Interreg
CENTRAL EUROPE
European Union
European Regional
Development Fund

CE-HEAT

CE-HEAT
Waste heat - Free energy

Comprehensive model of waste heat utilization in CE regions

wasteheat

CE-HEAT

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Content

01 Introduction

CE-HEAT Project

The CE-HEAT project draws its purpose from a shared European context in which a major challenge of our time lies in transitioning our energy and related systems to become carbon neutral.

The CE-HEAT project focuses on bringing to the fore the energy potential that is currently lost, due to our inaction to capture it.

Our current practices predominantly treat excess heat as waste rather than a resources. This “waste heat“ occurs in almost all mechanical and thermal processes.

The most significant amounts of waste heat are being lost in the industrial and energy generation processes. Waste heat recovery can lead to many advantages, first of all for the environment: a better use of energy can reduce fossil fuel consumption for power generation and the related emissions in the atmosphere. It is an opportunity for enterprises which could spend less money for buying energy, increasing their competitivity or, if the waste heat cannot be re-used in the internal processes, it can represent a new income source by selling it to other companies. The exact amount of industrial waste heat is difficult to quantify, but various studies have estimated that as much as 20 to 50 percent of industrial energy consumption is ultimately discharged as waste heat and that between 18 and 30 percent of this waste heat could be viably utilized.

Some Interesting Facts

326154 TJ

Estimated Waste Heat Potential in CE-HEAT Partner Regions

27 %

Share of Waste Heat Potential of the Final Energy Consumption in the Industry in CE-HEAT Partner Regions

20055198 t/a

Potential CO2-Saving by Utilizing Waste Heat in CE-HEAT Partner Regions

Waste Heat Platform

To capture the energy, the partners of the CE-HEAT project developed a suite of innovative solutions, available online at **www.waste-heat.eu.** The waste-heat.eu platform integrates the knowledge and know-how that support the acceleration of waste heat recovery in Europe and beyond.

The platform allows the users to explore the waste heat energy potential for some EU regions and provides guidelines to estimate the potential for other areas. Software tools, such as decision support system and waste heat calculator, can be used for exploring technical and economic viability of waste heat recovery projects. The platform also illuminates some of the best practice examples of waste heat recovery in Europe and provides policy, permit procedures and funding insights relevant in this field, for seven European regions.

Waste heat platform options

About Waste Heat
Get an overview about typical waste heat sources and main technologies for waste heat recovery.

Waste Heat Maps
The purpose of waste heat cadastres is raising awareness of waste heat energy potential and sources ...

Waste Heat Potential
Are you interested in how to estimate the waste heat potential in your region?

Decision Support System
The Decision Support System (DSS) is a tool which shows how waste heat could be recovered in industrial processes.

Waste Heat Toolbox
Do you need more help planning your investment? Here you will find information about funding, project viability and best-practice examples.

Waste Heat Calculator
The calculator may be applied to analyse four most common waste heat recovery technologies from both technical and economic perspective.

02 About Waste Heat

About Waste Heat

Waste heat occurs in almost all thermal and mechanical processes. The most significant amounts of waste heat are being lost in industrial and energy generation processes.

Process exhaust air

Between 30% and 90% of the waste heat can be utilized for preheating of fresh air, for heating or process heating supply.

Cooling systems

Between 35% and 95% of the waste heat from cooling plants can be utilized for heating or process heating supply.

Air compression facilities

Up to 90% of the electrical capacity can be recovered for heating or warm water supply.

Ventilation technology

Between 35 and 90 % of the waste heat can be utilized for preheating of fresh air.

An equally significant aspect is the demand side for heat energy. In EU generation of hot water, space heating and other forms of process heat accounts for well over half of the total energy use. According to EU data, in industry about 71 percent of total energy consumption is used for space and industrial process heating, while in households heating and hot water generation accounts for 79 percent of total energy consumption. Waste heat therefore represents an important, but as of yet, not well-enough tapped energy source.

Generation of electricity

Waste heat capacity of 500kW enables 50 kW electricity capacity (base: ORC-plant with 10 % efficiency).

Cooling generation

Waste heat capacity of 20 kW enables between 12 and 15 kW cooling capacity (base: absorption chiller with a coefficient of performance between 0,6 and 0,75).

Heating and warm water supply

Depending on the demand the waste heat utilization enables the complete replacement of the heating or warm water supplying system.

