BEcoop

UNLOCKING THE COMMUNITY BIOENERGY POTENTIAL

Toolkit – Tools study template

SEPTEMBER, 2022

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Dissemination Level	
x	PU - Public
	PP - Restricted to other programme participants (including the EC)
	RE - Restricted to a group specified by the consortium (including the EC)
	CO - Confidential, only for members of the consortium (including the EC)

Document history

Version	Date	Main modification	Entity
v0.1		Draft version distributed for partners' review	

V1.0		Final version submitted to the EC	

1. Template for selected tools

Name of the tool	Handbook on Investment schemes for REScoop projects
Logo	THERMOS
Link	THERMOS: Home (thermos-project.eu)
Brief Description	**THERMOS** is a user-friendly, free and open-source software to make heat network planning faster, more efficient, and more cost effective. The software was developed by a team of planning experts & practitioners from universities, local and city-wide authorities, energy and environmental agencies, and specialist consultancies based in the UK, Spain, Poland, Latvia, Denmark, Germany, Portugal, and Romania as part of the THERMOS (Thermal Energy Resource Modelling and Optimisation System) EU Horizon 2020 funded research project.
Type of tool	Technical tool
Subtype	Bioenergy Relevant Tool
Related to	Local district energy network
Most valuable information that can be obtained	THERMOS is a free, web-based energy planning software that provides accurate heat and cold network options analysis instantly within one web-based, user-friendly tool. Developed by the THERMOS EU-funded project, the software is designed to optimize local district energy network planning processes and sustainable energy master planning to facilitate the deployment of new low-carbon heating and cooling systems and a fast upgrade, refurbishment, and expansion of existing systems. Whereas traditional heat and cold network planning is lengthy, tedious, complex, resource and time intensive and often suboptimal in both process and result, THERMOS is identifying place-based, user specific optimal network solutions for any given area within minutes.
How does the tool work / manual of the tool	The THERMOS tool makes District Heating and Cooling (DHC) planning processes easier, faster, and more cost-effective, supporting energy planners in the evaluation of the expansion of an existing system, the planning of an entirely new system, or in comparing the performance of a potential energy network with the deployment of individual solutions on buildings. To access to the tool, registration is needed (THERMOS: Login (thermos-project.eu)),.the basic account is limited to 8000 buildings, 10 optimisations across all projects per 7 days. Once a new project has been started, the first step is to obtain a map of the district heating/cooling area (Figure 1). There are several alternatives to obtain tis map: ○ From OpenStreetMap, which is the most direct option. ○ GIS files: accurate demand and cost information on the case study area. You can upload 3 types of files : shapefiles, GeoPackage, GeoJson

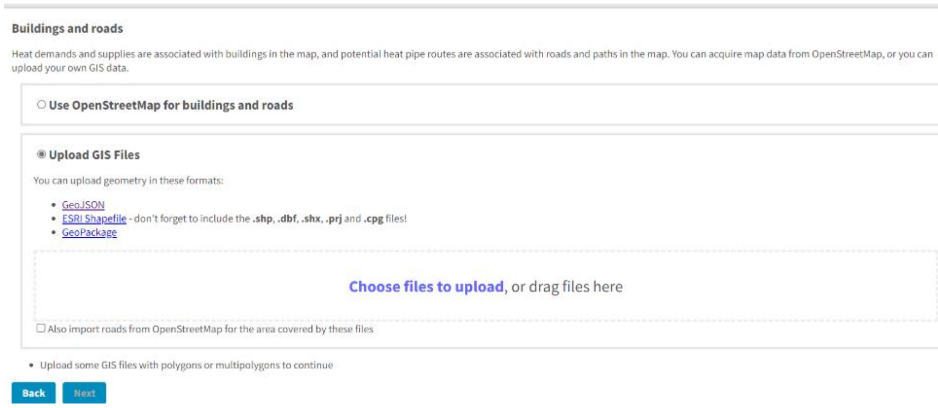


Figure 1. Creation of a map in automatic mode (OSM) or upload your geometries (GIS)

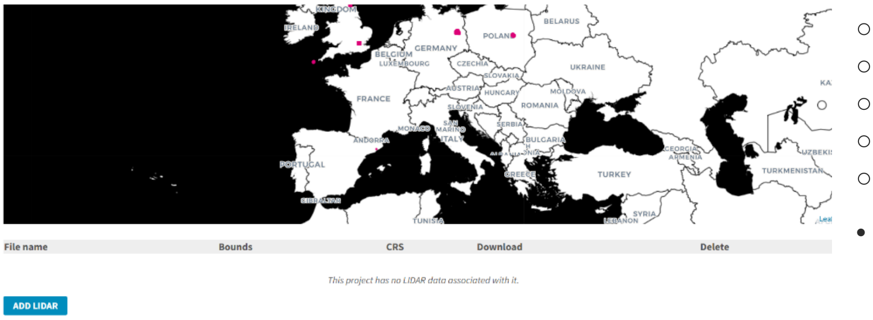


Figure 2. In the OpenStreetMap you have LIDAR areas (pink) created, but you can add new coverages.

