Abstract Waste Heat Recovery (WHR) in waste heat sources of automotive engines has proved to be a path to increase its overall efficiency. Numerous works in the literature show the recovery potential of up to 15 %, but most of them are theoretical estimations, and only in some of them there are results from prototypes fed not with actual engine exhaust gases but steady flow generated in a gas-stand.

The main objective of this work was the theoretical-experimental evaluation of a waste heat recovery system based on a Rankine cycle, applied to automotive reciprocating internal combustion engines in steady conditions. The purpose of this system is to achieve an improvement in the overall efficiency of the automotive engine and a subsequent reduction in fuel consumption and pollutant emissions. The methodology followed to achieve the work combines theoretical studies based on 0-D models in order to evaluate the theoretical feasability of different cycles and working fluids. The interaction between both activities have allowed attaining the indicated objectives.

Respect to the theoretical work, a methodology has been developmented in order to evaluate easy and orderly the WHR system performance for different different working fluids, cycle conditions and waste heat sources temperatures. Subsequently, a technical feasibility was performed in order to obtain information about the construction elements (expanders and heat exchangers), design criteria and overall performance obtained. The purpose of these theoretical works are: firstly, they are an important contribution for the implemetantion of bottoming Rankine cycle, as a waste energy recovering system in vehicles, and secondly, the heat exchanger sizing and expander selection results were used to built a prototype in a test bench.

In order to perform an experimental evaluation of this kind of systems, an experimental ORC prototype has been designed and built and coupled to an automotive gasoline engine. The experimental studies, on which the evaluation of the potential of the cycle was based on most frequent operating points at engine steady operation. The goal of the experimental works was studying the ORC implementation effects on the automotive and, consecuently, quantify the overall engine efficiency.