where this SDH system is operating, has given its availability to interact with Valle d'Aosta to expose how they faced and solved the authorization issue.

Additional development actions for the strategies are then:

- The development of new local grids for small mountain villages, following the German idea of the "bioenergy villages" combining solar thermal and other renewable energy sources. Such grids could use, as installation areas for the solar collectors, the roofs of industrial warehouse in special districts called "pepinieres" (industry incubators), thus solving the problem of available surfaces.
- Include solar thermal in already existing small grids in order to save biomass and to reduce air quality issues. The technical goal in these cases could be to cover the summer demand through solar energy, thereby turning the biomass boiler off in the hot season.



Example of a "pepiniera" (source: www.svda.it).

Italy – Veneto Region

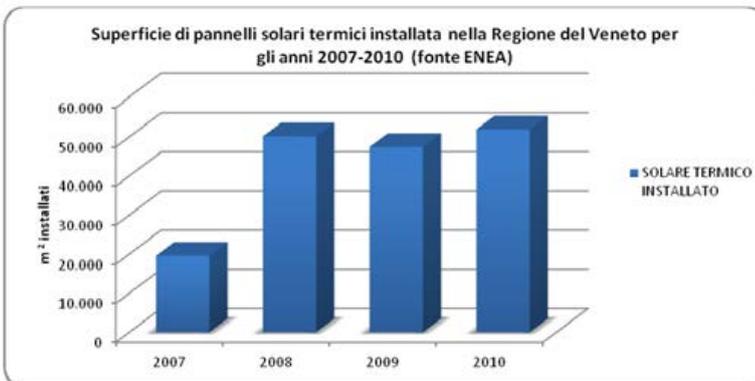
Current status: Barriers and opportunities

Final energy consumption by renewables in the heating sector in Veneto amounted to 1,133 ktoe in 2014, mainly produced by biomass (especially for the residential sector) and heat pumps. Thermal energy represents about 60% of the regional overall energy consumption.

Regarding district heating, the heated volume in the region is around 14.4 Mm³, the grid extension is about 100 kilometers (2.6% of the Italian total extension) and the ratio between this volume and the population is 2.9 m³ per inhabitant.

7 DH grids are operating in the Region and have been classified as “not effective” by GSE (www.gse.it) according to the EC Directive 27/2012.

The GSE report on district heating has recently calculated a potential of 133 GWh/year of heat in DH grid fed by waste incineration. It also estimated an energy efficiency potential of 10,364 MWh/year for the large



DH grid in Verona, of 2,313 MWh/year for the large grid in Vicenza and of 587 MWh/year for the small grid also operating in the city of Vicenza. Nevertheless, the same report does not take into account any potential contribution by SDH systems.

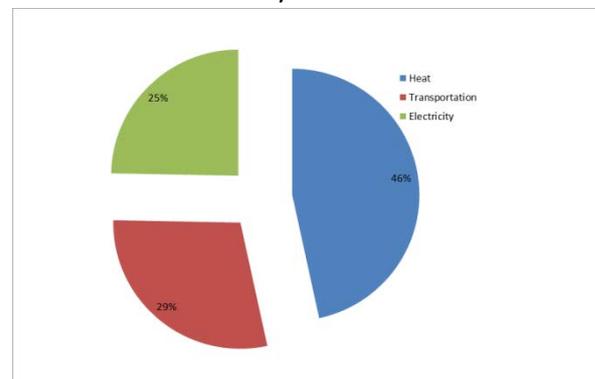
About solar thermal technology, it is mainly used for domestic hot water production in residential applications.

New ST installations in Veneto (source: Regional Energy Plan).

Given such a framework, the main opportunity for SDH could lie in the fact that, as reported above, there is a need for making the existing DH grids more effective and that biomass cannot be always considered as a valid alternative choice because of the air quality issue and of the complexity of the supply chain.

An additional positive chance is that only a few grids are operating in the region, thereby leaving room for a large potential use of SDH, especially in small and medium cities in more rural areas, where the exploitation of a number of different local renewable energy sources could be favored also by the direct involvement of the citizens. For such systems, also regional budget derived from EU funds may be available.

