

# Advanced Waste Heat Recovery Systems within Hybrid Powertrains

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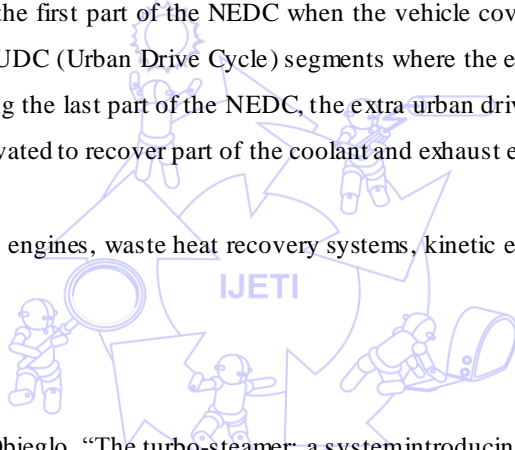
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## Abstract

A waste heat recovery system (WHRS) is very well known to provide no advantage during the cold start driving cycles, such as the New European Driving Cycle (NEDC), which are used for certification of emissions and assessment of fuel economy. Here, we propose a novel integrated WHRS using the internal combustion engine (ICE) coolant passages and an exchanger on the exhaust working as pre-heater / boiler / super-heater of a Rankine cycle. The expander is connected to an electric generator unit (GU), and the pump is connected to an electric motor unit (MU). The vehicle is also fitted with an electric, kinetic energy recovery system (KERS). The expander and condenser are bypassed during the first part of the NEDC when the vehicle covers the four ECE-15 (Economic Commission for Europe - 15) - UDC (Urban Drive Cycle) segments where the engine warms-up. Only after the engine is fully warmed up, during the last part of the NEDC, the extra urban driving cycle (EUDC) segment, the expander and condenser are activated to recover part of the coolant and exhaust energy.

**Keywords:** internal combustion engines, waste heat recovery systems, kinetic energy recovery systems, vehicle hybridization

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