

THE HOTMAPS TOOLBOX

supporting strategic heating
& cooling planning at local level

HOTMAPS

The Heating and Cooling Open Source Tool for Mapping and Planning of Energy Systems

www.hotmaps-project.eu

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INTRODUCTION

Many cities and regions are currently preparing ambitious climate and energy

strategies and action plans, committing to net-zero carbon by 2050. In November 2018, the European Commission presented its strategic long-term vision for climate neutrality by 2050: "A Clean Planet for all". Decarbonisation of the heating and cooling sector plays a major part in the plan: the largest share of energy consumption in cities (where 75 % of the EU population live) is used for heating and cooling.

Phasing out fossil fuels from the energy system will bring three main advantages: it will reduce greenhouse gas (GHG) emissions, improve the security of supply and positively affect the commercial balance (which at local level means an increase of job opportunities). However, achieving a 100% renewable energy system, and in particular a fossil-free heating and cooling supply, requires strategic planning. New technical, regulatory and governance frameworks are necessary to transition to a more sustainable and green system.

The aim of strategic energy planning, including heating and cooling planning, is to promote the transition to a more flexible integrated energy system with focus on energy efficiency and renewable energy. In most European cities and regions, there is a need to better identify, analyse and map resources and solutions to make energy demand more efficient on one hand and to meet the demand with efficient, cost-effective and greener energy sources on the other hand.

The Hotmaps project addresses this challenge. Leading research institutions in Europe¹ developed a website that allows you to discover in just 5 minutes an estimate of heating and cooling demand in your region and the potential of local renewable energy to cover this demand.

By uploading data that are more detailed and applying Hotmaps calculation modules, you can elaborate comprehensive heating and cooling strategies for your area of interest². Hotmaps can help cities to reach their climate and energy objectives, become greener and more liveable.

HOTMAPS: A TOOLBOX TO DISCOVER YOUR CITY'S CLIMATE-NEUTRAL ENERGY FUTURE!

¹ TUWien Energy Economics Group – Technical University Vienna; Hes.so – University of Applied Sciences and Arts Western Switzerland; eurac – Institute for Renewable Energy; eThink – Energy Research; PlanEnergi; Aalborg University Department of Planning.

² This publication will focus on the use of the toolbox to plan at local level. However, Hotmaps can also be used to identify potentials and strategies at national level. https://github.com/HotMaps/hotmaps_wiki/wiki/en-GL-national.

The toolbox was developed together with cities, to make sure Hotmaps is useful for local authorities and city planners. Seven European pilot areas have been successfully testing it, to develop their heating and cooling strategies: Aalborg (Denmark), Bistrita (Romania), Frankfurt (Germany), Geneva (Switzerland), Kerry County (Ireland), Milton Keynes (UK) and San Sebastián (Spain).

This brochure will guide you through strategic heat planning. You will find out how the Hotmaps toolbox works and how it supported the pilot cities in their urban energy planning.

HOTMAPS SOFTWARE

Hotmaps GIS (geographic information system) - based software is

- **Fast:** it provides a quick indication about which direction to go, in order to kick-start a detailed technical planning.
- **Free and open source:** it is available online, no fees. You don't need to install additional tools.
- **Easy to use:** no need to be a GIS expert, the software combines web-based visualisation of GIS data with flexible selection tool. Data are visualised directly on the website.
- **Adaptable:** You can retrieve indicators at various geographical and administrative level. Moreover, you can upload your own data to your account and use it for further analyses.

Thanks to Hotmaps, users can obtain a large-scale vision of the whole territory covered by their city, allowing them to identify energy issues very easily. Hotmaps helps gather all the information required to identify planning priorities for the future and can be used as a decision making tool. It helped cities to bring together all the actors of the energy sector, in order to refine their knowledge of the territory and to share data and analysis.

www.hotmaps.eu

 Pilot areas
 PARTNERS



Kerry County 

Milton Keynes 

Aalborg 
AAU
PLANENERGI 

Frankfurt 
FRAUNHOFER ISI 

ENERGY CITIES 
HES-SO 

Geneva 
CREM 

San Sebastian 

EURAC 

E-THINK
TU WIEN 

Bistrita 

WHAT IS STRATEGIC HEATING AND COOLING PLANNING?