On the other hand, the natural gas network is widespread in the region and then economic competition with this fossil energy source can be very tough. Furthermore, the region is in a good position with respect to its targets for the national burden sharing and, therefore, this does not represent any push towards a wider use of renewables also in the district heating sector.

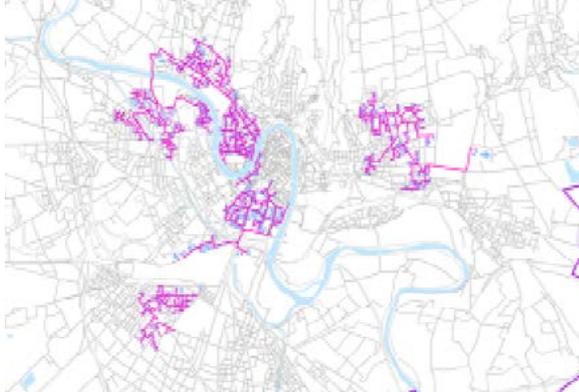


The relevance of the heating sector in Veneto (source: Regional Energy Plan).

Strategy and action plan

The Veneto Region has already set up a working group on energy topics, which will be restored also thanks to the SDHpm2 initiative. It is also planned to organize a technical tour to the city of Varese, where the only SDH plant in Italy is operating with very satisfying performance results.

One of the main actions which would be strategic for the SDH development at regional level is the



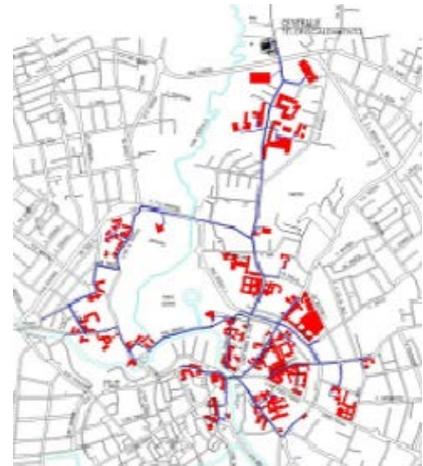
assessment of the potential for SDH integration into the larger existing DH grids in the cities of Verona and Vicenza. The key aspects to be evaluated for this action are the operation strategy for solar thermal in combination with the existing production units, as well as the individuation of suitable areas. This latter point is crucial for two reasons: First of all, the cost of land in areas close to cities may be very high and, secondly, because of recent issues with large photovoltaic plants, installing some thousands of square meters of solar thermal on the ground may be not that easy.

The DH grid in Verona (source: Regional Energy Plan).

Another key point is the analysis of existing regional funds, coming from EU budget, to check if and where new district heating grids for small cities may apply for a public support. Such grids could combine several renewable energy sources at local level, such as biomass or biogas and, of course, solar thermal.

Furthermore, it has to be taken into account that also incentives at national level are available thanks to the “Conto Termico” support scheme. Under this scheme, an incentive of about 50÷60% of the investment cost may be reached in large solar thermal systems for integration into district heating grids.

To develop these actions, a preliminary step that should be carried out is a deep information transfer to the key involved stakeholders, mainly utilities and local authorities, given the current low knowledge about solar district heating. This will be done through the above mentioned stakeholder group and also by a specific workshop organized either in Veneto or in Varese to benefit of the chance to visit the SDH plant.



The DH grid in Vicenza (source: Regional Energy Plan).

