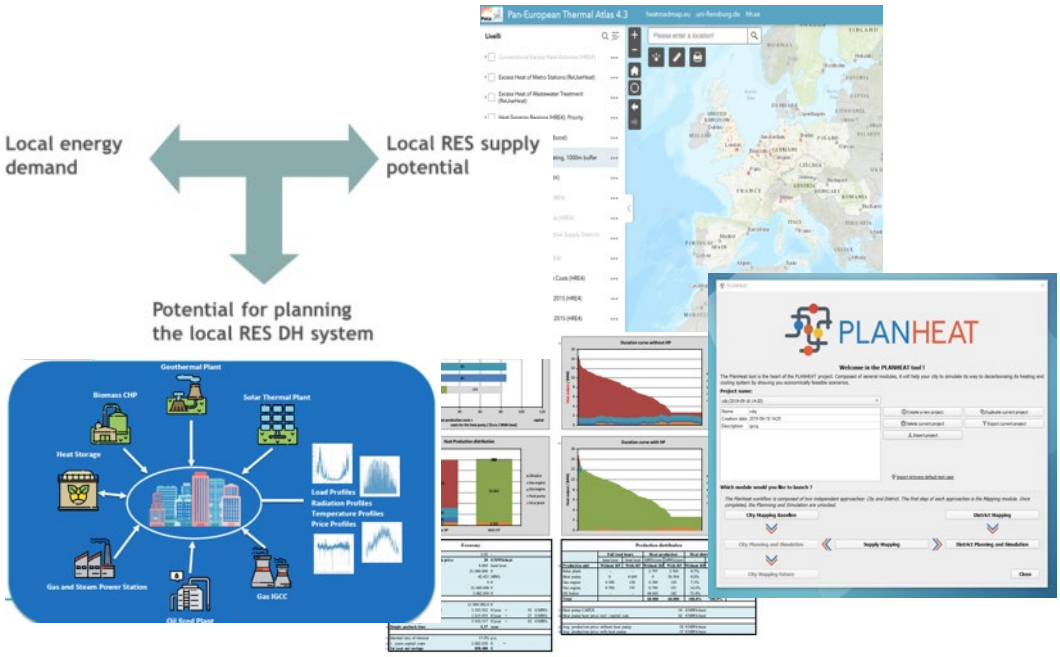
RES DHC

Renewable Energy Sources for District Heating and Cooling

Transformation of existing urban district heating and cooling systems from fossil to renewable energy sources

Renewable Energy Sources in District Heating and Cooling

# Factsheets of available tools

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## 1. INTRODUCTION

Within the RES-DHC project, stakeholders in the 6 pilot areas will foster the market development for renewables in district heating and cooling networks.

For reaching this objective, they could also benefit from a number of already existing tools on the topic of DHC (District Heating and Cooling) by RES (Renewable Energy Sources), often developed within the framework of other European projects. Therefore, one of the RES-DHC activities is the collection and systematisation of these tools, which are listed and described in this document.

The choice of the tools to be included in this deliverable was made basing on different criteria:

- Specific tools related to RES-DHC and not more general tools, for example on energy planning.
- A wide variety of typologies for the tools, such as planning, design, policy, training, etc.
- Different categories of target groups (policy makers, professionals, district heating sector, etc.).
- Suggestions from RES-DHC project partners.
- Specific needs and requests by the RES-DHC pilot areas, also discussed within the Regional Stakeholder Advisory Groups.
- Preferably non-commercial tools.

Regarding the last point, commercial tools which can be useful for working on RES by DHC were anyway summarised in the Appendix.

## 2. TOOLS: LIST AND CHARACTERISTICS

The following table summarises the key characteristics of the tools included in this document.

| NUMBER | NAME OF TOOL | TYPOLOGY | LANGUAGE | TARGET GROUPS | LINK |
|---|---|---|---|---|---|
| 1 | POTENTIAL FOR RENEWABLE HEATING AND COOLING (ENTRAIN) | Guidelines | English | Public administrations, project developers | https://www.interreg-central.eu/Content.Node/ENTRAIN/Guidelines-for-evaluation-of-renewable-heat-potential-%5bENG%5d.pdf |
| 2 | COUNTRY HEAT MAPS AND ATLASES (HEAT ROADMAP EUROPE) | Map | English | Ministries, associations of DH operators, networks of cities and regions | https://heatroadmap.eu/maps/ |
| 3 | ONLINE PACKAGE FOR VIRTUAL STUDY TOURS (ENTRAIN) | Videos | Various | Mayors and other representatives of Municipalities, Regions and other Public Authorities, district heating utilities and experts, renewable energy professionals, consumer associations, environmental NGOs | https://www.interreg-central.eu/Content.Node/ENTRAIN/Study-tours.html |
| 4 | ECONOMICS OF HEAT PUMPS IN DISTRICT HEATING | Calculation tool | English, Danish (full document with instructions in Danish) | Utilities, technical personnel of Local Authorities | https://www.danskfjernvarme.dk/groen-energi/projekter/drejebog-om-store-varmepumper |
| 5 | OPEN SOURCE TOOL FOR MAPPING AND PLANNING OF ENERGY SYSTEMS (HOTMAPS) | Calculation tool | English | Public administrations, energy agencies, planners, district heating and renewable energy associations | https://www.hotmaps.eu/ |

