Available online at www.sciencedirect.com
ScienceDirect
Renewable and Sustainable Energy Reviews
11 (2007) 998–1007

RENEWABLE
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ENERGY REVIEWS

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Use of different methodologies for thermal load and energy estimations in buildings including meteorological and sociological input parameters

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Received 17 August 2005; accepted 24 August 2005

Abstract

This review paper provides first an overview of the background for meteorological and sociological influences on thermal load and energy estimations. The different yearly representations of weather parameters (test reference year (TRY), design reference year (DRY), typical meteorological year (TMY) and weather year for energy calculations (WYEC)) are discussed, and compared to simplified representations of weather characteristics. Sociological influences on energy demand are discussed in relation to attitude and culture.

Many methods exist for estimating thermal load and energy consumption in buildings, and they are primarily based on three different methodologies; regression analyses, energy simulation programs and intelligent computer systems. Regression analyses are mainly based on large amounts of metered load data, long-term weather characteristics and some information about the buildings. Energy simulation programs require detailed information about the buildings and sociological parameters, as well as thorough representation of weather data. Intelligent computer systems require metered load data, weather parameters and building information. The advantages and disadvantages of the alternative methodologies are discussed, as well as when and where to use them. Finally, the more specific usages of the methodologies are exemplified through three specific methods: conditional demand analysis (CDA), engineering method (EM) and neural networks (NN).

Keywords: Energy planning; Methodologies; Load estimations; Regression analyses; Energy simulation; Intelligent computer systems

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doi:10.1016/j.rser.2005.08.005

Contents

1. Introduction

Energy planning is a complex task that includes many uncertainties such as available energy resources and energy carriers, distribution systems, peak load values, load profiles and total energy demand. Load and energy demand may be estimated using many different methods. The problem is, which method should the energy planner choose for his or her estimates of the maximum load, load profile and total energy demand for the area in question? Energy planners need this information to be able to project an economically, technologically and environmentally optimal energy system in terms of design and operation [1].

The maximum load value indicates the load level that the energy production unit has to fulfill, and the load level also helps to establish what kind of existing technology can meet that requirement. The running costs and the environmental impact of the energy system are dependent on the operation of the system. The load profile for the specific area will give an indication of the system's behavior throughout the year and will also show the optimal operation of the energy system. It is important to estimate the total energy demand in terms of the possible exploitation of available energy resources in the surrounding area.

The following textbox specifies the difference between the methodology concept and the method concept used in this review article:

Methodology—the fundamental background for the different methods.
Methods—the different estimation techniques developed for load and energy estimations.