D.T1.3.1 GUIDELINES FOR THE SIMPLIFIED EVALUATION OF THE POTENTIAL FOR RENEWABLE HEAT

A.T1.3 Evaluation of the potential for renewable heat

Version 3

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List of abbreviations

Abbreviation	Explanation
CHP	Combined Heat and Power
COP	Coefficient of performance
DH	District heating
EU	European Union
GIS	Geographic Information System
RES	Renewable energy sources
RSAG	Regional Stakeholder Advisory Group
SDH	Solar District Heating

1. Introduction

1.1. About the ENTRAIN project

ENTRAIN project aims at improving the capacities of public authorities to develop and implement local strategies and action plans for enhancing the use of locally available renewable energy sources (hereinafter: RES) in small district heating (hereinafter: DH) networks.

DH is considered as the main option for an efficient renewable heat supply for both urban and rural areas thus enabling the transition to higher RES share in energy generation and consumption. A further expansion of DH networks is part of the recent national and regional Climate and Energy Strategies, which are setting a focus on the extended use of biomass and enhanced integration of solar thermal and waste heat to improve air quality and foster more efficient use of biomass.

The outcome of the ENTRAIN project will lead to fossil fuels and CO_2 emission reduction, improvement of local air quality and, socio-economic benefits for local communities by developing technical expertise, initiating investments and launching innovative financial tools. ENTRAIN's main objective is to promote structural cooperation between public authorities and key stakeholders at transnational level and to build-up skills and know-how for a systematic, holistic and efficient planning of small DH systems within five target regions (Poland, Croatia, Germany, Italy and Slovenia), based on RES (solar, biomass, waste heat, and geothermal).

As a part of the project, five Regional Stakeholders Advisory Groups (RSAGs) involving project partners from five target regions and local actors will be set up and will be responsible for conducting five initial surveys and five local action plans. Acting as regional and transnational energy networks, they will be crucial for the implementation and achievement of ENTRAIN objectives, by involving local and regional authorities, DH utilities, energy and development agencies, and consumers. Heat planning guidelines and quality criteria will be made available, based on knowledge transfer from regions with advanced planning capacities and long-term experience in renewable DH (Austria, Germany), also through an ambitious capacity building programme with 25 training session. ENTRAIN will trigger the initiation of nine pilot local DH networks and nine heat planning studies, along with the development of three innovative local and regional financing schemes and the adaptation and adoption of the existing Austrian quality management system "QM Holzheizwerke" in at least three target regions.

ENTRAIN focuses on addressing challenges, which are common for the countries and regions participating in ENTRAIN, such as lack of energy planning skills and experiences of municipal and regional authorities, increasing local air quality issues, significant land occupation by the RES plants resulting in the decreased share of land for agricultural and forest use, need for increasing the use of waste heat to improve energy efficiency, as well as lack of users' acceptance of new energy plants. Therefore, transnational cooperation is needed to exchange best practices and models on how to tackle these challenges in different frameworks by adapting successful experiences to the local needs and conditions.

1.2. Scope of the deliverable

With the heating and cooling in buildings and industry accounting for half of the European Union's (hereinafter: EU) energy consumption, it is necessary to start considering and using heat sources other than the traditional fossil fuel-powered heat plants. Instead, RES, such as biomass, geothermal, solar thermal energy, waste heat and the heat pump application can be used to provide heat with a low or neutral contribution to CO_2 emissions. Mentioned resources can be used as the fuel for the DH system, supplying heat energy to the wide range of users, from households to commercial, public and industry sector. One of the main driving forces behind the increasing use of RES in the DH sector is the agreement on the EU level to reduce CO_2 emissions and increase RES share in final energy consumption.[1] Switch to the RES for DH can help meet rising urban energy needs, improve energy efficiency and reduce emissions.