| | | | | | |
|---|---|---|---|---|---|
| 6 | QUALITY MANAGEMENT SYSTEM FOR RENEWABLE DISTRICT HEATING (ENTRAIN) | Documents | English, Croatian, German, Italian, Polish, Slovenian | Regulatory bodies, Ministries, regional administrations, energy agencies, technical managers of the utilities, designers and planners | https://www.interreg-central.eu/Content.Node/ENTRAIN.html |
| 7 | SOLAR DISTRICT HEATING – PLANT DATABASE | Database | English | Researchers, technical personnel of Municipalities, utilities, ESCOs, engineering companies and single professionals | https://www.solar-district-heating.eu/en/plant-database/ |
| 8 | PERFORMANCE ASSESSMENT OF DHC SYSTEMS (WEDISTRICT) | Document | English | Researchers, technical personnel of the utilities, local, regional and national authorities | https://www.wedistrict.eu/new-publication-performance-assessment-of-district-energy-systems-with-common-elements-for-heating-and-cooling/ |
| 9 | THERMOS SOFTWARE | Calculation tool | English | Planners, utilities and university researchers | https://www.thermos-project.eu/thermos-tool/tool-access/ |
| 10 | Solar District Heating in cities | Guidelines | English, Bulgarian, French, Italian, Polish | Managers of utilities, policy makers at the local, regional and national levels, planners | https://www.solar-district-heating.eu/wp-content/uploads/2018/05/20171116-3-SDHp2m_Implementation-of-SDH-in-Cities-with-DH_27.11.2017.pdf (English version) |

**Table 1: Characteristics of the tool**

## 3. TOOL 1: POTENTIAL FOR RENEWABLE HEATING AND COOLING (ENTRAIN)

### The tool at a glance

Within the framework of the ENTRAIN project, supported under the Interreg Central Europe programme, specific guidelines were prepared for assessing the potential for exploiting renewable energy sources for heating and cooling, with a special focus on district heating networks. The scope of such a potential assessment could be at different scales: local, regional or even national.

The tool is available for free here.

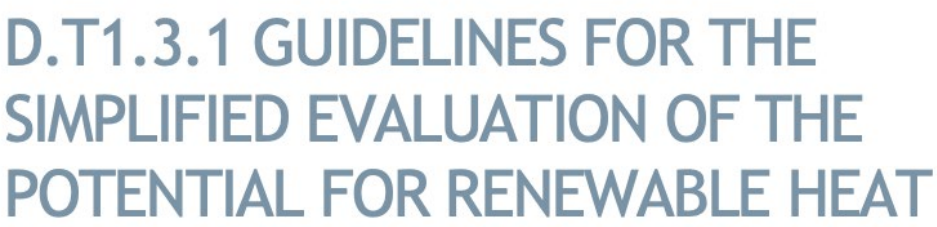




**Figure 1: Front cover of the guidelines**

### Tool description

The potential guidelines aim at supporting, and at the same time motivating, potential stakeholders and local communities to seek better and more efficient solutions to meet local heat demand. The purpose is not to provide a comprehensive methodology for performing a detailed assessment but rather to give an overview of the necessary information prior to deciding on the investments and initiating projects.

For each one of the key topics of the guidelines (heat demand, heat supply, external aspects), the main questions which should be answered for carrying out a good potential analysis are presented, together with a list of tools and references, collected from a number of projects and publications.


**Figure 2: The basic scheme of the guidelines**

A thorough analysis of energy supply and demand in the targeted area lays the foundation for further planning of renewable DH system. Initial energy balance in the targeted areas helps to identify the needs of the communities, as well as to evaluate potential solutions to the current state. Therefore, guidelines for determining heat demand and supply are given as the primary steps of such evaluation.

In the heat demand step, additional attention is given to the territorial aspect of the target area, i.e. climate of the area, urbanisation, industrial areas, which all provide important elements to consider when planning the DH systems. Heat supply step provides an overview of the locally available renewable energy sources (biomass, solar heat, geothermal, waste heat and heat pumps) each with a set of questions, which can help determine the potential for each in the target region.

Finally, the last step of the evaluation is combining the inputs and insights gathered in the two previous phases in order to reach some conclusions on the potential for using DH from renewables in the target area.

The reader may also be interested in having a look at the potential reports, also developed within ENTRAIN, on the renewable heat potential in the 5 pilot areas in the project (in DE, HR, IT, PL and SI). The reports are available here, under the 'TARGET REGIONS' section.

### Target groups

This tool is mainly addressing public administrations at different levels, such as Municipalities, Regions, Provinces, National Ministries, etc.

Furthermore, it could be used by local stakeholders (for example DH project developers) for assessing the DH potential at a smaller scale (urban regeneration for a single district or block, heat supply for a small suburb, etc.).

## 4. TOOL 2: COUNTRY HEAT MAPS AND ATLASES (HEAT ROADMAP EUROPE)

### The tool at a glance

The Horizon 2020 funded Heat Roadmap Europe project developed a set of tools basically divided into two main sections:

- An interactive map providing a variety of resources for heat planning in 18 EU countries.
- A Pan-European Thermal Atlas reporting, for 14 EU countries, the heat demand density for performing potential analysis.