In both cases, THERMOS allows to check for LIDAR coverage (Figure 2) for the study cases as well as uploading a pre-made layer. LIDAR coverage is not mandatory but building height data will improve the quality of demand estimates produced from the built-in 3D regression model. For already existing maps the parameters (Figure 3) can be modified by downloading a MS excel spreadsheet and then uploading it again.

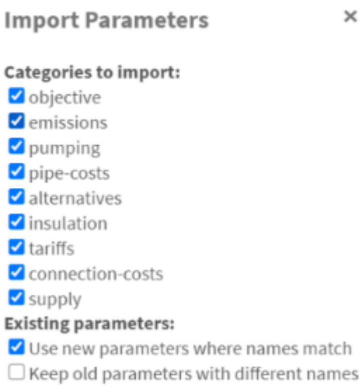


Figure 3. Editable parameters

Currently, THERMOS offers two complementary functionalities to analyse a thermal energy problem: network optimisation and supply optimisation.

- Network optimisation: allows to determine an optimal network solution to satisfy the thermal energy problem described in the current project.
- Adding new sites and connections (**¡Error! No se encuentra el origen de la referencia.**): An existing network can be selected. Once this has been done, the user needs to categorise it as 'required' because the tool is now forced to include the existing network in the solution. The potential candidates for expansion should be included as optional. Then, the user has to choose from:
    - Maximize network: the profitability is analysed based on market tariffs, capital expenditures…
    - Maximize whole system: in this case revenues and tariffs have no effect

  After pressing 'Optimise → Network', if a solution is found, the tool will provide a description of the optimal solution

Figure 4. Adding new sites and connections to an existing network

- Planning a new network (Figure 5): define the heat supply source categorised as a heat plant building. The user can select the candidate building and categorise it as optional. In order to exclude other connections from the analysis, they can be categorised as forbidden. If a solution is possible the tool will provide a description.

Figure 5. Creating a new network

- Designing a new network to supply a given set of buildings: the way is the same that in the previous case, but in this scenario the user can add multiple heat supplies.
- Assessing and comparing the performance of specific networks and individual non-network solutions (**¡Error! No se encuentra el origen de la referencia.**): The aim of this use case is to provide an easy way for energy planners to compare the viability

of implementing a district heating network against individual solutions used as an alternative.

- The user can set individual solutions from the tool menu and select buildings independently creating a network as in the other cases. Finally, “maximize whole system” tab has to be chosen. The tool will then compare, for each building, the individual systems with the possibility of connecting it to the network and, if it is possible, choose the solution which allows to supply heat at the minimum overall cost. In the “results summary” tab, the tool will provide the most relevant data regarding the individual systems installed.

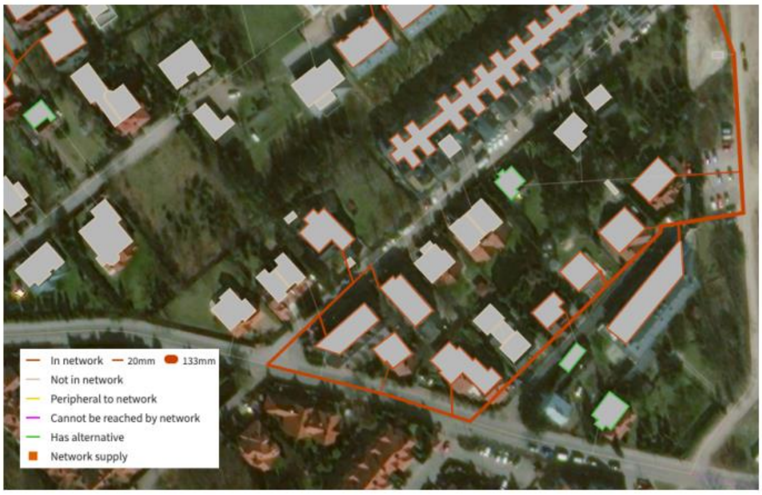


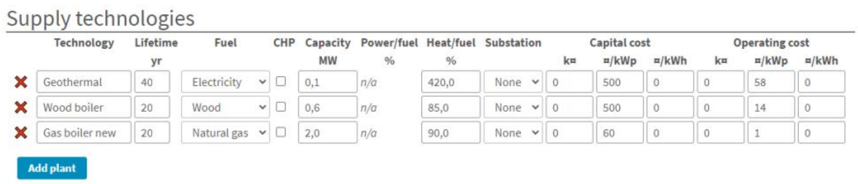
Figure 6. Example of result of mixed network and non-network solution

- Supply optimization: it identifies which technologies should be included in the network over the whole year. The parameters are:
  - Profile: The first step is setting the different standard days that will be considered, pressing “+” the user can change the frequency. For setting the time precision there could be: heat profiles, price fuel profile and substation load.
  - Technologies (Figure 7): it defines equipment involved in covering the system’s demand. Some parameters are: lifetime, fuel, capital cost, operating cost…
  - Objective: This section provides the opportunity to define the different criteria that impact the supply optimisation result financials. These sections are: accounting period, emissions costs, computing resources and model option.

