

Science, Technology and Innovation

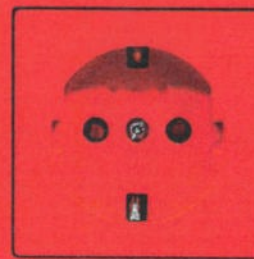
€20

Projects

 **INSIGHT**
publishers

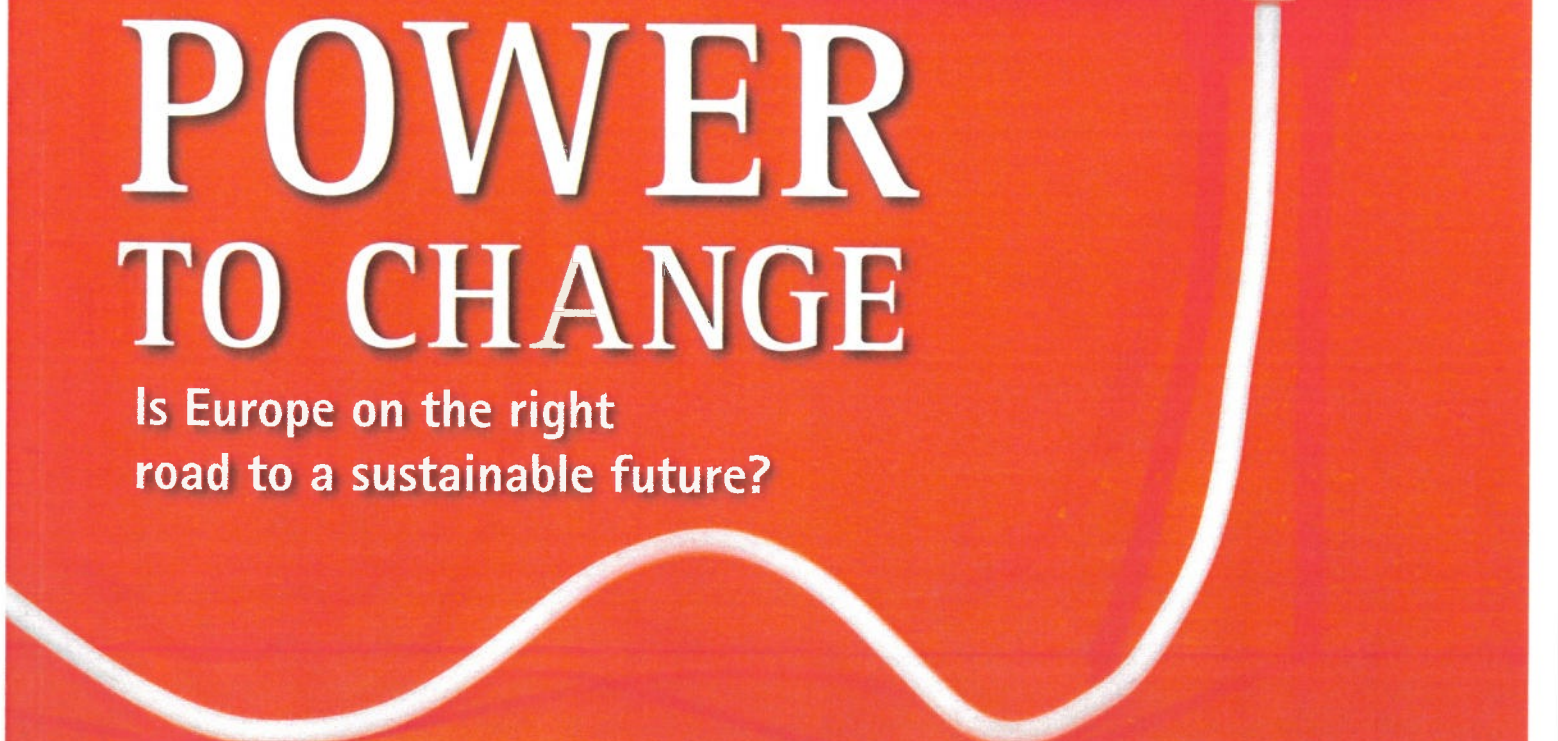
Energy Edition

IN PARTNERSHIP WITH SUSTAINABLE PLACES 2019



POWER TO CHANGE

Is Europe on the right
road to a sustainable future?



DryFiciency – new heat pump technologies for industrial drying

The European DryFiciency project is developing two new types of heat pump technology that use waste heat to produce high temperatures suitable for industrial drying processes. These heat pumps are being tested in three real industrial settings, with the aim of helping energy intensive industries to improve energy efficiency and reduce carbon emissions

Heat pumps are already regarded as an essential technology in residential buildings for reducing carbon emissions and improving energy efficiency. For industrial applications, heat pump applications are still in their infancy, primarily because the temperatures they typically produce are too low to be efficiently used in most industrial processes.