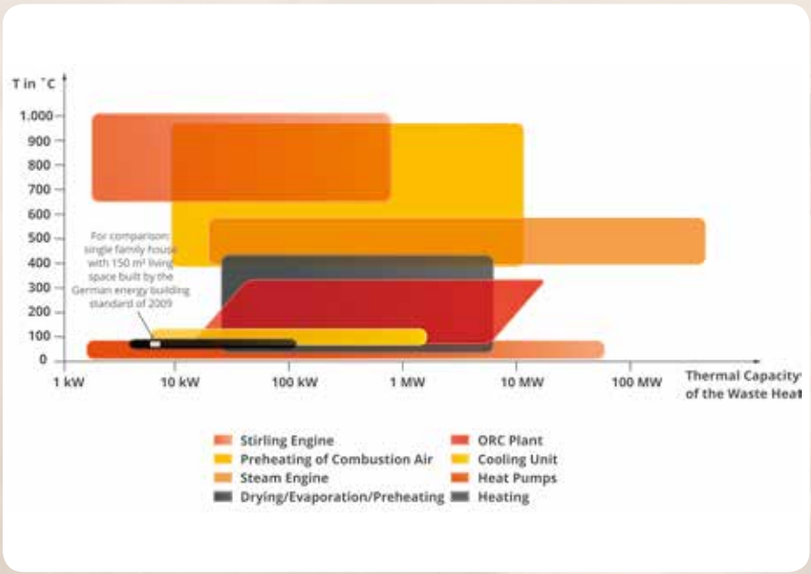
External use

Sufficient amount of waste heat with 90 °C enable a feed into district heating systems or the supply of neighboring companies/buildings.

It is good to know...

Waste heat utilization technologies frequently reduce the operating costs for facilities by increasing their energy productivity. A number of different technologies are available on the market depending on the source type, temperature range and end-use requirements.

The following figure shows the main waste heat utilization technologies for various temperature ranges and their thermal capacity.



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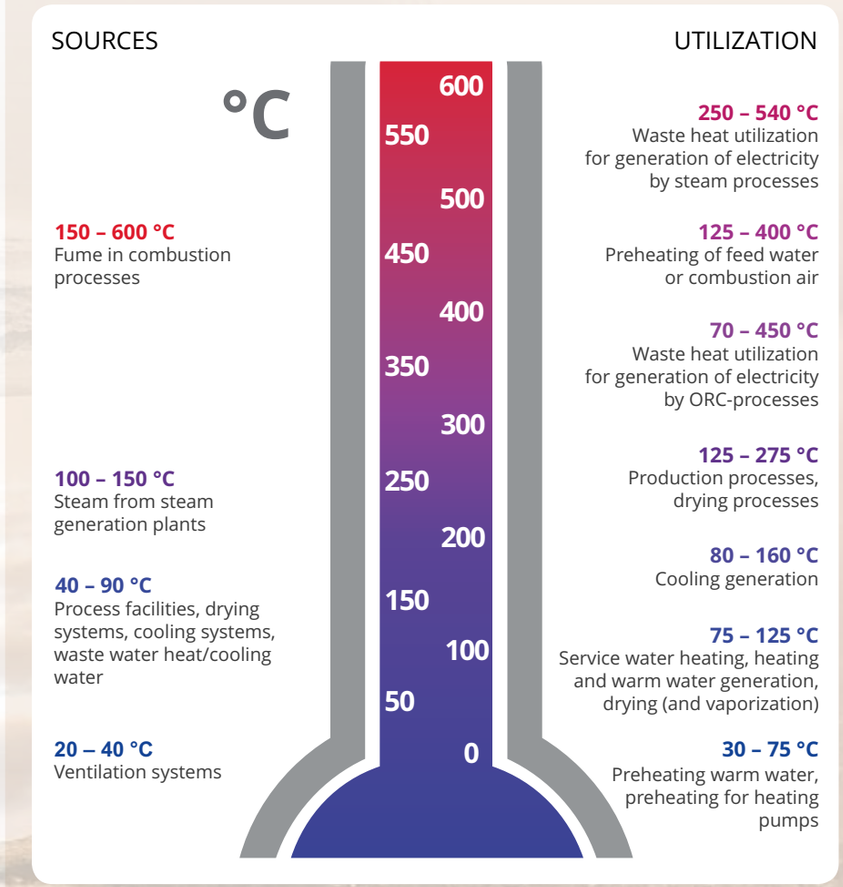
Waste heat sources differ regarding the aggregate state (mainly fluid and gaseous), temperature range, and frequency of their occurrence.