These guidelines are prepared with the intention to motivate potential stakeholders and local communities to seek better and more efficient solutions to meet local heat demand. Purpose of these guidelines is not to provide steps for the detailed assessment, nor the methodology for determining the feasibility of the DH system, but rather to give an overview of the necessary information prior to deciding on the investment and initiating a project. Users of this document can benefit from inputs and hints given in the following chapters, as well as from tools and references given at the end of each chapter, based on which the quality and effectiveness of local policies and energy planning can be improved. Tools and references given in each chapter have been collected from a number of projects and publications in which members of project consortium took part. Besides Guidelines for the simplified evaluation of the potential for renewable heat, reports on the current state of the DH in target regions in national language are also available (D.T1.2.1 Report on the initial surveys in the target area), including a brief overview of the legal and regulatory framework and incentives. These reports provide additional insights into the local conditions and regulatory framework so that the interested parties can make an informed decision.

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 an important element to consider when planning the DH system. Heat supply step provides an overview of the locally available renewable energy sources, each with a set of questions, which can help determine the potential for each in the target region. The final step of the evaluation is combining the inputs and insights gathered in the first two steps in order to reach a conclusion whether there is a potential for planning the local DH system. Although there may be sufficient heat demand and supply, without the involvement and support of the local community, successful implementation and future operation of the project cannot be guaranteed. ENTRAIN project puts strong emphasis on the involvement and cooperation of the DH users and other relevant stakeholders and has established RSAGs in five target regions in order to grasp better understanding of the current situation in each target region.

[1] 2030 climate & energy framework, https://ec.europa.eu/clima/policies/strategies/2030_en

2. Heat demand

Initialization of the RES DH project should be primarily driven by the demand side. Therefore, emphasis should be put on determining heat demand in each sector to assess whether there is an actual need for the project and is there a potential to expand the heating network on other end users. However, prior to determining the heat demand, the territory with the highest potential for successful implementation of the RES heat plant should be determined. Presumably, local residents, public representatives and citizen groups will be the most interested in evaluating the heat potential from RES. Therefore, practical knowledge of the targeted area and the resources in the vicinity can be used as a starting point and input for the evaluation of the possibility of harvesting heat energy from a certain energy source. Furthermore, visual evaluation and the observation of the territory cover, and its purpose can be observed using the Corine land cover[2] tool. Besides this tool, there is a number of tools, which can be applied in this step

Accurate determination of the territory with the high capacity for satisfying the local heat demand is an essential step when considering investments in the local renewable DH systems.

Guidelines

1. **What is the population density in the selected area(s)?**

   When considering the area of the potential DH plant, it is important to consider who would be potential beneficiaries. In case of the remotely populated areas, one should take into account technical and financial feasibility of the project. On the other hand, if the industrial waste heat is being considered as the heat source for the households, the distance between the source (DH plant) and the end-user should also be taken into account.

2. **What is the climate (heating degree days) like in the target region and selected area(s)?**

   Heating degree days is a measurement used to quantify the energy demand for a specific location. It is defined as a product of the heating days and the difference between outside temperature and standard temperature determined for each region/country. Necessary information to conduct heating degree days calculations can be obtained from the Meteorology service centre.

3. **What is the current heat demand in the area and the heat demand per building sector?**

   The number of occupied dwellings and the total surface of occupied dwellings are essential information to determine the heat demand in the area. By determining the surface area of the buildings and using the coefficient of the specific annual heat demand for each building type, it is possible to determine the heat demand per building. Possible information source for the surface area of the buildings is the national census, local statistics or cadastre registers. Annual heat demand coefficient for each building type is not easily obtained and it depends on various parameters, such as building type, the age of the buildings, the energy efficiency of the building, climate etc. In some countries, heat demand for public buildings can be obtained using national databases or energy consumption monitoring and analysis tool.

