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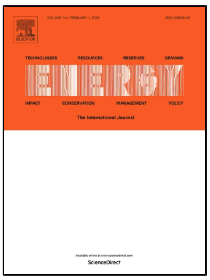

Investment risk for biomass integrated gasification combined heat and power unit with an internal combustion engine and a Stirling engine

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Investment risk for biomass integrated gasification combined heat and power unit with an internal combustion engine and a Stirling engine

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Abstract: In paper, the results of an analysis of the integration of a Stirling engine with a Biomass Integrated Gasification Combined Heat and Power system have been presented. The analyses were conducted for two systems: with and without Stirling engine. The priority for the power system is the utilization of waste biomass. In addition, the system produces electricity and heat for the municipal district heating network. The Stirling engine uses the high-temperature potential of the raw process gas. The use of an additional engine in the cogeneration system permitted an increase in the electricity production. Calculations were carried out for different degrees of gas cooling in the Stirling engine. The basic energy flows in the system, and the thermodynamic assessment indicators were determined. In the next step, the calculations were carried out to obtain the economic evaluation indices. The risk analysis was conducted using the Monte Carlo method. The main technical and economic risk factors concerning the implementation of the cogeneration technology were then identified. On the basis of the determined cumulative probability curves used for obtaining the specified values of the Net Present Value Ratio, the values of the defined indices of the investment risk assessment could then be obtained.

Keywords: Waste biomass gasification, Combined heat and power, Stirling engine, Risk analysis

1. Introduction

Currently around the world, including in the countries of the European Union (EU), technologies that allow the use of countries own energy resources, taking into account the criterion of minimizing adverse effects to the environment, are being promoted. All the technologies that enable an effective use of the potential of renewable energy sources perfectly fit this scope. At the end of 2016, throughout the world, such sources had an installed electricity generation capacity of 2,017 GW, of which 1,096 GW was power from hydropower plants. Among all the recently operating renewable energy sources, the most dynamically growing branches are the wind and solar power industries. Even though in the case of these technologies, the amount of installed electric power is relatively small, e.g., at the end of 2016, the installed electric power was only 487 GW for wind energy and 303 GW