<u>THERMOS SOLUTIONS:</u>

The solutions for each optimization are.

- Network optimization: Map view (Figure 8): This map depicts the thermal network developed by the tool as result of the optimisation process.



Supply technologies

Technology	Lifetime yr	Fuel	CHP	Capacity MW	Power/fuel %	Heat/fuel %	Substation	Capital cost k¤	Capital cost ¤/kWp	Capital cost ¤/kWh	Operating cost k¤	Operating cost ¤/kWp	Operating cost ¤/kWh
Geothermal	40	Electricity	☐	0,1	n/a	420,0	None	0	500	0	0	58	0
Wood boiler	20	Wood	☐	0,6	n/a	85,0	None	0	500	0	0	14	0
Gas boiler new	20	Natural gas	☐	2,0	n/a	90,0	None	0	60	0	0	1	0

Add plant

Figure 7. Supply technologies

Figure 8. Map solution

Solution summary: in this part economic, energy and technical figures can be found.

- Supply optimization:
    - Total cost: the tool returns a summary of the costs for all technologies involved in the optimisation, as well as their specific power generation throughout the whole project. Firstly, the tool provides a breakdown of all costs into capital costs, operating costs, fuel costs and results of electricity export, if considered.
    - Plant and storage: The results summary continues describing the characteristics of the supply plant and the thermal storage.
    - Heat production (Figure 9): This section provides a detailed description of the system's heat production. To do so, the tool presents the results in two different formats, graphs, and tables.

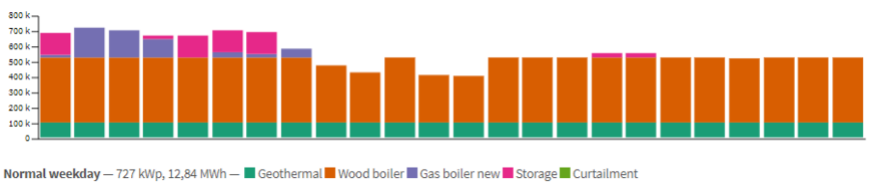
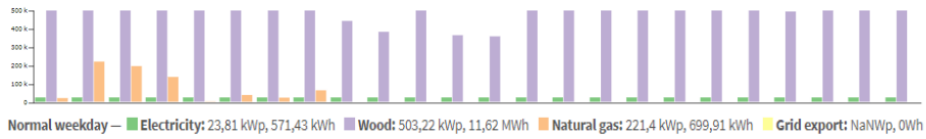


Figure 9. Heat production graphic results

	○ Fuel (Figure 10): fuel consumption and grid export solution are also presented as both tables and graphics. The fuel consumption depends on the source use.  Figure 10. Fuel consumption and grid export graphics for a normal week ○ Emissions: short summary about the emissions generated in terms of production and associated costs
Who is this tool destined to (potential users)	THERMOS users and beneficiaries are: ESCOs, Public authorities and policy makers, Cooperatives / RESCoops, Research centers / universities.
How can this tool affect/benefit or help a relevant stakeholder?	This users that use this solution can obtain different assets, such as: a network optimization model to optimize supply for identifying a cost-optimal; heat and cold map creation tool; demand estimation method operating with limited data inputs in any location; representation of variable pipe and dig costs (by pipe diameter), and network heat losses to the ground;
Additional information of the tool	Explore training materials to adopting THEMOS professionally using this link: THERMOS: Training Materials (thermos-project.eu) The open-source code is available for users in the following link GitHub - cse-bristol/110-thermos-ui Users can post their questions directly to other THERMOS users and developers here: THERMOS Forum (thermos-project.eu)
Organisation/project that developed/manages the tool	THERMOS H2020 project (Thermal Energy Resource Modelling and Optimisation System) was developed by a range of experts from universities, local and city-wide authorities, energy and environmental agencies, and specialist consultancies based in the UK, Spain, Poland, Latvia, Denmark, Germany, Portugal, and Romania partners to the THERMOS project. The project was coordinated by the Centre for Sustainable Energy and supported by an Advisory Board composed of a variety of stakeholders from the energy sector, as well as the heating and cooling sector who provided technical and dissemination advise.
Responsible for the study of the tool and organisation	• Jaime Guerrero (CIRCE)