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03 Waste Heat Potential

Waste heat potential we could be using...

Identifying waste heat potential is a key step towards better utilizing and managing waste heat.

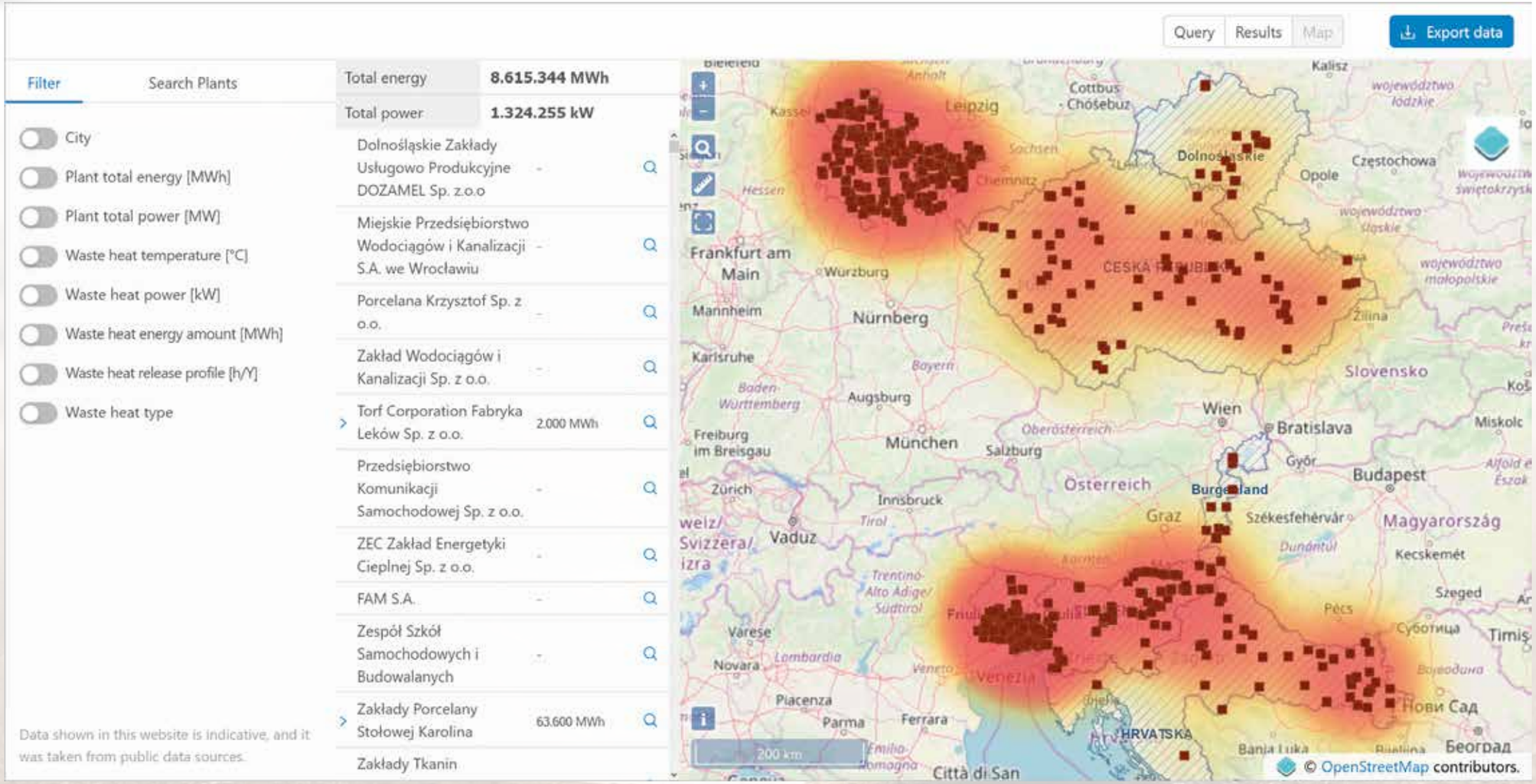
The lack of data on waste heat potential in a region or country makes it hard to plan, monitor, support and promote investments in waste heat utilization.

A regional GIS based waste heat cadastre is a great tool to identify and geolocate the waste heat potential of a region. On the **www.waste-heat.eu** website you will find regional cadastres for a number of Central Europe regions as well as instructions on how to develop such a cadastre for your area, and where the required data can come from.