Nevertheless, many industries stand to benefit significantly from the introduction of heat pump technologies in their industrial processes, using waste energy to provide heating and cooling. Increasing the energy efficiency of an industrial process by installing heat pumps provides substantial cost reductions for the industry. Furthermore, industrial heat pumps have

important positive environmental impacts for society in the form of reduced energy use and carbon emissions.

The EU-funded DryFiciency project is looking into technically and economically viable solutions for turning waste heat into useable heat at temperature levels of up to 160°C. The focus of the project is on



Insight in the closed loop heat pump prototype during construction (Photo credit: AIT Austrian Institute of Technology GmbH)

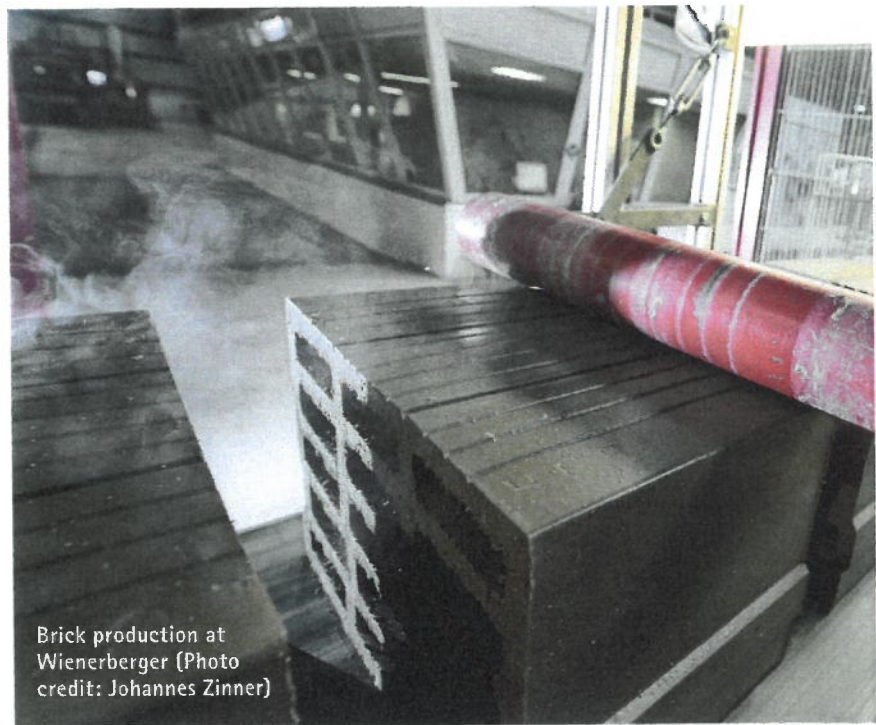
industrial drying applications, which typically account for 12-25 per cent of the total energy demand in industrial processes.

The project outcomes are two pioneering high temperature heat pump technologies: a closed loop heat pump for air drying processes and an open loop heat pump for steam drying processes.

The closed loop heat pump

Closed loop heat pump systems work by evaporating a synthetic refrigerant with waste heat, compressing the refrigerant and thereby providing heat at higher temperature levels. This delivers a much higher amount of energy in heat than the amount of electric energy needed for this operation due to the reuse of the existing waste heat as a valuable heat source.

The closed loop heat pump technology being developed in DryFiciency is being managed by Veronika Wilk, senior research engineer at AIT Austrian Institute of Technology. Several significant innovations will allow the closed heat pump to produce temperatures of up to 160°C, a temperature which can be used for several industrial drying options. Amongst these improvements is a previously-developed refrigerant known as OpteonMZ, which is well-matched to high temperatures, is non-flammable and non-toxic. Two new



Brick production at Wienerberger (Photo credit: Johannes Zinner)

will be integrated into a continuous starch drying process. The heat pump prototype will deliver up to ten per cent of the heat demand of the dryer and thereby reduce the CO₂ emissions by about 500 tonnes per year and end energy consumption by 2200 MWh per year.

The other demonstration site for the closed loop heat pump is at Wienerberger, a global

supplier of building materials, where, similar to AGRANA's food drying processes, heat pump drying is replacing fossil-fuel-based combustion-driven drying in the brick making process.

the sealant and the lubrication oil for the compressors. We will use online monitoring throughout the demonstrations to evaluate how efficiently the heat pumps are working, and to examine the heat pumps regularly for durability and degradation."

