



Project Summary for the Socio-Economic Impact Analysis - Civil Society



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Excellence

Problem Addressed

Europe has committed to becoming climate-neutral by 2050. Today, most greenhouse-gas emissions still come from how we produce energy for electricity, heating, transport, and industry. A large part of this comes from industrial activities that require heat for making everyday products such as food, paper, chemicals, and construction materials.

At the moment, most industrial heat is produced by burning fossil fuels, especially natural gas. This creates two major problems. First, it releases large amounts of carbon dioxide that drive climate change. Second, it makes Europe dependent on gas imports from politically unstable regions, which can lead to high energy prices and supply risks, as seen recently. This is why the EU launched initiatives aiming to reduce fossil-fuel dependence and strengthen energy security.

Cleaner heat sources already exist. For example, industries produce a lot of “waste heat” that is simply lost to the environment, and solar energy can produce heat without emissions. However, these heat sources are usually not hot enough to be reused directly for industrial needs. Many factories and district heating networks operate at lower temperatures, while industrial processes often need higher temperatures.

To make better use of clean and wasted heat, new solutions are needed that can raise (“upgrade”) low-temperature heat to higher temperatures in an affordable, reliable, and environmentally friendly way. Existing technologies struggle to do this efficiently at the required temperature levels and often rely heavily on electricity or harmful substances. This creates a clear need for a new approach that supports climate goals while remaining practical and safe for society.

Objectives and Ambition

The TechUPGRADE project aims to develop and test a new clean-energy technology that can turn low-temperature heat (from waste heat, solar energy, or district heating) into high-temperature heat suitable for industrial use. The goal is to reach temperatures between 150 and 250 °C, which are common in many manufacturing processes.

Unlike conventional systems that mainly rely on electricity, TechUPGRADE is driven mostly by heat itself. This means it can reuse energy that would otherwise be wasted and keep electricity use very low. The technology is based on a reversible chemical process using safe and widely available materials (salt hydrates), which absorb and release heat depending on conditions.

An important ambition of TechUPGRADE is to make clean industrial heat more accessible, affordable, and flexible. The system can also store heat, meaning energy collected at one time (for example, from the sun) can be used later when needed. This helps stabilize energy supply and supports wider use of renewable energy.

Technical Objectives

The project has clear and practical goals to make sure the solution is safe, reliable, and beneficial for society:

- **Use safe and affordable materials** that can store and release heat many times without losing performance, using common and non-harmful substances.
- **Build robust equipment** that can work reliably for many years with low maintenance and no safety concerns.
- **Test the solution in real conditions**, proving that it can turn low-temperature heat into much hotter heat that industry can actually use.
- **Keep costs reasonable**, so clean heat can compete with today's fossil-fuel heating.
- **Support climate-friendly heating**, by cutting greenhouse-gas emissions and using renewable and local heat sources.

These objectives are supported by earlier research carried out by universities and research centers involved in the project.

Proposed System

TechUPGRADE will build and test a pilot system that captures low-temperature heat and upgrades it to higher temperatures using a chemical reaction. In simple terms:

- Heat from sources like industrial waste heat, solar collectors, or district heating is used to “charge” a special salt material.
- When needed, the material releases this energy at a much higher temperature, suitable for industrial processes.

The system is designed to use very little electricity and to work mostly with heat flows that already exist. It can also include a storage option, allowing heat to be saved and used later. This flexibility makes it especially useful for renewable energy sources that vary over time, such as solar heat.

State-of-the-Art

Currently, most industrial heat in Europe is produced by burning fossil fuels. Some technologies exist to reuse waste heat, but they often cannot reach the temperatures required for industrial processes or they rely heavily on electricity, which may still come from fossil fuels.

Other alternatives, such as different types of heat pumps, are either limited in performance, expensive, complex, or not yet suitable for high-temperature applications. Many also rely on substances that can be harmful to the environment.

Because of these limitations, there is still no widely available solution that can efficiently and cleanly upgrade low-temperature heat to the levels needed by industry. This gap is what TechUPGRADE aims to address.

Progress Beyond the State-of-the-Art

TechUPGRADE introduces several improvements compared to existing solutions:

- **Very low electricity use**, helping reduce pressure on power grids and emissions;
- **Minimal mechanical complexity**, which improves safety, reliability, and lifespan;
- **Ability to reach higher temperatures** than most existing clean-heat technologies;
- **Use of safe, abundant, and recyclable materials**, supporting a circular economy;
- Includes **heat storage**, helping balance when energy is available and when it is needed;
- **Can be used at different scales**, from smaller facilities to large industrial sites, depending on local needs;
- **Works well with renewable energy**, such as solar heat and recovered waste heat, helping reduce fossil-fuel use.

Technology Readiness and R&I Positioning

Some elements of the TechUPGRADE concept have already been tested in laboratories, while others are still at an early development stage. The project's goal is to bring these components together into a working pilot system that operates under realistic conditions.

By the end of the project, TechUPGRADE aims to demonstrate the technology at a level where it is proven to work reliably outside the laboratory. This step is crucial before moving toward wider deployment and real-world use in industry.