The operation of a regional waste heat map shows relevant waste heat sources and allows for identification of interesting projects. In particular, cadastres enable better understanding and awareness of the energy potential, and have capacity to trigger interest for investments. They are very useful for initiating and developing heat concepts for communities and energy providers, and for developing local/regional/national strategies and support mechanism schemes for better energy efficiency.

Waste Heat Cadastre

Regional Waste Heat Potential for CE-HEAT Partner Regions



04 Waste Heat Toolbox

Waste Heat Toolbox

The toolbox contains useful tools and information for better understanding of waste heat. It is aimed at supporting entrepreneurs and investors who would like to discover untapped potential of waste heat, understand technological aspects of its recovery into usable energy and get familiar with formal, administrative and financial issues of starting a business based on waste heat.

INVESTMENT DECISION SUPPORT
If you would like to get a high-level feasibility estimate for your WH project

FUNDING
If you would like to find financial resources and learn about business model construction for your investment

PERMITS
If you want to find out about administrative and legal requirements and procedures for your WH project

POLICY
if you would like to know more about relevant energy policies in various Central Europe countries

BEST PRACTICE
if you would like to find out how others successfully utilise waste heat energy

Decision making process can be a challenging issue for potential investors in the waste heat recovery sector.

The toolbox provides useful tools that can help inform the first steps of the investment decision making process. Decision support and waste heat recovery calculator tools enable project developers to test the viability of their potential projects. Based on the results from the waste heat calculator and decision-making algorithm, investors will obtain useful preliminary economic and technical information on the feasibility of their project. This in turn will help with the decision on whether to further pursue the investment or not.

PROJECT STEPS

DECISION SUPPORT SYSTEM

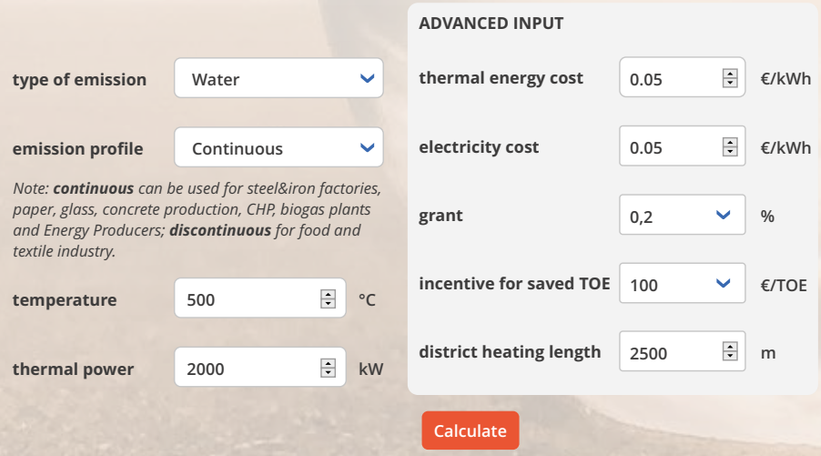
WASTE HEAT RECOVERY CALCULATOR

Decision Support System

The Decision Support System (DSS) is a tool which shows how waste heat could be recovered in industrial processes. The minimum data required for the simulation can be taken from the CE-HEAT cadastre and more data can be further added by users to refine the results. The output is a pre-feasibility study useful also for policy makers to define which incentive schemes should be developed to make waste heat recovering an attractive investment.

The DSS provides two energy environmental parameters - avoided CO_2 emissions and Primary Energy Saving - and four financial parameters - Payback Period, Internal Rate of Return, Net Present Value and the Debt Service Coverage Ratio.

WASTE HEAT SOURCE INFORMATION



Waste Heat Recovery Calculator

The Waste Heat Recovery Calculator may be applied to analyse four most common waste heat recovery technologies from both technical and economic perspective. Any calculator user can use one's own data on waste heat source, choses one's own application of four considered technologies, checks its adequacy and predicts basic techno-economic parameters.

Media carrying the waste heat should be selected first. One can choose between exhaust gases and cooling water (liquid).

Exhaust gasses application

- Simple heat exchanger within heat supply system
- Heat driven refrigerator used within chill supply system
- Organic Rankine Cycle for electricity production

Cooling water application

- Heat supply system using heat pump
- Heat supply system using central heat exchanger

Regional Waste Heat Project Implementation Manuals

Funding
To support potential investors, the waste heat utilization toolbox includes useful information related to different possibilities of funding for waste heat projects in selected regions. Furthermore, some useful instructions on how to develop and to prepare a business plan are included.

