Green heating and cooling technology turns carbon from eco-villain to hero

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This is Professor Bob Critoph of the University of Warwick. Credit: University of Warwick

Carbon is usually typecast as a villain in terms of the environment but researchers at the University of Warwick have devised a novel way to miniaturise a technology that will make carbon a key material in some extremely green heating products for our homes and in air conditioning equipment for our cars.

Most domestic heating and automotive air conditioning requires a lot of

energy. Domestic space heating and hot water account for 25% of energy consumption in the UK. Across the EU, vehicle air conditioning uses about 5% of the vehicle fuel consumed annually, and within the UK it is responsible for over 2 million tonnes of CO_2 emissions.

To combat global warming, new technologies to reduce these emissions are vital. Researchers at the University of Warwick have been working on practical solutions for many years and are now developing new energy saving technologies.

In houses, the best condensing boilers are about 90% efficient. There are electric heat pumps on the market that use electricity to extract heat from the outside air or the ground to heat homes more efficiently, but the electricity used still incurs large CO_2 emissions at the power station. Researchers have long been aware of a much more energy efficient way to drive heat pumps (or air conditioners) using adsorption technology. This uses heat from a gas flame or engine waste heat to power a closed system containing only active carbon and refrigerant. When the carbon is at room temperature it adsorbs the refrigerant and when heated the refrigerant is driven out. A process which alternately heats and cools the carbon can be used to extract heat from the outside air and put it into radiators or hot water tanks. In the case of air conditioning it extracts the heat from the inside of the car. The major snag has been that adsorption technology to date would need to be roughly 300 litres in volume for a car air conditioner and larger for a heat pump to heat your house. Clearly that is not going to fit into a car and the volume of unit required for domestic heating probably couldn't fit under your stairs at home either...

However University of Warwick researchers have made a breakthrough in adsorption systems design that dramatically shrinks these devices making them small and light enough for use in both domestic heating and automotive air conditioning. They have devised and filed a patent on a clever new arrangement that distributes thin (typically 0.7mm thick)

sheets of metal throughout the active carbon in the heat exchanger. Each of these sheets contains more than a hundred tiny water channels (typically 0.3mm in diameter) designed to make the heat transfer much more efficient. This has enabled the Warwick team to create adsorption based equipment that is up to 20 times smaller than was previously possible.

The researchers expect that their new adsorption technology can create domestic heat pumps that will produce a 30% or more reduction in domestic fuel bills (and CO_2 emissions) compared to even the best condensing boiler. In car air conditioning systems their new system can exploit waste heat from the engine, converting it into useful cooling. Because no (or very little) mechanical power is then taken from the engine it will reduce both fuel consumption and CO2 emissions by nearly 5%. The research team also anticipate that in new vehicle models the system can be integrated with little or no extra cost.

The University of Warwick engineers have had significant interest in the new technology from a range of companies, and they have already entered a technical partnership with a major global vehicle manufacturer to develop and demonstrate the technology. There has also been considerable interest from the domestic heating and hot water market

This significant commercial interest has led to a new spin-out company, Sorption Energy Ltd, being set up by Warwick Ventures, the university's technology transfer office, and H_2O Venture Partners. Initially the company will use the new patent pending technology to focus on two high value markets: greener heating and hot water systems for houses and air conditioning for cars.

Lead researcher on the new technology, University of Warwick's Professor Bob Critoph said:
"My team has been working on these developments for several years,

supported by grants from EPSRC and the EU totalling over £2.5million. The technology is now ready for commercialisation and we are very excited by the opportunities which are developing. It is particularly pleasing that the technology will significantly help reduce CO_2 emissions."

Dr David Auty, Chief Executive of Sorption Energy said:

"This is exciting stuff. The technology has been proven in the University's laboratories at the sizes needed for vehicles and domestic systems, and there are several other large markets. The ability to provide products which make significant reductions in both energy consumption and CO2 emissions at a similar price to existing products will make Sorption Energy very attractive to customers, and is very satisfying for the team."

"The UK is the global market leader in gas boilers. There are 21 million gas boilers in the UK with 1.7million installed each year, mainly replacements, and around 11 million units sold annually worldwide. For domestic housing the retrofit market is the primary interest: 80% of the housing for 2050 has already been built. This presents both a massive opportunity both for emission reduction and for UK industry."

Source: University of Warwick (news : web)