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Techno-economic evaluation of commercial cogeneration plants for small and medium size companies in the Italian industrial and service sector

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HIGHLIGHTS

► The best technologies for 1 ÷ 10 MW distributed generation plant are gas turbine and ORC.
► A variety of commercial cogeneration plants is available to meet user needs.
► Cogeneration is a technical and economical advantage for industrial sector companies.

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ABSTRACT

The liberalization of the electricity market and the concern for energy efficiency have resulted in a surge of interest in cogeneration and distributed power generation. In this regard, companies are encouraged to evaluate the opportunity to build their own cogeneration plant. In Italy, the majority of such companies belong to the industrial or service sector; it is small or medium in size and the electric power ranges between 1 ÷ 10 MW. Commercially available gas turbines are the less expensive option for cogeneration. Particular attention has been given to the possibility of combining an organic Rankine cycle (ORC) with gas turbine, to improve the conversion efficiency. Companies have to account for both technical and economical aspects to assess viability of cogeneration. A techno-economic analysis was performed to identify, in the Italian energy market, which users can take advantage of a cogeneration plant aimed to cover at least part of their energy demand. Since electricity and thermal needs change considerably in the same sector, single product categories have been considered in the analysis. Our work shows that in the industrial sector, independent of the product category, cogeneration is a viable option form a techno-economic perspective.

1. Introduction

The term “distributed generation” refers to a power generation scheme where an isolated plant provides energy only to a limited region around the production/conversion site. As reported by Pepermans et al., it entered recently in the vocabulary of scientific literature related to the electric market [1] even though it was the first method used for electricity distribution. Hence, a precise definition of distributed generation is still missing and the meaning changes very much from author to author in terms of maximum electric power of the plant, application, technology and so on [2,3]. The IEA [2] highlighted five main topics that brought new interest on distributed generation: they are mainly concerned with liberalization of the electricity market, increase of conversion efficiency (loss reduction, combined generation of electric and thermal power), environmental issues (biomass utilization, Kyoto protocol). Many works dealing with distributed generation analyze the feasibility of small self-sufficient plants (up to a few hundred kiloWatts electric power) designed for the exploitation of energy resources placed in isolated locations (such as biomass, geothermal sources, and so on) for onsite production and utilization of electric and thermal power [4–13]. Among the main issues of distributed generation there are lower electric efficiency if compared with large power plants and high initial cost. It follows that the possibility to use distributed generation is related to a more efficient use of the fuel and to a net positive economic income at the end of the plant's lifetime.

The easiest way for a better exploitation of the primary energy is the combined production of electric and thermal power, which is commonly called cogeneration. This technology is very promising because it allows to get higher overall efficiency, and greater energy

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