Funding opportunities

Business plans and business models

Permits
This section of the Toolbox presents an overview of relevant procedural requirements and national regulations (such as acts of parliament, statutory provisions, government regulations as well as ministerial and local ordinances) related to waste heat investment implementation.

Policy
Making energy generation and consumption more efficient and sustainable is a priority for the European Union. The EU Strategy on Heating and Cooling states: “Some industries generate heat as a by-product. Much more of this could be reused within plants or sold to heat buildings nearby. The same applies to waste heat from power stations, the service sector, and infrastructure such as metros. Therefore, the trends and potential of this sector need to be assessed better in the future”. Some national policies already stipulate that in energy efficient systems waste heat must be recovered.

EUROPEAN UNION POLICY

NATIONAL POLICY

05 Best Practices

EU Regional Best Practices

Manner wafers factory, Vienna, Austria

Waste heat in the form of hot air produced during baking of wafers is used intrenally for cooling purposes and extrenally for local heating in one of the Vienna's districts. The local grid (3.5 km) was modernized in less than a year and additional 600 households connected to the grid and are supplied by heat and hot water thanks to waste heat. There is now additional 1 MW supplied to the grid. The company cooperates with Wien Energie, which has led to higher efficiency of the whole system. Due to the size of the entire system, there is a significant reduction in CO_2 emissions (1,000 t/year). This project is a great example of cooperation between a private company and the grid operator.

Shipyard Viktor Lenac, Rijeka, Croatia

The Shipyard Viktor Lenac uses waste heat recovered from compressor cooling, via heat exchanger, for heating its facilities. The investment benefited from a very short payback period of less than 2 years. It is a good example of how ESCO projects can be implemented in private companies. Such example of waste heat recovery can also be transferred to food industry where compressors are installed for cooling process and heat is transferred in washing processes.

Vertobalsamo, bottle production, Milan, Italy

Waste in the form of gases emitted from the furnace is generated during bottle production. Instead of commonly used Organic Rankine Cycle, a 400-kW steam expander was installed and is used to generate electrical energy. The solution is optimized to provide electrical energy for the company's need and heating for nearby properties. The device lowers costs and improves overall effectiveness of the company. CO_2 emissions are also reduced thanks to a lower consumption of fossil fuels.

Schuler Pressen GmbH, Factory in Erfurt, Germany

Since 1897, the Schuler Pressen GmbH has produced scissors and punching machines. Nowadays, it is technology and world market leader in the field of forming technology. They shape doors, roofs and bonnets for car manufacturers and suppliers worldwide. Due to the high energy demand of the production, energy efficiency has a high priority. With the installation of a 700 kW heat exchanger in the forge the waste heat in the fumes with a temperature of 600 degrees Celsius was extracted and fed into the company's district heating system. Through this measurement altogether 1.000 MWh heat per year can be saved. The return of investment is with 1.58 years very short and shows how economical the waste heat utilization can be.

EU Regional Best Practices

Waste heat from London Underground, Islington Council, London, United Kingdom

Islington Council is working on the pioneering project to capture waste heat from London Underground tunnels to help warm local homes and cut energy bills. The core of the project is a 1MW heat pump that extracts low-grade waste heat from a ventilation shaft on the Northern Line of the London Underground network and utilzes it to provide heating and hot water to the residents. The system will provide heat into the network at a temperature of 75°C and a yearly production of 9,000 MWh. The total primary savings are estimated to be 6.7 MWh/yr and 500 tonnes of CO_2/yr. During the summer months, the system will be reversed to inject cool air into the tube tunnels.

Ice hockey stadium, City of Pilsen, Czech Republic

Waste heat is generated during the cooling process of the ice surface. It is used for melting scrap ice that accumulates in the waste pit during ice treatment. Ammonia's heat (20/120 °C) is transferred in a dismountable heat exchanger ammonia-water on its way to a condenser, where it condenses, and its temperature drops below the freezing point. Heat from overheated steam and condensing heat is used to melt ice scrap that has accumulated in the waste pit. The system is equipped with a storage tank in close proximity of the cooling device. Temperature of the used water (0/85 °C) depends on the stadium's occupancy. It is much higher during the hockey games. The device is almost unattended and trouble-free. It operates year-round except May and June (stadium is closed).