The tools are available for free here.


**Figure 3: A screenshot of the interactive map**

### Tool description

This set of tools was developed mainly within the Heat Roadmap Europe project, supported within the Horizon 2020 programme.

The goal is to provide stakeholders, especially at national level, with useful resources to evaluate the potential for renewable district heating and cooling as well as to create strategies for market development. The main difference with the previous tool, therefore, is the wider scope of the analysis, shifting from the local or regional scale to the national level.

First of all, the set of tools includes an interactive map with a variety of resources related to 18 EU countries: Atlases, maps, country presentations, roadmaps and other sources of information useful for heat planning (see, in the screenshot below, the example for Italy on the list of the available resources).


**Figure 4: An example: The list of resources available for Italy**

The second part of the set is a Pan-European Thermal Atlas (PETA), now available in its 4.3 version here. This atlas reports, for the 14 EU countries included in the analysis, heat density maps. Although the resolution is 100 m grid size, the atlas authors warn that the confidence level of the actual values on this scale is too low. Therefore, when looking at small scales, the heat demand figures can be only indicative, while a better level of confidence can be expected for larger resolutions, for example 1 km.

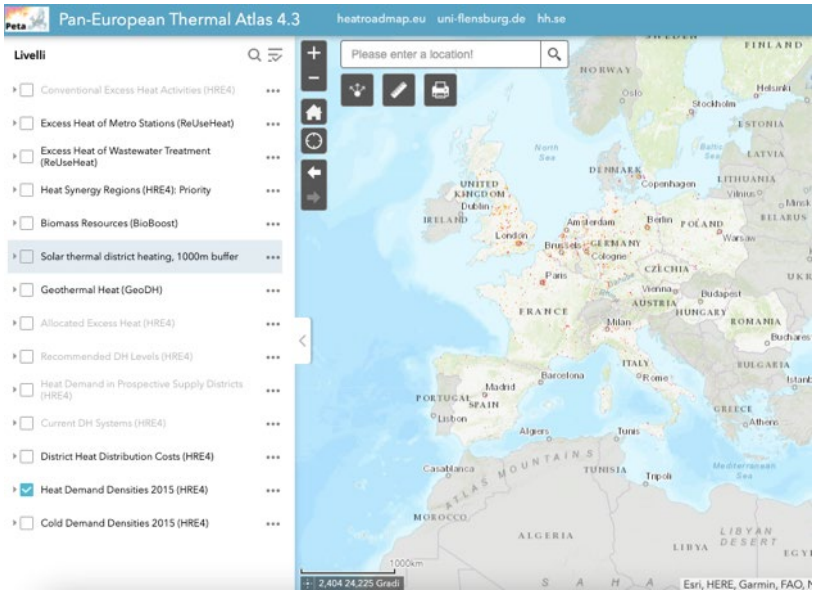



**Figure 5: A screenshot of PETA4**

Finally, a version 5.1 of the PETA was also developed containing, at the moment, preliminary data which are subject to validation.

**Target groups**

Given the scale of the available data and of the analysis, the Heat Roadmap Europe set of tools is mainly targeting key stakeholders of the district heating market operating at national level, therefore including, for example, Ministries, associations of DH operators, networks of cities and regions, etc.

## 5. TOOL 3: ONLINE PACKAGE FOR VIRTUAL STUDY TOURS (ENTRAIN)

### The tool at a glance

This tool, developed within the ENTRAIN project, offers an online collection of videos, from all over Europe, on district heating and cooling networks run on renewable energies.

The tool is available for free here.