4. **What are the current heat energy sources? Which systems are currently used for heating?**

[2] Corine Land Cover, https://land.copernicus.eu/pan-european/corine-land-cover/clc2018

Currently used heat energy sources provide important input for the financial and economic analysis in the later project phases. In order to determine heat, cost and environmental savings after implementing new heating system, it is necessary to know energy consumption and operating costs of the current DH system.

5. **What are the urban aspects of the selected area - industrial zones, rural areas, urban areas?**

Identifying urban aspects in the area can be helpful in further filtering of the possible DH solutions. Industrial zones might be more prone to utilize waste heat and use this type of source instead of choosing solar or biomass DH plants. On the other hand, rural areas might be more open to using biomass as the heat source.

6. **Which types of industries are located in the area or its vicinity? Which energy source is mostly used in those industries?**

Industry sector is important from the waste heat aspect, as this type of energy source is largely generated in industry. Vicinity of the industry represents potentially additional and valuable heat energy source, which can be reused with adequate technology.

7. **Is the current and/or planned DH system sufficient for the expected future heat demand? Are there any future plans, which can result in the increased heat demand (connecting more buildings such as kindergartens, schools, other public buildings and similar) or decreased heat demand (decrease in population, warmer winters, energy renovation of the buildings)? What is the expected increase or decrease of the future demand changes? What should be the capacity of the new DH system?**

8. **What are the annual heat costs for an average building/household?**

When considering different resources and the potential installation of the DH plant, it is necessary to take into account existing heat costs and aim towards the cost reduction.

9. **What is the energy class of the buildings in the selected area? Have they already been subjected to energy requalification interventions?**

Energy class of the buildings can help in calculating current and future heat demand, which is important input for determining DH system capacity.

Tools & references

- ENTRAIN deliverable D.T1.2.1 Report on the initial survey in the target area
- Further information on demand site assessment will be given in the deliverable D.T2.2.1 Country specific planning guidelines for small DH, which is one of the ENTRAIN deliverables. These country specific guidelines will be based on the experience of the Austrian and German project partners and other EU projects focusing on RES DH implementation and it will cover the procedure from project initiation to plant commissioning.
- Corine Land Cover, https://land.copernicus.eu/pan-european/corine-land-cover/clc2018
- The THERMOS is a free, open-source software that aims to offer local authorities address-level data for the optimal design of new or expansions of a

district heating system. The software includes data regarding the heat demand at a building level which can be used to identify high density areas. Based on the defined ecological, economic and technical boundary conditions the tool can calculate an optimal district heating system for the selected area. https://www.thermos-project.eu/home/

- Heat demand and the resources available in some EU regions can also be visually examined using the Pan-European Thermal Atlas, developed as part of the Heat Roadmap Europe Project (HRE4), funded by the Horizon 2020 Programme of the European Union. These can be found on the following website: "Pan-European Thermal Atlas", Flensburg, Halmstad and Aalborg Universities 2018., https://heatroadmap.eu/peta4/
- Sophena is an open source software for the planning of heating plants and local heating networks. It offers the possibility to carry out the technical and economic planning of a heat supply project. Further results include a greenhouse gas balance and the heat occupancy density of the network. https://www.carmen-ev.de/infothek/downloads/sophena
- During TABULA and its follow-up project EPISCOPE residential building topologies have been developed for 13 European countries. Following the seasonal method described in EN ISO 13790 the energy need for space heating and domestic hot water preparation has been calculated for each of this building topology. Values for the specific heat demand can be obtained directly from the webtool or using the excel workbook “TABULA.xls”. http://episcope.eu/welcome/
- The main goal of the Hotmaps project is the development of an open source heating/cooling mapping and planning toolbox and to provide default data for EU28 at national and local level. The Hotmaps toolbox is already available and contains data at different scales resolution, being 1 hectare the finest grid element and national the coarsest. A useful option of the tool is the possibility to select specific areas, e.g. hectare cells or regions, and obtain a results summary for it. https://www.hotmaps.hevs.ch/map

3. Heat supply

Using RES and waste heat instead of fossil fuels for the DH systems contributes to the emission reduction, primary energy savings and reduced dependence on fossil fuels. Using locally available resources can also boost local economy, contribute to the creation of new jobs and reduce heat costs in the long term. When deciding on the resource which can be used for heat production, the primary consideration should be the territorial aspects of the area (cover type of the area, industry in the vicinity, possible natural obstacles for the heat distribution,…), and the availability of the energy/heat supply.