Poland – Mazovian Region

Current status: Barriers and opportunities

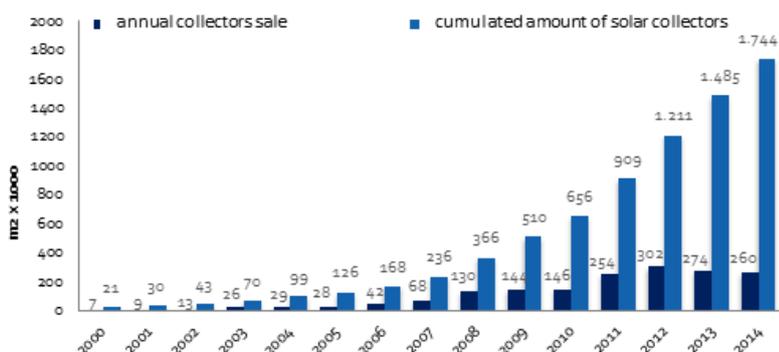
Though the district heating demand has recently shown a slight decrease, it is still the main technical solution for providing thermal energy in Poland. The largest share of this heat (77% in 2013) is generated through coal-fired cogeneration plants while heat from RES covers less than 7%.

Modernization of buildings, refurbishment or replacement of heating networks, limiting network losses and energy saving behavior of consumers cause a reduction of the intensity of heat use (as shown in the table below), partially offset by the expansion of networks and connecting new customers.

		2002	2013	2014
Number of licenses	unit	894	455	451
Installed capacity	MW	70952.8	56521	56796.2
Ordered capacity	MW	38937	33944.5	33640.2
Heat delivered to customers	TJ	298938.1	243799.2	217677.1
Production efficiency	%	79.7	85.9	86.0
Transmission efficiency	%	88.2	87.0	86.3

Polish heating sector (sources: Heating Energy in numbers - 2014, Regulatory Energy Office, Warsaw 2015).

Regarding solar thermal, Poland is currently one of the EU leaders, though the 2014 statistics reported a 5% decrease, 182 MW_{th} (about 260,000 m²) installed compared to 192 MW_{th} in 2013.



Polish ST market (source: Report - Solar collectors market in Poland. Institute for Renewable Energy (IEO), 2014).

The Mazovian Region looks like a very promising area for SDH due to the high number of DHC utilities and to the dense DHC network. Furthermore, local inhabitants have a good purchasing power.

In addition to that, according to Article 116 of the Polish RES Act, companies generating or trading heat are obliged to purchase thermal energy connected to their networks if it comes from waste treatment or from RES, thereby constituting a relevant opportunity also for SDH.

Finally, a funding program in the National Fund is under preparation for heating companies for achieving the status of ESC (Efficient Heating Systems), as introduced by the EU Directive on energy efficiency.

In spite of these good conditions, some barriers are still hampering the use of RES for DHC:

- DHC grids do not easily adapt to the decreasing heat demand, thus increases the fixed costs and lowering their economic performance.
- New low-energy constructions may reduce the viability of DHC grids.
- The increase in DHC heat prices could isolate more vulnerable customers, thereby reducing the demand and causing a further escalation in the cost for the remaining users.

Strategy and action plan

A regional stakeholder group was set up in the Mazovian Region with the main goal of developing a plan for modernization of heating companies by incorporating renewable energy sources. More specifically onSDH, the aim is to include solar thermal technology in the “Roadmap of the development of green district heating companies in Poland”.

The group was kicked-off in May 2016 with 19 participants from associations, chambers of commerce operating at Mazovian region, Mazovian municipalities, decision-makers: representatives of the Energy Regulatory Office, the National Fund for Environmental Protection and Water Management, heating companies.

A study tour to Denmark will be organized in December 2016, inviting the vice-president of National Fund for Environmental Protection and Water Management, a representative of Ministry of Energy and a representative of Economic Chamber for Polish District Heating, for exploring Danish SDH installation with high potential for successful replication in Poland (both small local installations and larger systems managed by DHC utilities).



