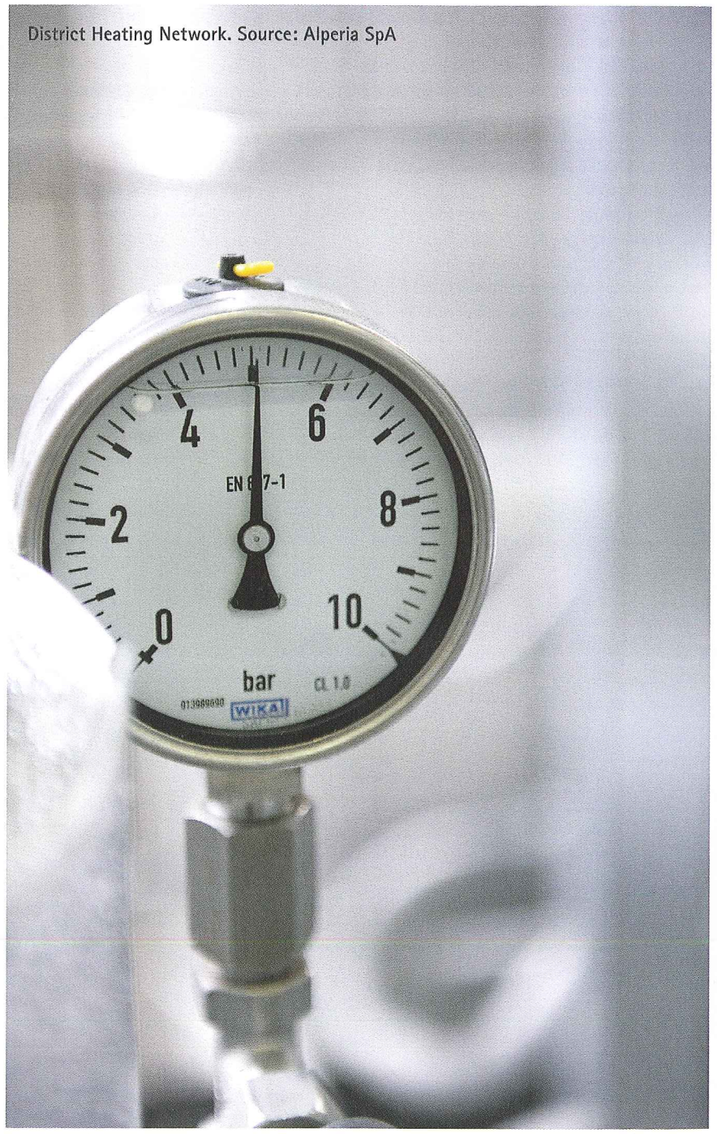
Putting waste heat to work

Buildings across our towns and cities are pumping huge amounts of heat into the atmosphere, a valuable source of thermal energy that is just wasted. Life4HeatRecovery is a project looking to reverse this by putting this waste to work, helping it heat our homes and supply our hot water for less. In an interview with project coordinator **Roberto Fedrizzi**, we learn more about Europe's hidden renewable energy source and the enormous potential it offers

The average mid-sized supermarket in Europe produces enough waste heat from its refrigeration and air conditioning units in one year to be able to provide the thermal energy needs of 200 homes over the same period. It's not just our supermarkets producing this kind of waste – there are data centres, factories, hospitals, offices and many other buildings and institutions in towns and cities all over Europe producing this energy as a by-product of their activities, all too often just wasted into the atmosphere.



District Heating Network. Source: Alperia SpA

This wasted thermal energy is often referred to as a "pseudo renewable energy source" but, despite its potential value there are currently few ways to use it. As it is most often available at low temperatures – around 10 to 30°C – using it to directly warm water to use in the home or warm water to use in district heating systems is simply not possible: shower water, for example, is typically used at around 40°C. Meanwhile conventional district heating networks supply water at around 80-90°C, so again, the waste thermal energy cannot be used to warm water directly to be useful around these networks.

As well as this being a waste of a potentially valuable energy source, this wasted heat also produces what is known as a "heat island effect", which raises the temperature of towns and cities to a few degrees higher than those in the countryside. Put simply, heat lost into the built environment just heats our cities and is not easily used for anything else. Moreover, warmer cities use more energy for cooling - and so the vicious circle continues.

Life4HeatRecovery is an EU LIFE program-funded project seeking to change this, by using wasted energy recovered from different sources and applying it to district heating systems. The central idea of the project is to recover waste energy to create a "circular economy of heat". Heat is, therefore, collected from where it is produced (the supermarket or factory, for example), recovered into a district heating network and then redistributed into buildings. These could be the same buildings that provided the waste heat in the first place or it could be other buildings on the district heating network around the same town or city.

To do this efficiently, the project is developing complete, pre-fabricated skids that can be installed where the waste heat is produced, which both collect the waste energy using heat pumps in a similar way to how they are also used in a typical geothermal system.