The most widely used renewable heat source is biomass, but lately, other sources such as solar thermal energy, geothermal and waste heat started to be used increasingly due to the technology development. DH systems have been used for decades in European countries, but not many of them have incorporated renewables into their DH systems. According to the Eurostat data, households in the EU mainly use energy for heating homes (64,1% of final energy consumption in the residential sector) and heating water (14,8 % of final energy consumption in the residential sector). With such high shares of the final energy consumption being used for heating, it is alarming that more than a third of energy needs, 36%, is covered by natural gas, indicating a high dependency on the natural gas.[3] Decentralisation of the heat production and supply, with the individual RES DH solutions, will lead to reductions in transport losses, CO_2 emissions and more secure heat supply with lower dependency on the geopolitical situation.

Guidelines

1. **Do you use Geographic Information System (hereinafter: GIS) tools for territorial planning and what available data can be used as input for the GIS tool?**

   GIS tools are powerful software tools used for urban planning and providing enhanced visibility into data by processing geospatial data from satellite imaging, aerial photography and remote sensors. One of the possible methodologies to use for GIS planning is the Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM). WISDOM is a spatial-explicit method for highlighting and determining priority areas of intervention and supporting wood energy/bioenergy planning and policy formulation. It serves as an assessing and strategic planning tool to identify priority places for action. Although it is used for planning woody biomass areas, it can be easily adapted to be used for other energy sources.

2. **Are there other projects and/or studies related to the renewable DH system in your area? If so, is it possible to cooperate with the project coordinators to determine the necessity of the new DH system and offer cooperation?**

3. **Are there areas potentially more suitable to provide RES in the target territory/region?**

   After selecting a wider territory suitable for implementing RES DH, you might find certain areas within, e.g. bigger share of public forests with the increased cap for the annual allowable cut, which could be more suitable for the project implementation.

4. **What is the prevailing cover type - forest, agriculture land, urban areas, rural areas? Are there any natural barriers in the target region, such as bodies of water, hills, which can influence the implementation or the feasibility of the project?**

[3] Energy consumption and use by households, https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190620-1

Determining the cover type and the topographical features will have a significant impact on deciding upon the type of RES and the DH solution.

5. **Is there any existing heating infrastructure? What kind of infrastructure (natural gas supply pipelines, fossil fuel DH) and how much of the populated area is connected to the infrastructure?**

Tools & references

- Energy consumption and use by households, https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190620-1
- Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM), Case study detail: Slovenia 2010, http://www.wisdomprojects.net/global/csdetail.asp?id=26
- This excel-based feasibility tool can be used to carry out feasibility studies for five different hybrid concepts with 100 % RES such as solar collector, seasonal water pit storage, heat pump and biomass CHP (ORC) or solar collector, short-term water tank storage and biomass boiler. The Sunstore 4 tool is based on the district heating grid in Marstal (Denmark) and includes data (default values) from that project. The tool can be used with other boundary conditions by selecting a different country/region. http://sunstore4.eu/use-results/sunstore4-tool/

3.1. Biomass

Biomass is a broad term used to describe the material of recent biological origin that can be used as an energy source or for extraction of chemical components. Biomass sources are very diverse and include, but are not limited to forest biomass, wood biomass, agricultural biomass, animal residues (biogas), energy crops, waste biomass, such as wastewater, sludge etc. Forestry is the main source of biomass for energy (logging residues, wood-processing residues, fuelwood, etc.) in the EU. Furthermore, biomass continues to be the main source of renewable energy in the EU.[4]

Guidelines

1. **What is the total forest area and the area covered with vegetation that can be used for the heat production? Out of the forest area available, what is the ratio between the state-owned forests and the private-owned forests? Are the forests categorised in certain categories, such as economic, conservation, special purpose and if so, what is the forest area in the economic category?**

   Most of the forest biomass comes from logging and from that aspect it is necessary to identify the forest area, which can be used for this purpose. Besides identifying the area and the potential possibilities, it is necessary to resolve the ownership of the forest area.