Effective (green) and not effective (red) DHC systems in Poland according to the EU Directive on Energy Efficiency

The strategy for fostering SDH development in Mazovian is founded on the following three key actions:

1. Create a new support program for heating companies, within the National Fund for Environmental Protection and Water Management, to build large SDH systems. This program gives the opportunity to receive a loan, whose amount ranges from 1 million to 90 million PLN, granted for a period up to 15 years, for building or refurbishing effective systems for heating and cooling. However, specific budget lines for renewable DHC should be introduced.
2. Organise stakeholder meetings and capacity building training to demonstrate the practical viability of SDH market for Poland. The main topics to be dealt with will be the SDH technical peculiarities, its cost-effectiveness and the possible business models for its development, the funding opportunities and examples of existing installations.
3. Prepare an application to the National Research and Development Centre for the building of a pilot plant SDH, under the call for Activity 1.2 "Sectorial R & D programs" in the framework of Priority Axis I "Support for conducting R & D work by enterprises". Manufacturers of renewable energy systems, district heating companies, under the condition to be enterprises based in Poland, will be invited to participate. In order to be able to apply for funding, potential projects should include industrial research and experimental development or experimental development only and they should have a total budget between 2 and 30 million PLN. The expected contribution by this funding program is 50% of eligible costs for industrial research and 25% of eligible costs for experimental development.

Sweden – Västra Götaland Region

Current status: Barriers and opportunities

The Swedish Region of Västra Götaland has 49 Municipalities ranging from 5,000 to 500,000 inhabitants, where more than 110 block and district heating plants are operating. Their main heat source is solid biomass (wood chips, forest and wood industry residues, briquettes, pellets, etc.). Other energy sources used are waste heat from incineration plants and industrial factories and natural gas, while only a few examples of heat pumps exist. Oil is used only to cover peak loads.

The starting situation for SDH is therefore not a very easy one: DH is already well known and established and there is no need for replacing fossil fuels due to the large use of biomass. Furthermore, energy performance of buildings is based exclusively on the amount of delivered energy, not taking into account the RES share in this energy.

However, opportunities can be found in the local pollution and the air quality issue due to biomass combustion, in the savings in fuel and transportation costs if part of the load is covered by solar and in potential improvements in the biomass boiler efficiency due to the synergy with solar thermal. Many DH plants have often only one boiler that runs all year around, sometimes even without a buffer storage tank, thus implying that the boiler operates at a very low capacity (and with low efficiency) during the summer months, when the heat demand is low. A combination with a SDH plant equipped with a storage would then increase the overall operational efficiency.



The map of Västra Götaland Region

Another opportunity lies in the fact that the majority of DH companies aim at increasing their RES share. In order to exploit these opportunities, one key point is to show reliable system operation for the SDH plant, to overcome the common “don’t touch my plant” attitude: If the biomass boiler is working well, then there should be strong reasons behind the introduction of a new energy source. An additional aspect regards the SDH economics which must demonstrate the viability of such initiatives, maybe also through an investment support for pilot plants. However, business plans for SDH may be hampered by the low cost for bioenergy, due to the large amounts of available local resources.



The Vallda Heberg DH plant

Strategy and action plan

The Region, through the Department of Environment, has set up a stakeholder group as a sub-group of the ongoing regional project “Smart Energy”. This group has already met two times and, during the SDHp2m project, it will meet twice a year.

The main involved stakeholders are the municipalities that own and operate the majority of the block and district heating plants in the region, as well as the Swedish District Heating Association (Svensk Fjärrvärme), especially their regional members, and the Solar Energy Association of Sweden (Svensk Solenergi).

The main outcome expected by the group activities and by the regional action plan is to explore the possibility of complementing small wood chip or wood briquette boilers, with a size between 4 and 30 MW, with a solar collector array and, if not present yet, with a heat storage. The focus will be on this kind of plants since there lies the major potential for optimizing the system efficiency by reducing the partial load operation of the boiler.

Pellet boilers look less interesting as they usually perform quite well in different load conditions.



The Ellös DH plant

The feasibility studies which will be carried out also take into account the chance to lower the return temperatures, as well as the need for finding suitable areas for solar collector installation. These analyses will also consider planned boiler replacements and extensions of the DH networks.

On the basis of these characteristics, about 10 potential candidates for demonstration SDH plants were identified and the first studies will be carried out for Herrljunga (6 MW), Vara (10 MW), Tibro (19 MW) and Töreboda (20 MW).

Further feasibility studies will then be performed based on the technical conditions and on the interest shown by the local plant owners.