



LIFE WHIN - LIFE WHIN : Waste Heat recovery
in silicon INdustry

LIFE16 CCM/FR/000104



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Project description:

Background

Energy-intensive industries in Europe account for up to 40% of total energy production costs and are responsible for a quarter of the EU's total carbon dioxide (CO₂) emissions. The EU silicon sector comprises 23 companies that operate 50 plants in 14 countries, employing 8 000 people, with a cumulative turnover of more than €2 billion. The European Commission recognises it as an energy-intensive sector, with a high risk of carbon leakage. Silicon production by electro-metallurgical processes is associated with intrinsic and unavoidable process emissions.

Organic Rankine Cycle (ORC) technologies allow the efficient production of electric power from low-temperature and/or low-power heat sources in various industrial processes, achieving substantial CO₂ emission reductions via the recovery of waste heat. However, ORC technologies are currently not deployed in the silicon sector. Moreover, currently available ORC technologies use fluorinated working fluids with a high global warming potential (over 1 000). Therefore, to increase the competitiveness of the European silicon industry and decrease greenhouse gas emissions, there is a great need to design more energy-efficient solutions. These will integrate components such as heat exchangers, and ORC technologies with environmentally-friendly working fluids.

Objectives

The LIFE WHIN project aims to design and implement the first full-scale pilot demonstration of a new integrated, cost-effective and energy-efficient solution for the silicon industry. This will consist of a waste heat recovery system, equipped with an innovative cleaning system, coupled with an ORC system that transforms recovered heat into electricity.

More specifically, the project will implement the integrated solution in a real industrial environment (a silicon production plant at Ferropem's Anglefort site) to:

- Reduce CO₂ emissions by 26% by recovering 26% of the energy fed into the production process;
- Demonstrate the efficiency and environmental benefits of the integrated waste heat recovery system in an innovative prototype for silicon industries able to recover 47% of the waste heat available;
- Transform the heat recovered into electricity through an ORC system coupled to the heat exchanger through an advanced design and control system, to generate carbon-free electricity;
- Radically reduce the global warming potential of the working fluid used in the ORC, through the use of the innovative refrigerant R-1233;
- Reduce the electricity bill of the plant's furnace by consuming the carbon-free electricity generated through the ORC;
- Show the positive social and economic impacts of reducing the operational costs of silicon production, which increases the competitiveness of the EU silicon industry and enhances the sustainability of jobs;
- Replicate and transfer the technology in the silicon sector and other energy-intensive industries;
- Monitor performance and transferability to prepare its inclusion in the Best Available Techniques Reference Document for waste heat recovery in the silicon sector; and
- Foster the deployment of the project's solution at local and EU levels, through dissemination actions aimed at relevant stakeholders and the general public.

LIFE WHIN addresses two priorities identified by the LIFE Climate sub-programme, namely energy-intensive industries and fluorinated greenhouse gases, and contributes to the implementation of the EU Regulation on fluorinated greenhouse gases (F-gases) that plans an 80% phasing out of F-gases by 2030.

Expected results:

- Recovery of at least 47% of the waste heat generated during the production process (i.e. 140 GWh/year of carbon-free heat) via a unique heat exchanger, compared to the 0% currently recovered;
- Decrease of 99% in the global warming potential of the working fluid (< 10), compared to state-of-the-art fluorinated working fluids (>1 000), through the integration of the refrigerant R-1233;
- Generation of 23.4 GWh of carbon-free electricity per year, via the recovery of waste heat and its transformation into electricity;
- Maximisation of the yield of the heat exchanger by implementing an innovative cleaning system (recovering over 90% of the heat available);
- Reduction by 10% of the electricity bill of the furnace attached to the silicon production process, achieved by consuming the electricity generated by ORC technology;

- Definition of three sound business models to enable the replication of the project's solutions in the silicon and other energy-intensive sectors;
- Identification of at least 10 industrial sites for short-term replication of the technological solutions, and drawing up of a detailed replication plan with short and mid-term steps to enable at least two replications to start within the project and three additional replications during the three years after the project; and
- Engagement of the main stakeholders, to ensure wide dissemination of the project's results, the creation of an advisory board, participation at events and the publication of at least five articles.

Results

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Environmental issues addressed:

Natura 2000 sites

Not applicable

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Beneficiaries:

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|----------------------|--|
| Coordinator | DALKIA |
| Type of organisation | Large enterprise |
| Description | Dalkia, a subsidiary of the EDF Group (Electricité de France), has nearly 80 years of experience in its field. It provides energy services to 2 100 industrial sites, including heating and cooling networks, improving the energy performance of buildings, and developing renewable energy sources. In 2015, Dalkia's activities relating to energy performance gave rise to savings of 3.9 TWh of global energy (mainly heat) and 2.5 million tonnes of CO ₂ . |
| Partners | TURBODEN SPA, Italy FERROPEM, France |

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Administrative data:

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|-------------------|-----------------------------|
| Project reference | LIFE16 CCM/FR/000104 |
| Duration | 01-JUL-2017 to 31-DEC -2020 |
| Total budget | 7,355,414.00 € |
| EU contribution | 3,215,678.00 € |
| Project location | Rhône-Alpes(France) |

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