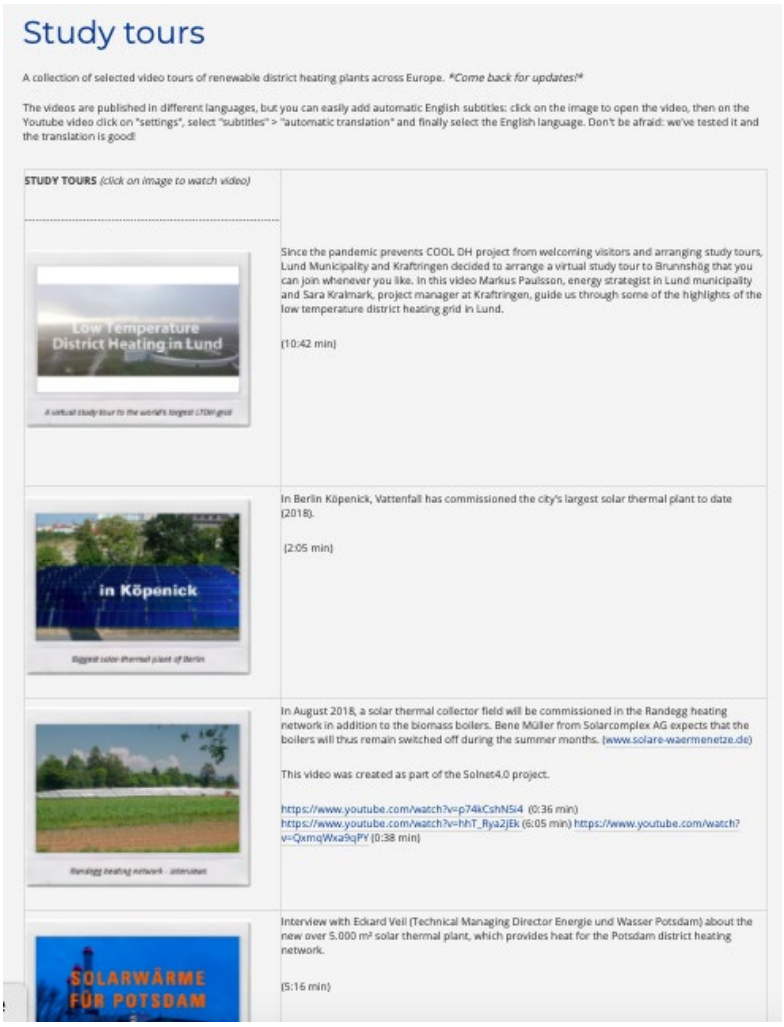



**Figure 6: Partial screenshot of the webpage on virtual study tours**

## Tool description

The idea of this virtual package was born soon after the COVID-19 pandemic, since this sudden emergency prevents many projects, initiatives and single DH operators from welcoming visitors and arranging study tours.

It includes, at the moment, 10 examples in Europe of district heating systems using different solutions with renewables, namely solar thermal, biomass, waste heat, etc. The videos usually report not only the technical details of the heating plant and of the connected network but also the story of how the project was initiated, which where the barriers to be overcome, the opportunities to be exploited, etc.

The number of available videos, however, will constantly grow since the package is being continuously updated.

In many cases, furthermore, you can hear directly from the stakeholders involved in the project, such as DH utilities, Mayors of the Municipalities, citizens as users of the system, etc.

The videos are published in different languages but, since they are all available on YouTube, automatic English subtitles can be easily added just by clicking on the image to open the video and then, on the YouTube video, by clicking on "settings", selecting "subtitles" > "automatic translation" and finally selecting the English language.

## Target groups

The virtual package is addressing all stakeholders who want to learn about how renewables are used in practice for supplying district heating and cooling systems.

Therefore, the targeted recipients belong to a wide variety of actors: Mayors and other representatives of Municipalities, Regions and other Public Authorities, district heating utilities and experts, renewable energy professionals, consumer associations, environmental NGOs, etc.

## 6. TOOL 4: ECONOMICS OF HEAT PUMPS IN DISTRICT HEATING

### The tool at a glance

This tool, developed by the Danish Energy Agency, allows to perform an initial and simple calculation of the economics of electrically driven heat pump projects in district heating.

The original tool in Danish is available for free here. Within the RES-DHC project, the Excel spreadsheet was translated in English and coupled with a short document summarising the instructions for filling in the sheet.

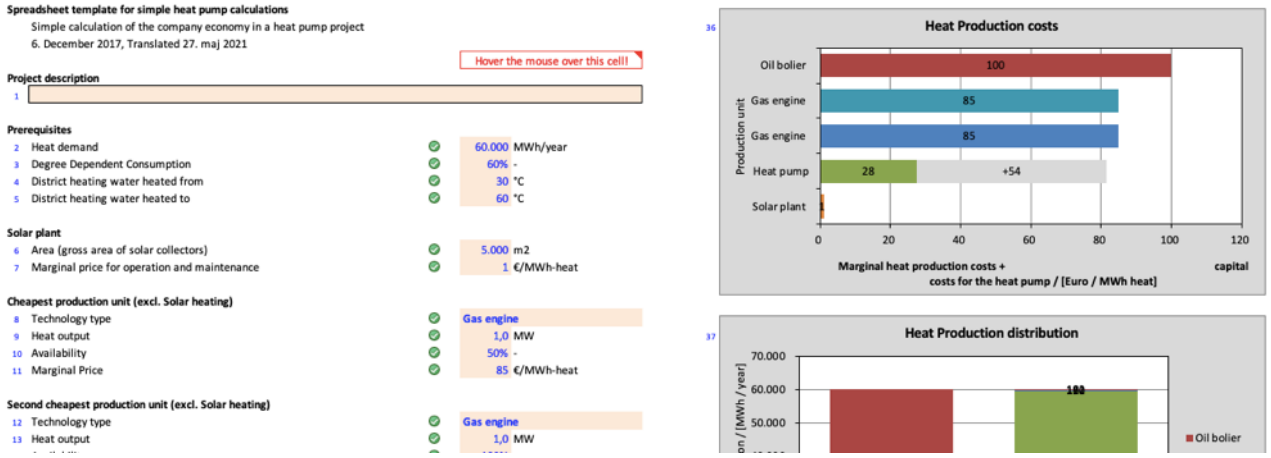



**Figure 7: Partial screenshot of the tool spreadsheet**

### Tool description

In connection with the document "Guide to large heat pump projects in district heating", the Danish Energy Agency also developed a spreadsheet-based tool, which can be used for a simple calculation of the economics of electrically driven heat pump projects in district heating.

First of all, it should be stressed that the actual economics of a project may differ significantly from the tool outcomes. It should be used, therefore, only at an initial stage of a project and the calculated results should always be validated through other studies before being used for investment decisions.

The spreadsheet, developed in Microsoft Excel, consists of one tab. It is recommended to zoom the spreadsheet so that the whole tab can be seen on the screen.