2. **What is the amount of growing stock, yield growth and annual allowable cut? Out of those, what is the share of private and state-owned growing stock?**

   Possible sources for the data on forests and growing stock can be National Census, Forest Management Plan issued by the public bodies responsible for forestry.

3. **What is the amount of growing stock, yield growth and annual allowable cut on the non-forest land? Is there any wood logistic in the area to transport the wood from the forest?**

   Knowledge of the growing stock and its share by species of trees, age classes, thickness classes, growth, annual allowable cut and similar indicators is required to evaluate the possible production of biomass. This data is the basis of planning for forest residues in energy use.

4. **Are there any wood processing industries in the area?**

   Due to various woodworking processes involved in this type of industry, a lot of wood waste in the form of saw millings, barks and off-cuts are produced. These can be used as fuel for heating processes.

5. **What is the amount of wood residues regarding the quantities of timber supplied to wood processing companies?**
6. **How far is the forest area from the potential location of the DH plant? What are the transport and storage possibilities?**
7. **Are there any forestry companies interested in management or already running small heating systems?**

[4] Brief on biomass for energy in the European Union, The European Commission's Knowledge Centre for Bioeconomy, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109354/biomass_4_energy_brief_online_1.pdf

Tools & references	- Woodfuel Integrated Supply/Demand Overview Mapping (WISDOM), Case study detail: Slovenia 2010, http://www.wisdomprojects.net/global/csdetail.asp?id=26 - Brief on biomass for energy in the European Union, The European Commission's Knowledge Centre for Bioeconomy, http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109354/biomass_4_energy_brief_online_1.pdf - Situationserfassung V35 (QM Heizwerke) - this excel-based tool can be used to obtain a load duration curve and size different standard technical solutions with biomass and fossil fuel boilers for a set of predefined boundary conditions (locations). https://www.qmholzheizwerke.at/de/situationserfassung.html - B4B BioHeat Profitability Assessment Tool v66 The B4B BioHeat Profitability Calculator can be used for a comparison of the economic efficiency (pre-feasibility level) of mid-scale, solid biomass and fossil fuel fired (district & in-house) heat-only plants. The application range is for biomass heating plants with and without district heating networks, in a capacity range from 0.1 to 20 MW. https://www.energyagency.at/fakten-service/register.html

3.2. Solar energy

Solar thermal provides a technically proven and 100 % renewable heat source for DH. In recent years, the solar district heating (SDH) market was initiated and has experienced growth with an increasing popularity in the northern and central European countries, such as Denmark, Sweden, Germany and Austria. In addition, other European countries have started following the initiative and working on market development.

Fields of solar collectors can be ground-mounted or installed on the roofs or infrastructure. In cases where they are part of the heating systems, solar thermal energy contributes up to 20% to the total heat supply and with the addition of seasonal storage, the share of solar thermal can go up to 50%.[5] However, some countries like Denmark are combining solar heat with the heat from natural gas-fired cogeneration plants.[6] Usually SDH systems provide between 20 and 50 % of the heat load in a DH network. Ideal complementary heat generation technologies are biomass fired heating or cogeneration power plants, geothermal source and fossil or natural gas fired cogeneration power plants.

Determining whether the chosen location is appropriate for installing solar collectors is not an easy task, but the guidelines below can help you in getting the idea about it. Additionally, you can check the Solar District Heating Guidelines[7] for more information on how to assess the solar heat potential.

