Abstract

One of the current main objectives of the European Union is focused on primary energy conservation, as a consequence of the enduring climate change the world is undergoing. Buildings are responsible for almost 40 % of the final energy used in the EU while in Spain, the built environment accounts for 28 % of the final energy consumption. Therefore, such sector plays an important role in the total energy consumption and many specialists are working for the improvement of buildings energetic efficiency.

The benefits obtained through the application of *exergy* concept in buildings are currently known, since they contribute to the proper use of energy as well as to a better adequacy of the different energy qualities taking part in a facility. This is especially useful in buildings where low quality energy demands are required, such as heating, cooling and domestic hot water.

The aim of **Chapter A** is to show the enormous possibilities for the energy efficiency improvement that still exist, which cannot be assessed through a common energetic analysis; in both, new and retrofit buildings.

Because buildings are permanently changing over the time, *dynamic models* are imperative. In **Chapter B** two innovative methods are developed for their transient representations.

Besides, an exergy analysis supports the identification of the economic cost formation in every phase of the energy transformation chain, which is, precisely, the objective of **Chapter C**. Such study is the base of *Thermoeconomics* that, among other applications, enables the exergetic and exergoeconomic costs of all the flows along the system. For that, Symbolic Thermoeconomic is used to obtain general equations, which relate the thermoeconomic variables of every component. The pioneering point is related to the dynamism incorporation, which is, in addition, seconded by a ground breaking dynamic software in the **Annex**.

Furthermore, *thermoeconomic diagnosis* attempts to identify the components affected by any anomaly by analyzing its symptoms according to the exergetic efficiency variations and quantifying the energy recovery potential; unfortunately, it limps in certain aspects. **Chapter D** overcomes the essential issues of the application and succeed in the direct dynamic diagnosis problem resolution.

In **Chapter E**, by contrast, a *Dynamic Advanced Exergy Analysis* is applied for the first time in buildings. Therefore, the corresponding dynamic challenges are solved.

The overall research purpose it to stand out the advantages and disadvantages of the Second Law analyses in buildings dynamic systems. After all, a critical

judgment is the base of any application and the only way forward to achieve the goal of energy and economic savings in buildings.

Key words: