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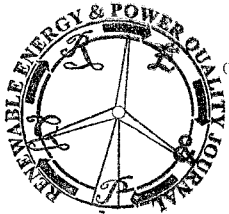


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## Energy Efficiency in Data Processing Centers:

### TECHNICAL-ECONOMIC VIABILITY STUDY FOR A TRIGENERATION



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#### Abstract

This article explores the case of the viability for a trigeneration system, consisting in the production of electricity to provide energy, in a Data Processing Center, both in economical terms and in environmental protection.

Furthermore it is analyzed the present and future situation of IT center energy consumption and associated environmental effects, and also looks at how state-of-the-art technology, correctly implemented, could ensure significant rationalization of data processing center energy consumption. The article will examine optimization techniques, specific problems and case studies.

#### KEY WORDS

Energy Management. Data Processing Centers.  
Energy Efficiency. Trigenation

#### 1. Principles and antecedents of absorption cycle for refrigeration

The system of refrigeration for absorption is a way of producing cold, that, similar than systems of refrigeration for compression, use the heat generated by certain substances while changing from liquid to gas. Compression systems make the cycle using a compressor and the absorption system is based on the capacity of certain substances as lithium bromide to absorb other substances as steam of water through an interchanger of heat.

Microgeneration systems are consolidating as an alternative solution to the progressive reduction of natural resources, because offer high energetic efficiency due to the centralized generation of heat and electricity, avoiding losses of Energy for reasons of transportation [1].

#### 2. Device for Cycle of double effect water/lithium bromide

The device of double effect water / lithium bromide lets a performance both in cold and hot conditions, as in described below [2]:

##### Working in cold condition:

Constructive items of a double effect device are the same that those of a simple effect device, just adding a low temperature generator.

The concentration of the substances is realized in two different stages (in terms of thermodynamics are different effects). First stage is similar than this of simple effect. Second stage consists on a concentration of substances inside the generator in a low temperature, that finally is sent to the absorption system.

##### Working in simultaneously:

The system lets produce simultaneously hot water (80/60 ° C) and cold water (7/12 ° C) adapting it everytime to the necessities of every season, so during the winter it produces hot water for heating, and using an interchanger it could produce cold water.

#### 3. Energy management model (case study: Castile and León Technological Center for Supercomputing), antecedents

One of the most active non-profit making organizations, the Green Grid, has proposed a metric which is becoming the standard when measuring this type of efficiency. It comprises two different parameters, and two equivalent forms of measurement: PUE (*Power Usage Effectiveness*), that represents the total power consumed by the installation, divided by the power consumed by the