In cases, when the heat supply during the summer comes from waste heat or fossil-fired cogeneration plants producing cheap heat, the integration of solar energy must be examined carefully. It is quite possible that the combination of solar thermal and waste heat/CHP is not economically feasible. However, by the declining CHP operating times in the last years, a combination with solar thermal is quite possible. Nevertheless, it should be considered that solar thermal generates stable and calculable heat production costs in the long term.

Guidelines

1. What is the solar irradiation of the area?

The first step of assessing the feasibility of the SDH plant in the area is determining whether there are sufficient quantities of solar irradiation. Although the solar irradiation in almost all locations in Europe is sufficient for solar heating, the approximate amount of solar energy per surface area can be obtained from the Photovoltaic Geographical Information System, which provides quick and easy access to solar resource data globally.[8]

2. Where will the solar collectors be placed - on the roof or on the ground?

Mounting collectors to the ground is significantly cheaper than mounting them to the roof and leads to low heat prices. In both cases, the possible availability of area has to be examined and the property situation should be clear. Before choosing the location, costs of land and installation, as well as aesthetical aspect should be considered. The local inhabitants are also a decisive influencing factor and should not be underestimated in any way. Additionally, the spatial relation of the planned solar thermal system to the housed network must be taken into account: per 10.000 m^2 collector surface, the system can be installed one km away from the network connection point.

[5] Solar District Heating, https://www.solar-district-heating.eu/en/about-sdh/

[6] Solar District Heating Guidelines, https://www.solar-district-heating.eu/en/knowledge-database/?sbCategory%5B%5D=53&sbType%5B%5D=56&sbLanguage%5B%5D=66&sbProject%5B%5D=76&orderBy=date

[7] Ibid

[8] Photovoltaic Geographical Information System, https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html#PVP

3. **How much area is available for setting up the collectors and the storage units?**

The available area will determine the number of solar collectors and respectively the amount of annual energy yield. Usually, 1 m^2 of solar collectors requires 2-3 m^2 of land, and the optimal storage size is dependent on the collector area, solar fraction, total system load and other heat-generating systems, commonly 0,2-2 m^3 each m^2 collector area.

Tools & references

- Check the Solar District Heating Guidelines for more information on how to assess the solar heat potential, developed by a number of experts working on the three international projects regarding market development of solar DH plants (https://www.solar-district-heating.eu/en/knowledge-database/)
- The approximate amount of solar energy per surface area can be obtained from the Photovoltaic Geographical Information System (https://re.jrc.ec.europa.eu/pvg_tools/en/tools.html#PVP), which provides quick and easy access to solar resource data globally.
- Besides the aspects considered above, there is a number of additional parameters to consider when assessing the feasibility of solar DH plants. One of them is solar energy output, which strongly depends on the solar irradiation and operating temperatures of the DH network. Thereby, the lower the grid temperatures, the more efficiently operates the solar thermal system. Another parameter is the solar fraction, indicating the contribution of the solar system to the total heat production. Methodology for calculating these parameters is given in the Solar District Heating Guidelines (FS 2.3 – Feasbility Study, https://www.solar-district-heating.eu/en/knowledge-database/?sbCategory%5B%5D=53&sbType%5B%5D=56&sbLanguage%5B%5D=66&sbProject%5B%5D=76&orderBy=date)
- ScenoCalc Fernwärme (SCFW) - SCFW is a calculation tool for the integration of solar installations in district heating systems. It does use hourly weather data to calculate the solar gain. The district heating system is defined by a load profile with hourly values for load, supply and return temperatures. The tool allows a technical evaluation with some flexibility but lack of economic evaluation. https://www.scfw.de/

3.3. Geothermal energy

Geothermal energy is derived from the thermal energy stored in the Earth and it can be exploited for the extraction of heat for power generation, the extraction of heat for direct use and the extraction of heat from shallow resources. The use of the geothermal energy as a source dates back to Roman times but it started to be more widely used during the oil crises in the 1970s. It gained new momentum recently due to the technology improvements and the energy dependency concerns. However, due to the higher investment costs and higher risks associated with the initial stage development, investors may be reluctant towards using this type of RES. Therefore, prior to initializing geothermal DH project in your area, additional documentation check should be performed, alongside the preparation of the feasibility study.