Roberto Fedrizzi, of EURAC Research, who coordinates the Life4HeatRecovery project explains how this works: "The heat pumps are used in two ways. The low-temperature waste heat can be warmed to a level that is useful for district heating. This is done by connecting a heat pump to this waste source which increases the temperature of the available heat from around 10-30°C to something useful, like 70-80°C. This is then connected to the district heating system and the heat is made available for traditional district heating networks.

"The other possibility, however, is for a new generation of district heating networks. These directly distribute the waste heat through the network: this heats the water in the network to around 10-20°C and this low-temperature water is distributed to the door of the buildings on the network. Of course, this low temperature water is not a useful supply of domestic hot water or heating, but it can be warmed up to a useful heat at the individual buildings using heat pumps. The value here is that the low-temperature water does not suffer heat losses along the network pipelines.

"In either case," he concludes, "with the waste heat being used at source, or being warmed up at the user end, the idea of the project is to use heat pumps between the user and the source of the waste heat."

While this process of collection and distribution of thermal energy may not be novel in itself, Fedrizzi believes the innovation he and his project partners will deliver lies in three main areas:


Skid Installation. Source: Mijnwater B.V.

"We are simply using heat pumps...But in doing so, we provide heat to the home by using in part thermal energy that is available from the district heating network, as well as using electricity – so we match to sectors that traditionally separated"

- How the project proposes using this thermal energy, that would otherwise be wasted, by coupling low-temperature waste heat with district heating.
- The simplification of this process using skids that can be easily implemented on site
- The attractive returns on investment that are available from utilising this source of waste energy in our towns and cities.

"We are simply using heat pumps," he explains. "But in doing so, we provide heat to the home by using in part thermal energy that is available from the district heating network, as well as using electricity – so we match to sectors (i.e. district heating and electricity) that traditionally separated.

"On the one hand we have utility companies distributing heat through district heating networks," he continues. "On the other hand we have electricity companies supplying the electricity to run the heat pumps. Normally these two sources do not talk, but we now have a machine which uses both sources and electricity companies are getting very interested, as this gives them a way to enlarge their markets – they have the opportunity to effectively sell electricity for domestic hot water and heating in the home."

There is an abundance of waste heat that can be used in this way, while recovering it from these sources using heat pumps is also

District Heating Network. Source: Alperia SpA

a relatively cheap process. "We are studying different business cases for our technology," explains Fedrizzi, who acknowledges that though this is a complicated, early market place, there are several reasons to be optimistic about future success.

"We are looking at several options. There may well be a business case in supermarkets, for example, selling their waste heat, but we are also proposing a case for waste heat to be collected free because it costs money to waste heat into the air – fans and extractors are needed, and these could be dispensed with, if waste heat was being used in the ways we suggest, saving the company money that way.

"Meanwhile, the green dividend for companies providing their waste heat for free should not be ignored, either," he continues, using the example of a foundry in Italy being used as a demo site for the project. "Here, waste is supplied free of charge to the local low-temperature district heating network, as the company their products are more attractive to customers wanting greener products if they can demonstrate a lower environmental impact with the overall production process consuming less energy or recycling part of this. Moreover, they can claim to be having a positive impact on the town".

At the moment, the project is designing the waste heat recovery plants to be used at its four demo sites. As well as in Italy, sites include a hospital and a detergents factory in the Netherlands as well as a solution in Germany, where waste heat is being recovered from sewers, where it is collected from the warm water that leaves people's bathrooms. As well as this work, the project is developing the prefabricated skids and working on their functionality for the different applications to be connected at the sites. Work then moves to assessing the results from the sites, so modelling can take place to assess the impact for towns and cities of using waste heat in these ways.

Fedrizzi is confident that this work will deliver exciting results. As well as the energy savings to be made and the associated reduction in emissions and the use of fossil fuels, this type of waste recovery will also generate significant employment opportunities in the towns and cities where it is deployed.

"Our impact will be of a socio-economic impact at the local level in addition to the megawatt hours being saved by using these systems," he concludes. "By using real-life examples of waste heat recovery in action, companies will be making decisions at the local level that impact on their local area directly – reducing CO_2, creating jobs, reducing heat islands and providing heat and hot water to homes."

PROJECT INFORMATION

Project Title:
Life4HeatRecovery

Project Objective:
Life4HeatRecovery steps further beyond by developing and demonstrate a new generation of smart district heating and cooling networks, where low-temperature waste heat sources can be as distributed as consumers are. Life4HeatRecovery solutions will integrate effectively multiple waste heat sources from urban wastewater and service buildings, where they are available along the DHC network, by managing energy at different temperature levels.

Project Duration and Timing:
4 years, starting June 2018

Project Funding:
3.360.000 € - funded by the European Commission through the LIFE program

Project Partners:
EURAC Research, Alperia, Cogeme, KWA Contracting, Enisyst, Linea Group Holding, Mijnwater, UHRIG, Warmtebedrijf Rotterdam, Municipality Wüstenrot

LIFE 4 HEAT RECOVERY

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