From exhaust gases to energy: Making combustion engines more efficient

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Credit: Egor Kunovsky from Pexels

Antoine Lavoisier's timeless statement about chemistry, which goes

'nothing is lost, nothing is created, everything is transformed' could easily be recycled into an EU motto for energy efficiency. Waste heat, for instance, is an important source of CO2 emissions from households, industry and transport which the EU seeks to tackle. But is there viable way to prevent this loss and convert it into additional power?

The EU POWERDRIVER project is one in several projects aiming to enable large scale waste heat recovery in Europe. The project deals specifically with the transport sector, which accounts for a quarter of Europe's total greenhouse gas emissions. It aims to turn waste heat from combustion engine exhaust gas into electricity through the use of a thermoelectric generator (TGEN) technology.

The project was initiated in February 2012 and has already started to bear fruit. Simulation work on a potential automotive application predicts a TGEN output of 300W and 2.5 percent of fuel savings under the New European Driving Cycle (NEDC). The simulation is a key step in designing both the TGEN and the heat exchangers to obtain the optimum system performance (euro/watt) and thermal stability.

'Thermoelectric generators are a very promising technology that enables the recapture of heat energy that would otherwise be lost,' commented Dr. Barri Stirrup, of project partner European Thermodynamics Ltd. 'The POWERDRIVER project aims to help bring this technology much closer to commercial realization. With the simulation work indicating a power output equating to a very significant fuel saving over the NEDC, the project will now progress the design of prototype systems aimed at providing cost-effective implementations of this technology.'

The prototype consists of a TGEN design for a Jaguar passenger car, which is expected to provide both a reduction in fuel consumption and a decrease in carbon dioxide emissions. It will be mounted between two heat exchangers - a hot side heat exchanger and a cold side heat

exchanger. Thanks to the large difference in temperature, the thermo electric materials will produce energy.

Designs will also be developed for two marine diesel applications, but their development and that of the automotive technology will not be a walk in the park. First, the thermoelectric materials under consideration for the automotive application are silicide-based materials, which have a potentially low cost base but need further development to achieve the performance and thermal stability required the viability of the technology. This is not least due to the fact that the TGEN is located within the exhaust line and is subject to significant thermal cycling.

Then, the lead telluride based thermo electric materials being investigated for the marine application have a proven track record in similar applications but present financial and thermal stability issues which need to be overcome. The thermo electric generators require electronic controls which also need to be developed to maximize output efficiency, and the joining of current conductors to the thermo electric material also poses significant challenges.

'Waste heat lost through the exhaust system is one of the greatest sources of inefficiency in current engines and thermo-electric generation offers a potentially attractive means of harnessing this in the form of usable electrical power. We look forward to working with our partners on the POWERDRIVER project to create viable prototype designs for cost-effective implementations of this technology,' said Ricardo chief technology and innovation officer Professor Neville Jackson.

The POWERDRIVER project is a FP7-funded collaborative research initiative involving major UK based end-user organizations. Jaguar Land Rover Ltd is interested in technology capable of being applied to petrol engine passenger cars while Rolls-Royce PLC is interested in marine applications related to diesel engines.

More information: www.powerdriver.info/

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