Guidelines

1. **Are there any geothermal sources in the area?**

   Unlike solar energy, which is available in all areas, geothermal energy depends on the existence of the geothermal source. If there is not a single geothermal source, then the extraction of heat for DH will not be possible and other RES DH options should be examined. Online map developed by the GeoDH project highlights the areas in 14 EU countries where the potential for geothermal DH exists and this can be the first step in determining whether there is potential for geothermal DH in your area.

2. **What is the hot water/steam temperature of the source?**

   Based on the temperature of the source near the ground (Earth's crust), it can be assessed whether there is the potential for using geothermal source and in which purposes.

3. **What is the value of the geothermal gradient of the geothermal source?**
   Geothermal gradient expressed in °C/m indicated the increase in Earth's temperature with depth.

4. **What is the heat flux of the geothermal source?**

Tools & references

- More recommendations for developing geothermal DH are given in the document: Developing geothermal DH in Europe developed as part of the GeoDH project funded by the Intelligent Energy Europe.
  https://ec.europa.eu/energy/intelligent/projects/sites/iee-projects/files/projects/documents/geodh_final_publishable_results_oriented_report.pdf

3.4. Waste heat

Waste heat is released as a by-product of almost all thermal and mechanical processes and its sources differ based on the aggregate state, temperature range and frequency of their occurrence. However, the largest quantity of the waste heat is generated in the industrial and energy processes and without adequate technology, the valuable heat energy source is lost and not put to practical use. Studies are showing that 20 to 50 % of industrial energy consumption is ultimately discharged as waste heat and that between 18 and 30 % of this waste heat can be recovered and utilized.[9] Given that approximately 70% of energy consumption in industry is used for space and industrial process heating,[10] waste heat potentially represents important heat energy source. Despite the "waste" in its name, waste heat contains large amounts of energy, which can be reused through one of the waste heat recovery technologies.

As the waste heat potential is not adequately tapped and represented, below are given guidelines and questions to further evaluate waste heat potential in the area.

Guidelines

1. **Are there any industry facilities in the area, which can be characterised as waste heat sources?**

   Some of the examples of such sources are: hot combustion gases discharged to the atmosphere, heated water released into the environment, heated products exiting industrial processes, and heat transfer from hot equipment surfaces.

2. **What is the total energy consumption of the industry?**

   Based on energy consumption and the branch of industry, potential waste heat energy can be estimated. Manual for the estimation of regional waste heat potential[11], developed by another Interreg CE project, CE-HEAT, provides conversion factors for the waste heat potential.

3. **What is the temperature of the process heat in the industrial facilities?**

   When considering utilization of the waste heat, it is important to consider the temperature of the process heat and the exhaust gas temperatures. The higher the temperature, the more potential there is to reuse waste heat.

4. **Is the potential waste heat energy sufficient to cover the heat energy demand of the targeted area?**

   Another important aspect in the evaluation of the waste heat reuse is the ability to cover the demand side.

5. **What is the distance from the industrial facilities to the nearest households?**

   Households with the potential to utilize industrial waste heat should be located in the vicinity of the industrial facilities to keep heat losses to a minimum.

