Modeling and Economic Analysis of Gas Engine Heat Pumps for Residential and Commercial Buildings in Various Climate Regions of Iran

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Abstract

There is an increasing trend in using heat pumps in air conditioning (heating/cooling) systems of residential and commercial buildings. The required power to drive the compressor of vapor compression heat pump cycles may be provided by either an electrical motor or an internal combustion engine. In this paper thermal modeling and economic analysis of gas engine heat pumps (GEHP) are presented based on energy and mass balance equations as well as the gas engine operating parameters (such as thermal efficiency, fuel consumption and fuel mass flow rate) and heat pump operating parameters (such as evaporator and condenser capacity and compressor input power). Based on the modeling results and with estimating GEHP fuel consumption, the economic analysis of using gas engine heat pumps (in comparison with the electrical heat pumps) at various climate regions of Iran, for both residential and commercial (office) buildings, and for both cooling and heating modes, was performed. Appropriate cost functions for predicting GEHP capital investment were proposed. Three approaches including Equivalent Uniform Annual Cost (EUAC), the annual cost of energy consumption, and payback period were applied in the economic analysis.

Keywords: "Gas engine heat pump", "Electrical heat pump"

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