The open loop heat pump

The open loop heat pump developed in the project first began to take shape when Michael Bantle, senior research scientist at SINTEF was in talks with the global manufacturer of confectionery, food and pet food Mars about their drying process used for producing petfood. At the time, this drying process was using up to 80 per cent of the entire production line's energy. "Mars wanted to reduce their energy use by using their own waste heat," says Bantle. "We did some calculations and worked out that using standard heat pumps would require an initial investment of around €1m, which would only be recuperated over the course of 25 years.

"So, we developed a new concept for a compression technology that uses a modified version of a turbo compressor from a car. These are mass produced components – every diesel car has one – so they are fairly cheap. This meant that the initial investment cost for Mars

"We did some calculations and worked out that using standard heat pumps would require an initial investment of around €1m, which would only be recuperated over the course of 25 years"

compressors are also being used which will work at the required temperatures.

The closed loop heat pump is being tested in two industrial settings. The first of these is with AGRANA, the leading Austrian food industry company that applies dryers in the production of sugar and starch. The heat for the dryers is normally provided through the burning of natural gas, but in this advanced demonstration a closed loop heat pump

supplier of building materials, where, similar to AGRANA's food drying processes, heat pump drying is replacing fossil-fuel-based combustion-driven drying in the brick making process.

"Many of the aspects we are looking at in the demonstrations are related to the high temperatures", Wilk explains. "The process is a challenge not only for the refrigerant but for all components that are used in the manufacturing of the heat pump, including



Starch Factory Agrana
Stärke GmbH
(Photo credit: APA-
PictureDesk/Agrana/Schedl)

could be reduced by 90 per cent to around €100,000, and the system would be able to save 75 per cent of the energy used for drying.”

The prototype heat pump has now been built, and the researchers are convinced that it can help to drastically reduce carbon emissions by switching from fuel-based combustion technology to electricity. Since the system uses turbo compressors, it has the added benefit of not needing lubrication, meaning that the usual temperature limitations on the lubricant need not be addressed. Because the heat pump uses steam, it is also possible to resort to the many standard components available that are certified to work with steam, although it will still undergo rigorous testing to provide detailed analysis regarding endurance and performance.

The open loop heat pump system will undergo testing for sludge drying processes at Scanship, the leading Norwegian waste processing and water purification company.

Next steps

The project runs until August 2020, so the team is looking forward to the operation of the demoplants. “We want to see what is possible with the configurations that we have at the moment,” says Wilk. “When we get to the end of the project, we won’t have a completed commercial product but we will be close to market entry.”

The versatility of heat pumps means that there are many potential applications for them beyond the ones being tested in the DryFiciency project. Ultimately, Wilk says, the researchers hope that their work can inspire others to consider integrating heat pumps in their industrial processes. “Whenever cooling is necessary or waste heat is generated in a process, heat pumps are a promising option,” she explains. “Our work can hopefully make other industries consider how they can implement heat pumps in order to decarbonise their own processes and gain a competitive advantage.” ★

Michael Bantle, Research Scientist at
SINTEF Energy Research
michael.bantle@sintef.no; +47 73593 000



PROJECT INFORMATION

Project Title:

DryFiciency – Waste Heat Recovery
in Industrial Drying Processes

Project Objective:

DryFiciency elaborated solutions to improve energy efficiency and reduced fossil carbon emissions for energy-intensive industries. High temperature vapour compression heat pumps facilitating the use of waste heat in other processes at temperature levels up to 160 °C are developed, demonstrated and validated in drying processes of several industrial sectors.

Project Duration and Timing:

48 months from 09/2016 to 08/2020

Project Funding:

Costs: €6.7 million
EC Funding: €5 million

Project Partners:

AIT Austrian Institute of Technology GmbH (Lead, AT), Agrana Stärke GmbH (AT), Bitzer Kühlmaschinen GmbH (DE), Chemours Deutschland GmbH (DE), European Heat Pump Association (BE), EPCON Evaporation Technology AS (NO), Fuchs Europe Schmierstoffe GmbH (DE), Rotrex A/S (DK), RTDS GmbH (AT), SINTEF (NO), Viking Heat Engines (NO), Wienerberger AG (AT)



MAIN CONTACT



Veronika Wilk

Veronika Wilk is a senior research engineer at AIT researching on the topic of industrial energy efficiency

and use of innovative renewable energy technologies with a special focus on developing and integrating novel industrial heat pump solutions. Veronika holds a PhD in chemical engineering from Vienna University of Technology.

Contact:

Tel: +43 664 6207794

Email: Veronika.Wilk@ait.ac.at

Web: www.dryficiency.eu