Strategic heating and cooling planning means developing an action plan to achieve a long-term vision of the heating and cooling supply. To get there, there are usually the following steps:

- 1 Analyse the challenges, formulate strategic objectives and identify key parameters;
- 2 Build scenarios based on cost-effective technical solutions from a societal perspective;
- 3 Evaluate existing framework and identify key stakeholders;
- 4 Make an action plan.

preparatory phase

Strategic planning starts with a preparatory phase to analyse challenges of the current heating and cooling system and to define strategic objectives. Reducing GHG emissions and improving the security of supply are probably one of your objectives. However, you can pursue additional targets depending on local and national contexts, such as:



**IMPROVING
AIR QUALITY**



**TAPPING LOCAL
RESOURCES**



**INCREASING
JOB CREATION**



**INVOLVING CITIZENS
AND FOSTERING
CITIZEN OWNERSHIP**



techno- economic scenarios

In this phase, technical solutions are defined, described and evaluated to see whether they can meet the strategic objectives. The following steps can be taken to build heating and cooling supply scenarios:

- 1 | Quantify existing heat demand;
- 2 | Identify the potential of heat sources in the surrounding areas;
- 3 | Assess the potential of energy savings (i.e. determine the future energy demand);
- 4 | Develop first technical scenarios to match energy demand and supply on short-, medium- and long-term basis;
- 5 | Assess the scenarios according to the strategic objectives and a socio-economic perspective, especially the balance between investments in energy savings and in energy supply infrastructures;
- 6 | Iterate steps 4 and 5 to find the best solutions.

When carrying out techno-economic assessment, you should consider the whole energy system and not only the heating and cooling supply. A holistic perspective including the different energy carriers (electricity, gas, heat, cold) and different sectors (industry and transport in addition to buildings) allows identifying synergies and possible bottlenecks of limited resources.

HOW HOTMAPS CAN HELP YOU TO ASSESS DIFFERENT ENERGY SCENARIOS

Hotmaps is a powerful tool to work on heating and cooling planning. It has led pilot cities to test and evaluate different energy scenarios, providing an integral analysis of their energy resources. Users can upload their own city's data and calculate precise energy scenarios. Hotmaps can also provide a set of indicators for these scenarios, allowing you to analyse their economic, financial and technical feasibility. You can see in the figure in the following page how the different calculation modules of the tool allow users to develop energy scenarios.

regulatory framework & governance

To achieve the desired transition, changes in policies and governance are necessary. In this phase, you perform an evaluation of the existing policy framework and identify the key stakeholders. In particular, you should analyse the economic, political and legal barriers and opportunities. These can concern price regulation, ownership and market

organisation at local, national and European levels. There can be regulations depending on the expected actions, regulations applying to the heating sector, to the building sector or to the energy sector in general.

action plan

The action plan will support the implementation of the long-term scenario. Relevant stakeholders (who could implement the heat plan) and planning authorities (who are able to influence the framework conditions) need to be involved. You should identify business models and governance processes to support the transition and achieve the strategic objectives.

THE HOTMAPS TOOLBOX

**OVERCOMING
YOUR HEAT
MAPPING AND
SCENARIOS
DEVELOPMENT
CHALLENGES!**

engineering capacities and data collection

Mapping and quantifying heating and cooling demand and sources is a difficult task: before investing in a long-term heating & cooling solution, access to reliable data is key. The collection and integration of fragmented and often inconsistent data is tedious and time-consuming. It usually requires involving a large number of stakeholders like municipal services, building owners, facility managers, utility companies including transport and distribution system operators, civil groups, industrial companies, social property owners and energy companies.

Assessing locations and energy potential of different energy sources (geothermal, solar thermal, biomass...) also requires engineering capacities, as well as developing techno-economic scenarios. It involves knowledge about different technologies, their technical potential, their environmental impacts and their costs (investment, operational and maintenance costs).