The purpose of the spreadsheet is to calculate the cost-effectiveness of a heat pump project in an already existing heating plant, which can consist of up to four different production units, one of which is a solar heating plant.

The calculation is based on user-based inputs in the 35 sand-coloured cells on the left side of the user interface. The calculation results are shown in the four graphs on the right side of the interface, as well as in the light blue tables.


**Figure 8: Graphs and tables showing the calculation results**

It is recommended that, before calculating a project example through this tool, the user read carefully all the details reported in the document “Spreadsheets instructions for simple heat pump calculations“.

## Target groups

Due to the expertise and competencies needed to fill in the spreadsheet correctly, this calculation tool is mainly addressing technical actors dealing with district heating as, for example, utilities or technical personnel of Local Authorities in charge of a first evaluation of the economic feasibility of a project.

## 7. TOOL 5: OPEN SOURCE TOOL FOR MAPPING AND PLANNING OF ENERGY SYSTEMS (HOTMAPS)

### The tool at a glance

The HotMaps project developed a toolbox to support interested stakeholders in strategic heating and cooling planning at local, regional and national levels, in line with European energy policies.

The toolbox is accessible for free here.

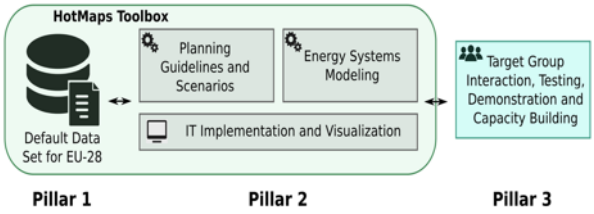



**Figure 9: The concept of the HotMaps toolbox**

### Tool description

The HotMaps toolbox is an open source software, for studying the integration of RES in DH by providing datasets, as well as tools for estimating demand reduction scenarios and analysing dispatch and related performance indicators for various supply portfolios under different conditions.

Another feature of this tool is that it is user-driven since it was developed, within the HotMaps project, in collaboration with 7 pilot areas. Furthermore, the scope of the tool is very wide, being applicable to all cities and other areas in EU-27 + the UK.

The tool provides the users with a large array of open source data sets for EU-27 countries + the UK, including many different layers, such as energy supply sources (geothermal, solar thermal, municipal solid waste, etc.), load profiles (residential loads for both space heating and domestic hot water, industrial energy needs, etc.), economic information (fuel costs, technology costs, electricy price scenarios, etc.), etc.

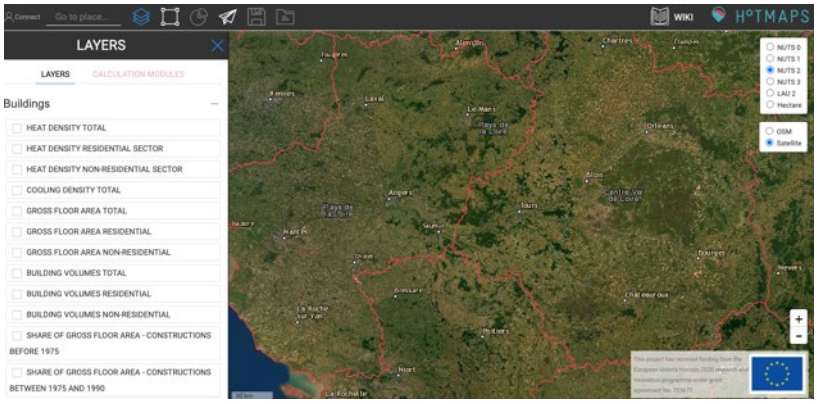



**Figure 10: Screenshot of the tool in use**

HotMaps also features a DH dispatch model available in three different versions. This model, accessible in the online browser tool via the “Calculation Modules” button, allows to look into the details of the demand side and to perform hourly-based calculation. It is possible to project the future heat demand based on scientific data on demographic and energy efficiency effects. It is also suitable for studies and analyses on both sector coupling and temperature levels in the DH networks.

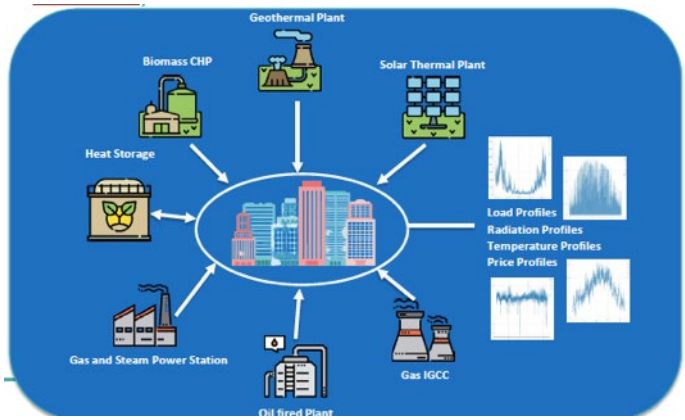



**Figure 11: The HotMaps district heating dispatch model**

### Target groups

The key beneficiaries of this tool are the main actors in strategic heating and cooling planning, namely public authorities at different levels, energy agencies and planners, as well as other interested and relevant stakeholders, such as district heating and renewable energy associations.