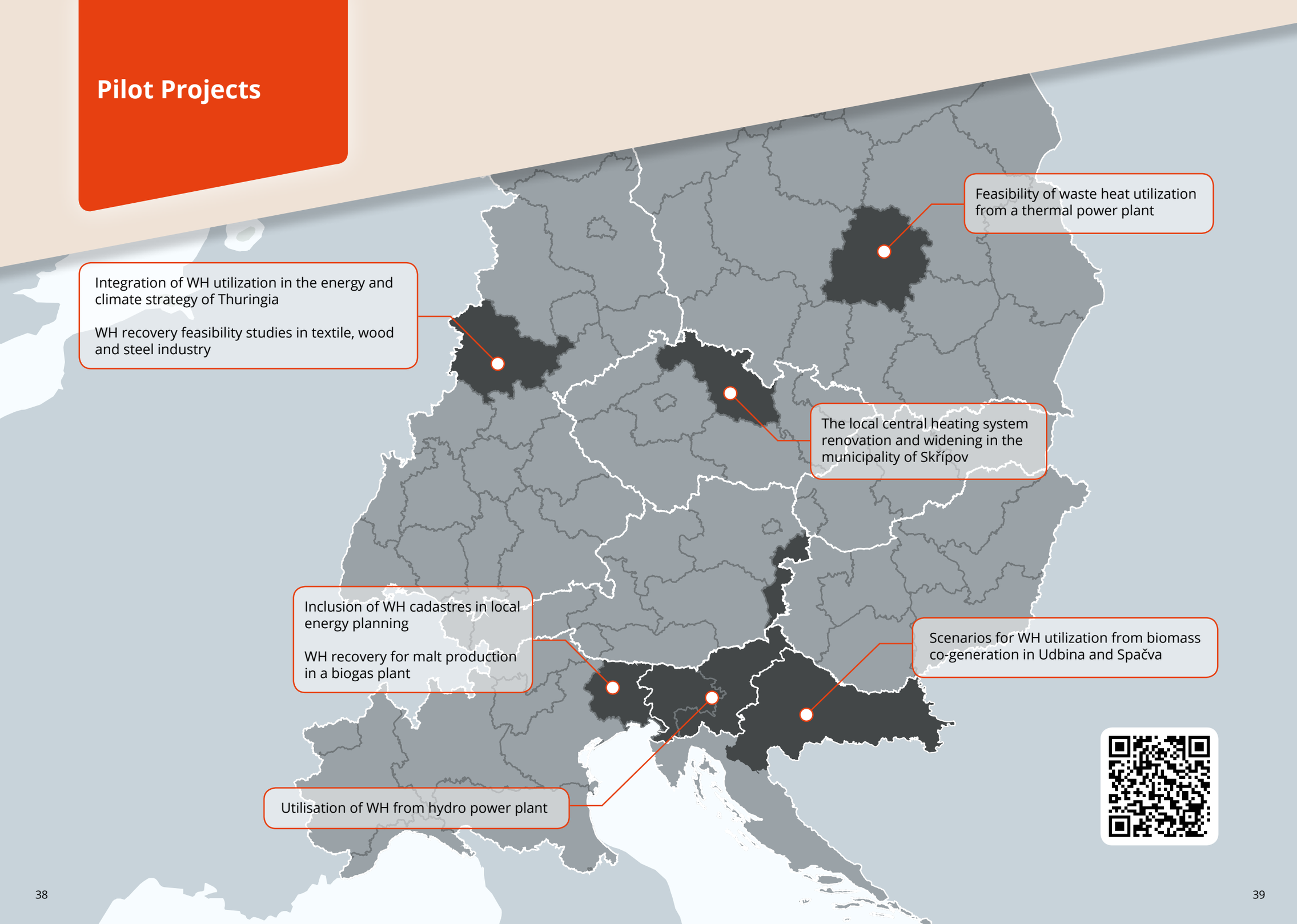
SIJ Metal Ravne steel factory, Ravne na Koroškem, Slovenia

In a small town in northern Slovenia, a cluster of stakeholders, including SIJ Metal Ravne, local utility provider, national research institute, and local community collaborated to deliver a waste heat recovery project that currently covers about 1/3 of energy needs of the local district heating system.

The waste heat that is emitted as part of the furnace cooling process, is captured with an innovative, site specific, high-temperature recovery system and used for smart heating, hot water and electricity co-generation for the needs of the industry and for the township of Ravne. Part of this energy is also donated by SIJ Group consortia for the heating of local swimming pools.

06 Pilot Projects

Pilot Projects



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