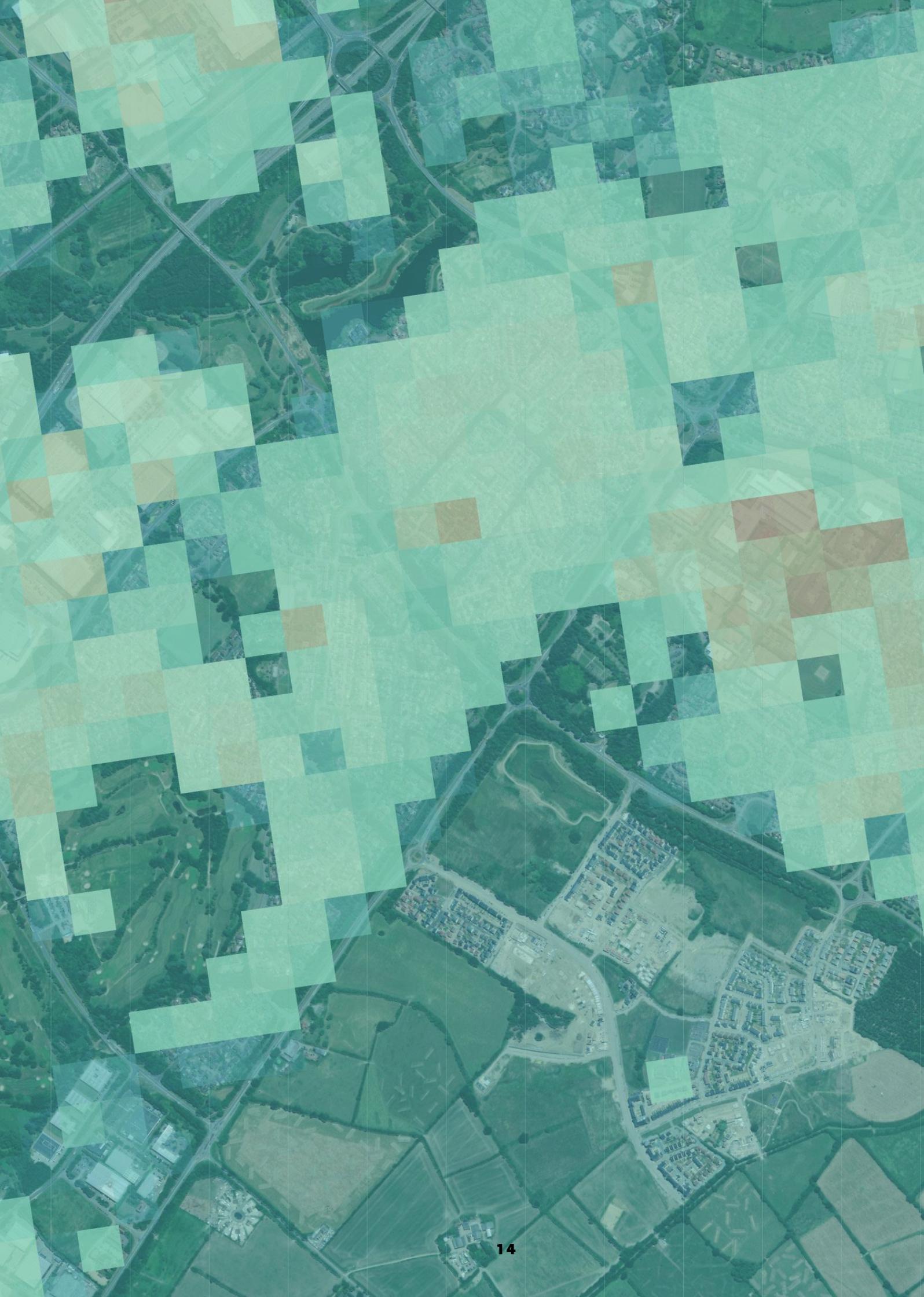
HOTMAPS: AN OPEN DATASET

The Hotmaps team brought together a unique presentation of open source and transparent data, collected at national or, if available, at regional and local levels. Information has been gathered for three different sectors: residential, service and industry.