While some features such as the heat demand and potential analyses are simple to use, the calculation modules require more skilled knowledge of the topic.

## 8. TOOL 6: QUALITY MANAGEMENT SYSTEM FOR RENEWABLE DISTRICT HEATING (ENTRAIN)

### The tool at a glance

The application of the quality management system “QM Heizwerke” can allow a more efficient realisation and operation of DH systems, thus ensuring a better quality of the service and low heat prices for the consumers.

All the details on this tool are available here, under the “QM TOOLBOX” section.

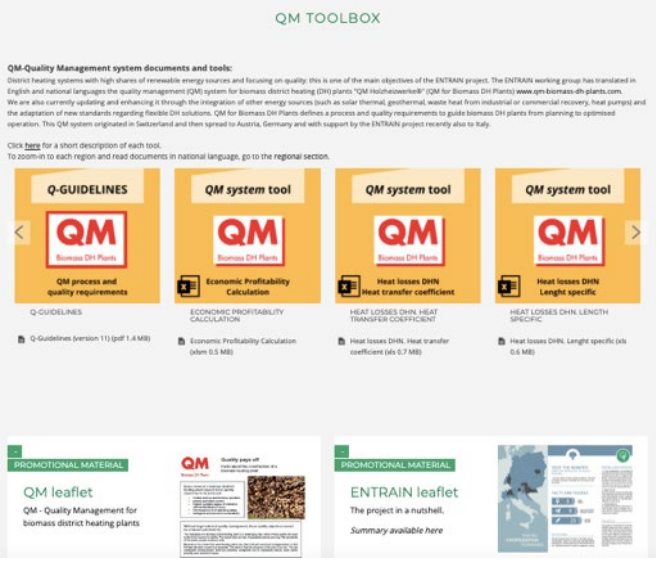



**Figure 12: Screenshot of the “QM TOOLBOX”**

### Tool description

The QM system was born as a quality management system, known as “QM Holzheizwerke”, as a collaboration between Austria, Germany and Switzerland to improve the quality of district heating systems run on biomass.

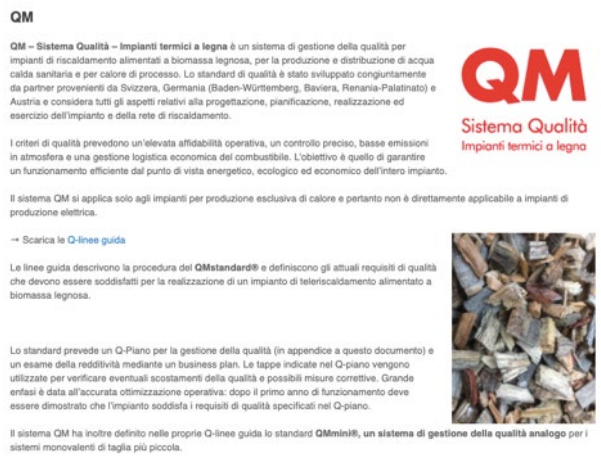
Later, thanks to the work done within the ENTRAIN project, the key documents and tools of the QM systems were translated first in English and then in the national languages of the project pilot areas in (Croatian, Italian, Polish and Slovenian).

One more action, carried out within the ENTRAIN framework, was the extension of the quality system from biomass only to all the potential renewable energy sources, including the recovery of waste heat, which can be used to feed DH systems.

Compliance with the QM system allows to reach several key objectives at the same time, namely reliable and low-maintenance operation, precise and stable system control, highest possible degree

of utilisation and low distribution losses, low emissions in all operating states and, finally, ecological and economic sustainability.

The QM TOOLBOX, freely available online, includes several documents and spreadsheets in English: The QM guidelines (describing the process and the quality requirements), the economic profitability calculation tool, two different tools for estimating heat losses, an information sheet on measurement equipment and, finally, a QM informative leaflet describing the key features and benefits of this quality system.


QM

**QM – Sistema Qualità – Impianti termici a legna** è un sistema di gestione della qualità per impianti di riscaldamento alimentati a biomassa legnosa, per la produzione e distribuzione di acqua calda sanitaria e per calore di processo. Lo standard di qualità è stato sviluppato congiuntamente da partner provenienti da Svizzera, Germania (Baden-Württemberg, Baviera, Renania-Palatinato) e Austria e considera tutti gli aspetti relativi alla progettazione, pianificazione, realizzazione ed esercizio dell'impianto e della rete di riscaldamento.

QM
Sistema Qualità
Impianti termici a legna

I criteri di qualità prevedono un'elevata affidabilità operativa, un controllo preciso, basse emissioni in atmosfera e una gestione logistica economica del combustibile. L'obiettivo è quello di garantire un funzionamento efficiente dal punto di vista energetico, ecologico ed economico dell'intero impianto.

Il sistema QM si applica solo agli impianti per produzione esclusiva di calore e pertanto non è direttamente applicabile a impianti di produzione elettrica.

→ Scarica le Q-linee guida

Le linee guida descrivono la procedura del **QMstandard®** e definiscono gli attuali requisiti di qualità che devono essere soddisfatti per la realizzazione di un impianto di teleriscaldamento alimentato a biomassa legnosa.