[9] Waste heat recovery: Technology and Opportunities in U.S. Industry, https://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf

[10] Heating and cooling, https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling

[11] Manual for the estimation of regional waste heat potential, https://www.waste-heat.eu/waste-heat-potential/manual-for-the-estimation-of-regional-waste-heat-potential

Tools & references	
	- Waste heat recovery: Technology and Opportunities in U.S. Industry, https://www1.eere.energy.gov/manufacturing/intensiveprocesses/pdfs/waste_heat_recovery.pdf - Heating and cooling, https://ec.europa.eu/energy/en/topics/energy-efficiency/heating-and-cooling - Manual for the estimation of regional waste heat potential, https://www.waste-heat.eu/waste-heat-potential/manual-for-the-estimation-of-regional-waste-heat-potential

3.5. Heat pump application

Application of heat pumps in the generation and consumption of heat energy is recognised as a renewable energy technology under the revised Renewable Energy Directive[12]. Heat pump technology can be used to transform thermal energy available at low temperatures to thermal energy with the usable temperature levels. Examples of such usage are waste heat energy (water, air) with a temperature below 70°C, near-surface geothermal energy, river water, ambient air, solar energy. In these cases, heat pumps provide the necessary increase in the heat temperature, so that the heat pump can be used as standalone installation to cover part of the heat demand or in a combination with another RES.

Guidelines

1. **What is the temperature of the waste heat or the shallow geothermal energy source and what is the preferred temperature your DH system would require?**
   The temperature difference between the input and output media impacts the efficiency of the heat pump and its coefficient of performance (hereinafter: COP). The smaller the difference, the greater the COP is, leading to lower operating costs.

2. **Are there any other (renewable) energy sources which could be combined with the heat pump application in the waste heat or geothermal energy?**

   In most cases, heat pumps alone will not be sufficient to meet the heat demand, so it is necessary to combine more energy sources in order to meet the demand, thus creating a hybrid (renewable) DH system.

3. **Is the heat source used as the input for the heat pump available throughout the year?**

   Availability of the resource is important as it is necessary to ensure constant heat supply during the year. In cases when the heat source is not constantly available, other heat sources should be considered.

[12] Directive (EU) 2018/2001 of the European Parliament and of the Council of 11 December 2018 on the promotion of the use of energy from renewable sources,

https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

4. Assessment of external aspects for the project initiation

Based on the demand and supply information, project beneficiary can draw a conclusion of renewable sources available to cover the heat demand of the local community. However, prior to initializing any kind of RES DH project, it is necessary to engage with the experts in this topic to reach the right decision and provide safe, reliable and affordable heat supply. After conducting detailed technical, financial and economic analysis, it will be possible to start planning the project and obtaining the necessary permits and documents. In cases when the project is initiated by the local governments, it is crucial to gain public support before commencing the project. Therefore, prior to the project initialization, investors should have the answers to the following questions.

Guidelines

1. **Is the project supported by the citizens and do they intend to become users of this DH system?**

   If the local community is opposed to the project, is it feasible to continue with the project? Transparency and openness are vital elements to consider when implementing public investment projects. Therefore, local government can organise public forums and conferences in which the local community could hear more information about the RES in their area and the renewable DH system plans.

2. **Who will be responsible for managing and maintaining the new DH system?**

   Utility services such as heating are provided by the publicly or privately-owned companies. Before commencing the project, it should be determined who will be responsible for managing and maintaining the DH system.

3. **Are the funds for the project provided in the public funds or there is a need for other sources of funding?**

   Prior to commencing a project, it is necessary to determine the sources of funding and explore the possibilities for potential incentives and financial support schemes. More information about the potential funding sources and the legal framework in ENTRAIN related countries can be found in one the recent deliverable Report on the initial surveys in the target areas.

4. **Are the skills and knowledge of people planning and implementing a project at a city or municipality level satisfactory?**

Tools & references

- Additional information about the legal framework concerning DH system, RES, potential incentives and financial support schemes in Croatia, Germany, Italy, Poland and Slovenia can be found in one of the existing deliverables of the ENTRAIN project: D.T1.2.1 Reports on the initial surveys in the target areas.