A comprehensive summary of the data collection process is available¹ and the Hotmaps team is updating the dataset on a regular basis. All datasets are freely accessible and downloadable at <https://gitlab.com/Hotmaps>.

You can download the datasets, edit them and visualise them in the Hotmaps software later. Hotmaps dataset is open, so it can be integrated in other software. On another hand, you can also upload your own datasets in your Hotmaps personal account if you have better information, in order to make simulations that are more precise.

¹ <https://www.Hotmaps-project.eu/d2-3-wp2-report-open-data-set-eu28/>



different levels of heating and cooling planning

Data required for analysis depends on the planning goals. Strategic planning requires data at the city level, ideally with a 100m*100m square accuracy, or even at building level. Yearly energy data for consumption and production can be sufficient to start (although monthly and daily data are better). As well, preliminary models can be based on generic cost information, to analyse macro-options and set strategic directions. For instance, if a city were to be supplied by 100% renewables, understanding the technical potential of local and renewable sources to cover the heating demand would give a framework and set the energy savings goal for buildings.

However, to derive the strategic plan in different actions, you will need more detailed data, such as:

- Information on buildings (individual energy consumption, load profile, type of heating systems, level of insulation, potential for energy production, type of building owner...);
- Existing energy networks (gas, electricity, district heating and cooling networks);
- Urban development and retrofitting projects;
- Natural and artificial barriers and constraints (rivers, protected natural areas, railways and high traffic roads, policies on land use, air pollution, building architecture...).

Feasibility studies will be the last step, to validate assumptions and hypotheses, once concrete projects are defined.

HOTMAPS: A LARGE ARRAY OF DATA SETS

Hotmaps provides a large array of data sets with detailed resolution: from NUTSO data down to LAU2 and even Hectare-level. Default data is available for the entire EU28 and Switzerland, with the aim to support local, regional and national heating and cooling planning.

Hotmaps open source data sets provide information on:

- Building stock;
- Space heating, cooling and domestic hot water demand;
- Climate context;
- Industrial processes;
- Heating and cooling supply;
- Renewable energy sources data collection and potential review;
- Hourly load profiles.

LONG-TERM IMPACT OF HEATING AND COOLING PLANNING: CITIES' INSIGHTS

Where are the Hotmaps pilot cities on their journey to long-term planning?

AALBORG, DENMARK

In certain countries and cities, there is already a long tradition of heat planning. For instance, in Denmark, the oil crisis in the 70s led to the first heat supply act according to which the local city council is responsible for the heat planning. In recent years, the local planning considers the entire energy system, including heating, electricity, transport, etc.

The municipality of Aalborg has recently, in cooperation with Aalborg University and other relevant stakeholders (utility companies, industries, organisations etc.) developed an energy vision for Aalborg 2050: Smart Energy Aalborg. The vision shows that it is possible for the city to be fossil free by 2050. It is implemented via an energy strategy that includes milestones for 2030 and 2040. Aalborg does not yet have a cooling plan, but started planning a district heating and cooling project for the new local hospital.

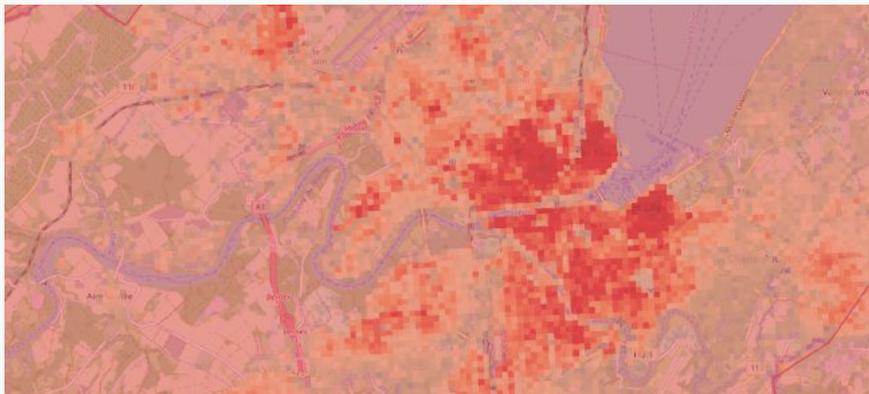
☞ **Thanks to Hotmaps, we have a quick overview of where the heat demand is high enough to make an investment in district heating pipelines. This enables us to easily identify hot spots which our energy utility can then investigate in more detail. A strategy across city boundaries is also made easy with the default data.**