Lo standard prevede un Q-Piano per la gestione della qualità (in appendice a questo documento) e un esame della redditività mediante un business plan. Le tappe indicate nel Q-piano vengono utilizzate per verificare eventuali scostamenti della qualità e possibili misure correttive. Grande enfasi è data all'accurata ottimizzazione operativa: dopo il primo anno di funzionamento deve essere dimostrato che l'impianto soddisfa i requisiti di qualità specificati nel Q-piano.

Il sistema QM ha inoltre definito nelle proprie Q-linee guida lo standard **QMmini®, un sistema di gestione della qualità analogo** per i sistemi monovalenti di taglia più piccola.

**Figure 13: The Italian page of the QM system, run by the energy agency of Friuli-Venezia Giulia**

### Target groups

The QM system aims at reaching two different group of stakeholders, depending on the phase of its application.

As a matter of fact, such a system could really help in improving the quality of the DH sector at national or regional level and, therefore, it could be introduced as a compulsory system or as a voluntary one, possibly linked to the granting of incentives for the realisation of a new DH system (as well as for its extension or revamping), as happens at the moment for example in Austria. From this point of view, then, the target groups of this tool are the national or regional authorities regulating the sector and the related incentives (regulatory bodies, Ministries, regional administrations, energy agencies, etc.).

Once in use, then, the system targets mainly technical subjects in charge of developing DH project, such as technical managers of the utilities, designers and planners of biomass heating systems, etc.

## 9. TOOL 7: SOLAR DISTRICT HEATING – PLANT DATABASE

### The tool at a glance

This database presents the basic data for several solar district heating plants in many different countries.

The tool is accessible for free here.

Ranking List Overview

Column visibility | CSV | Excel | PDF | Print

Country

Search:

| Plant | Operation start | Owner | Country | City | Apert. area in $m^2$ | Capacity in $kW_{th}$ |
|---|---|---|---|---|---|---|
| Fjärås Vetevägen | | | | | | |
| Åsa | 1985 | EKSTA Bostads | Sweden | Åsa | 1 030 | 721 |
| Kullavik | 1987 | EKSTA Bostads | Sweden | Kullavik | 1 185 | 830 |
| Ry | 1988 | Ry Varmeværk | Denmark | Ry | 3 040 | 2 128 |
| Saltum | 1988 | Saltum Fjernvarme | Denmark | Saltum | 1 005 | 704 |
| Tubberupvænge | 1991 | Herlev Boligselskab | Denmark | Herlev | 1 030 | 721 |
| Odensbacken | 1991 | Örebro Energi | Sweden | Odensbacken | 1 000 | 700 |
| Säter | 1992 | Säter Energi | Sweden | Hedemora | 1 250 | 875 |
| La Cité Solaire | 1995 | Plan-les-Ouates | Switzerland | Plan-les-Ouates | 1 668 | 1 200 |

**Figure 14: A screenshot of a part of the database**

### Tool description

The database includes basic information on 195 solar district heating plants in operation in many different countries. The set of data includes: Name of the plant, year of operation start, owner, Country, city, aperture area of the solar collector field (in $m^2$) and thermal capacity (in $kW_{th}$).

The database can be downloaded as both a sheet (CSV or Excel) or a pdf file.

### Target groups

The database is especially targeting technical stakeholders, such as researchers, technical personnel of Municipalities, utilities, ESCOs, engineering companies and single professionals.

## 10. TOOL 8: PERFORMANCE ASSESSMENT OF DHC SYSTEMS (WEDISTRICT)

### The tool at a glance

This tool is rather a methodology, summarised in a detailed scientific paper, for calculating different DHC key performance indicators (KPIs), distinguishing between heating and cooling ones.

The paper is described and downloadable for free here.

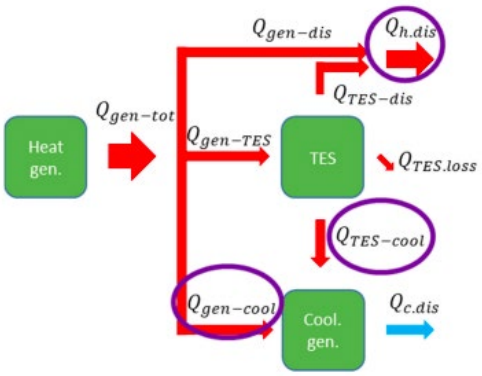



**Figure 15: Heat fluxes in the proposed methodology**

### Tool description[1]

The assessment of a DHC system is challenging when the same equipment or system elements are used for purposes of producing heating and cooling, either simultaneously or alternatively. This is particularly the case for complex systems, which involve different energy sources and technologies in a single district energy system.

Many components of such a system may be used for both heating and cooling: Reversible heat pumps, heat generation or recovery applied to thermally driven cooling technologies, geothermal probes coupled with ground source heat pumps, photovoltaics, etc. Moreover, a growing endeavour of energy vector coupling, including renewable heat, electricity, green hydrogen, and syngas, is going to lead to even more complex district energy systems.