Paul Fay, Frankfurt

FRANKFURT, GERMANY

In Frankfurt, district heating is one of the key pillars of the sustainable energy action plan. The first priority is to cut in half the total energy demand of the city by 2050 and then cover the rest with renewable energy and/or waste heat.

The energy transition in the heating sector is an important component of the local energy plan and climate protection policy. The first steps were the preparation of an inventory of heating needs and (waste) heat sources in the city. The planned new development areas were laid over this in order to get an idea of the future development of the heat demand and to match heat sources and heat demands.

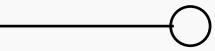


GENEVA, SWITZERLAND

In Switzerland, the Geneva Energy Act requires, since 2010, energy planning for new districts or districts undergoing renovation. In 2005, the City of Geneva adopted a long term vision: «100% renewable in 2050». This is guiding Geneva's action on energy policy with the objective to gradually transition from fossil fuels to renewable energies. To implement this vision, the City has developed an energy policy focused primarily on its 800 municipal buildings. To meet its commitments, the City must now develop a plan that is consistent with its vision 2050, across its entire territory, focusing on existing buildings and districts as well as on the largest consumers. One of the solutions to achieve this energy transition is the construction of heating and cooling networks, powered by renewable energies.

☞ **We quickly realized that we lacked a planning tool to, first, identify local energy resources and second, adapt them to urban development and the high concentrations of energy consumed throughout the municipal territory.**

Etienne Favay, Geneva



“ Thanks to Hotmaps, we will develop the strategy for the city’s heating and cooling system, on medium and long term, which will be promoted within the local community. These results will be included in the city’s strategic documents: Action Plan for Climate and Energy 2030, Local Development Strategy 2010–2030, Energy Vision 2050. Corina Simon, Bistrita

BISTRITA, ROMANIA

The city of Bistrita developed a 2050 energy vision with supporting strategic documents, such as the Action Plan for Climate and Energy 2030, and the Local Development City Strategy 2010–2030. Since 95 % of the fuel used to heat buildings in

Bistrita is natural gas and most houses have individual boilers, it is necessary to consider the transition to renewable individual heating systems. Although « cooling » was not a problem for Bistrita, the last summers’ high temperatures are raising more and more questions related to the need for cooling systems, in particular for non-residential buildings.

SAN SEBASTIAN, SPAIN

San Sebastián published in 2018 its climate plan to become carbon neutral by 2050. The municipal company Fomento De San Sebastián is leading the Smart City transition. It promotes sustainable development models and efficient energy systems based on renewable energies. In this sense, Fomento De San Sebastian has built the first municipal district heating system, powered by biomass, in a new part of the city.

San Sebastian started the heating and cooling planning thanks to the Hotmaps tool. One of the first steps was to identify the heating demand of the whole city.

Currently, the planning process is ongoing and the heating and cooling strategy is being prepared. In course of this process, San Sebastian is identifying new districts where district heating systems could be implemented.

“ The Hotmaps project is a very interesting opportunity to start developing a heating and cooling plan in San Sebastian and to begin a planned process in this topic for the local 2050 Strategy.

Iker Martinez, Fomento de San Sebastian

MILTON KEYNES, UK

According to the UK Climate Change Act (2008) the net UK carbon account for 2050 should be at least 80 % lower than the 1990 levels. The City of Milton Keynes approved its Sustainability Strategy for 2019–2050 at full council meeting in January 2019. Work is now in progress on the action plan to support the Strategy. There is not a specific

policy for heating and cooling in Milton Keynes at the moment, although the city’s 2050 strategy highlights the importance of heating/cooling networks in contributing to a low carbon future for the city.