As for now, there is no comprehensive methodology for performance analysis of combined DHC systems. This paper, therefore, proposes a methodology for calculating different DHC key performance indicators (KPIs), distinguishing between heating and cooling ones. A total of 11 indicators

[1] Text slightly edited from the original one, available at https://www.wedistrict.eu/new-publication-performance-assessment-of-district-energy-systems-with-common-elements-for-heating-and-cooling/

are organised under four categories: Energy, environment, economy and socio-economy. The methodology proposes demand-based and investment-based share factors that facilitate the heating and cooling KPI calculation.

**Target groups**

Given its very technical and scientific approach, this tool / paper is addressing researchers working on DHC and technical personnel of the utilities.

However, as a second priority, this methodology for DHC performance evaluation could be also used in support schemes managed by local, regional and national authorities and, therefore, though indirectly, they could also be regarded as target groups of this tool.

## 11. TOOL 9: THERMOS SOFTWARE

### The tool at a glance

This free online tool aims at helping to accelerate the decarbonisation of heating and cooling networks by supporting engineers, planners and other actors to create and optimise low-carbon heating and cooling solutions.

The geographical scope of the tool is worldwide.

The tool is accessible for free here.


**Figure 16: The software logo**

### Tool description[2]

THERMOS has been developed by the EU-funded project by the same name. The project software version (version 8) is freely available as an open-source code.

THERMOS main features include:

- Network optimisation model for identifying a cost-optimal network design; Users can estimate energy output or cost over time through different demand profiles and tariffs.
- OpenStreetMap for easy map creation and analysis or the possibility to upload own GIS data.
- Tool for generating heat and cold maps.
- Demand estimation method operating with limited data input in any location.
- Representation of variable pipe and dig costs and network heat losses.
- Incorporation of capital costs for plant, pipes and connection, set against revenues from heat sales and monetised emissions.
- Interoperability with GIS formats for model results and map export.
- Nearly comprehensive documentation of data requirements and model operation.
- Network supply model, for a more detailed modelling of the heat supply.

[2] Text slightly edited from the original one, available at https://www.thermos-project.eu/thermos-tool/tool-access/

### Target groups

The THERMOS software has, as first target group, technical actors in the field of DHC, such as planners, utilities and university researchers.


**Figure 17: A video tutorial of THERMOS**

## 12. TOOL 10: SOLAR DISTRICT HEATING IN CITIES

### The tool at a glance

These guidelines describe the implementation of solar district heating integrated in existing district heating systems in cities.

This tool, therefore, is not including all renewable energy sources in DHC but it rather focuses on solar thermal only.

The document is downloadable here, searching in the database for “SDH in cities”. Alternatively, the English version of the guidelines is directly accessible here.

### Tool description[3]

The manual describes the steps for integrating medium and large-scale solar thermal plants in existing district heating (SDH) systems in cities.

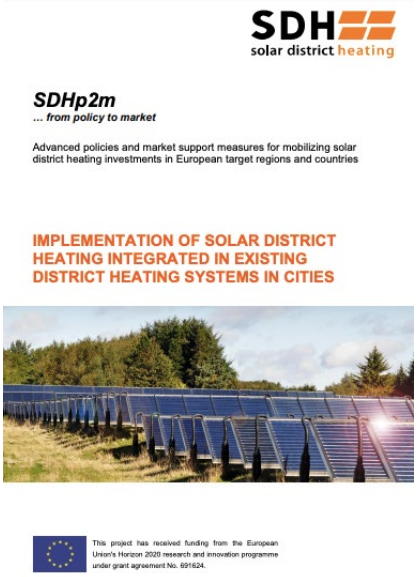



**Figure 18: The cover of the SDH guidelines**

When starting SDH projects in existing district heating there are two key problems. The first one is that the summer load, that is when the solar output is higher, is normally already produced by the utility through power production or other sources of excess heat.

[3] Text slightly edited from the document introduction.

The second barrier is that it is often difficult and sometimes expensive to find areas where to place the solar collectors.

Of course, that does not mean that it is impossible to integrate SDH in cities, especially because more and more cities want to change their heat supply from fossil fuels to RES. In order to reach this goal, for instance, DHC systems often need to have thermal storages in place and, in that case, large SDH plants can play a role, as they are one of the cheapest heating technologies.

These guidelines are divided into development steps following the decision-making process. After each step, a decision has to be made by the process stakeholders whether or not to continue the process, basing this decision on economic, social and logistic parameters.

**Target groups**

This manual is targeting both technical actors and decision makers such as, for example, managers of utilities, policy makers at the local, regional and national levels, planners, etc.

## 13. APPENDIX: LIST OF COMMERCIAL TOOLS

The table below summarises some of the most well-known commercial tools and pieces of software which can support the work on DHC by RES.

| NAME OF TOOL | SYNTHETIC DESCRIPTION | LINK |
|---|---|---|
| Sympheny | Optimal energy supply solutions. | https://www.sympheny.com/ |
| Dymola | Modelling and simulation of integrated and complex systems. | https://www.3ds.com/products-services/catia/products/dymola/ |
| IDA-ICE | Wwhole-year detailed and dynamic multi-zone simulation application for study of thermal indoor climate as well as energy consumption of entire buildings. | https://www.equa.se/en/ida-ice |
| EnergyPro | Modelling complex energy projects with combined supply of electricity and thermal energy (process heat, hot water and cooling). | https://www.emd.dk/energypro/modules/ |

**Table 2: List of some commercial tools**