“ The Hotmaps toolbox has been useful to identify and verify additional resources in our area, not just for heating/cooling networks, but other sources of locally generated energy. Jeremy Draper, Milton Keynes

KERRY COUNTY, IRELAND

Ireland has committed to a National 2020 renewable energy target of 16 % of its final energy requirement by 2020. The heating sector is the largest user of energy in Ireland and 12 % will come from renewable sources by 2020. District Heating is relatively new in Ireland and not very widely used, but smart district heating has been identified as a central element of the county's potential transition to 100 % renewable energy supply. Kerry County Council has a target of 33 % reduction on the energy consumption by 2020 based on 2006 baseline. Kerry was the first county in Ireland to have a fully operational biomass district heating system which was commissioned in 2008. The County Council will examine the potential district heating and cooling for the service sector in Tralee and the hotel sector in Killarney. The results of this will greatly assist in enhancing the design and financial viability of any potential schemes. Kerry County Council is also collaborating on the preparation of an Energy Master Plan for the Dingle peninsula.

The Hotmaps tool will be used to compare various heating technologies as options for renewable heating on the Dingle peninsula and for the production of heat maps.
Jimmy O Leary, Kerry County Council

THANKS TO HOTMAPS, CITIES ARE ABLE TO:

- identify the location of current heating and cooling demand as well as supply on a map for EU28;
- identify renewable energy potential to supply heating and cooling for a selected area;
- calculate the potential for efficient district heating options within a selected area;
- estimate and compare the costs of individual heating vs. district heating options within a selected area;
- compare the results from local heating and cooling planning with national and regional de-carbonisation pathway;
- compare the impact of different scenarios for the future development of heating and cooling in a certain area;
- calculate the optimal energy mix for district heating supply within a certain area.

The cities involved in the project have been using this free and open source tool to get preliminary information, before committing further resources to more detailed studies. They have also checked Hotmaps data against existing scenarios – created with other tools or by consultancy firms.

HEATING
AND
COOLING
PLANNING
IS EASIER
WITH
HOTMAPS!

IN ORDER TO MAKE IT AN ACCESSIBLE ONE-STOP-SHOP, SUPPORT MATERIALS ARE AVAILABLE ONLINE. IN-PERSON TRAININGS ARE ALSO ORGANISED IN DIFFERENT LOCATIONS IN EUROPE.



What's in it for you?

› **Hotmaps handbooks:** the project developed two handbooks¹ to guide and support strategic planning processes carried out at European, national and local levels. Case studies of district heating planning from various contexts across Europe complement the handbooks, presenting the diversity of contexts and conditions that can influence local strategies.

› **Hotmaps Wiki:** the wiki² hosts the documentation, guidance and manual of the toolbox. It is a living document: the developers continue updating HOTMAPS Wiki pages by introduction of new updates, improvements, functionalities and calculation modules.

› **Hotmaps tutorials:** step-by-step videos are available in all EU languages, to show how to use the software and all its functionalities.

› **Hotmaps trainings:** the training focuses on how to create energy scenarios, develop heating & cooling plans and choose between different resources options available in the area of choice. By becoming a “Hotmaps Follower”, cities are offered free trainings and support services up to the end of the project.

Check our website www.hotmaps-project.eu to learn more and join the Hotmaps users' community to decarbonise your city's heating and cooling system!

¹ <https://www.hotmaps-project.eu/Hotmaps-handbook-and-wiki-released/>

² <https://wiki.hotmaps.eu>





THE PROJECT

Hotmaps is a project funded by the EU research and innovation programme running from October 2016 until September 2020. The overarching goal of Hotmaps is the development of an open source heating / cooling mapping and planning toolbox. The project also provides default data for EU28 at national and local level. Such data and tool allow public authorities to identify, analyse, model and map resources and solutions to supply energy needs within their territory of responsibility in a resource and cost efficient way. Hotmaps helps authorities to develop heating and cooling strategies on local, regional and national scale which are in line with renewable energy and CO₂-emission targets on national and EU levels.

THE CONSORTIUM BEHIND



AALBORG UNIVERSITY



ENERGYCITIES





www.hotmaps-project.eu
The open source planning tool
for heating and cooling in cities.



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