



Residential building envelope heat gain and cooling energy requirements

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Received 1 December 2003

Abstract

We present the energy use situation in Hong Kong from 1979 to 2001. The primary energy requirement (PER) nearly tripled during the 23-year period, rising from 195,405 TJ to 572,684 TJ. Most of the PER was used for electricity generation, and the electricity use in residential buildings rose from 7556 TJ (2099 GWh) to 32,799 TJ (9111 GWh), an increase of 334%. Air-conditioning accounted for about 40% of the total residential sector electricity consumption. A total of 144 buildings completed in the month of June during 1992–2001 were surveyed. Energy performance of the building envelopes was investigated in terms of the overall thermal transfer value (OTTV). To develop the appropriated parameters used in OTTV calculation, long-term measured weather data such as ambient temperature (1960–2001), horizontal global solar radiation (1992–2001) and global solar radiation on vertical surfaces (1996–2001) were examined. The OTTV found varied from 27 to 44 W/m² with a mean value of 37.7 W/m². Building energy simulation technique using DOE-2.1E was employed to determine the cooling requirements and hence electricity use for building envelope designs with different OTTVs. It was found that cooling loads and electricity use could be expressed in terms of a simple two-parameter linear regression equation involving OTTV.

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1. Introduction

Buildings, energy and the environment are key issues facing the building fraternity worldwide. In the Hong Kong SAR, there is a growing concern about energy use in buildings and its likely adverse effect on the environment. Hong Kong has no indigenous fuels of her own and has to rely on imported fossil fuels such as coal, natural gas and oil products. With economic growth, especially during the 1980s and

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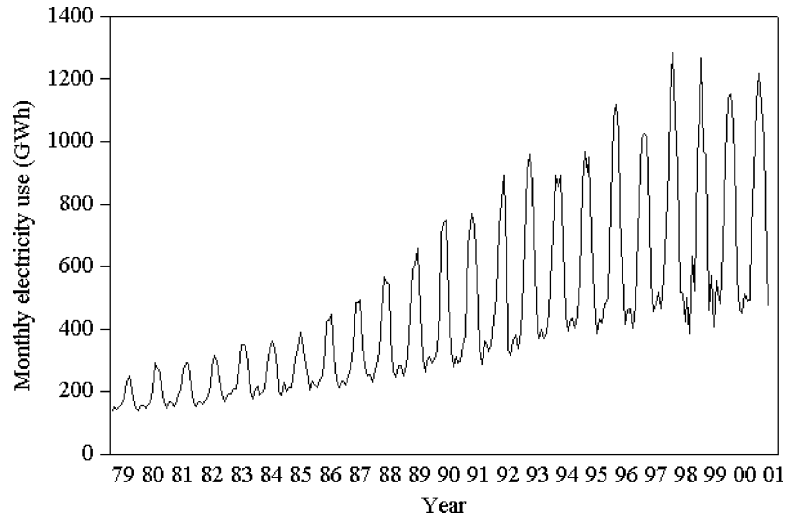


Fig. 1. Monthly electricity use in the residential sector (1979–2001).

early 1990s, there has been marked increase in energy consumption. During the 23-year period, the total primary energy requirement (PER) rose from 195,405 TJ in 1979 to 572,684 TJ in 2001, representing an average annual growth rate of just over 5% [1]. Electricity use in the residential sector is a key energy end-user in the territory. In 2001, residential electricity use accounted for about 24% of the total electricity consumption in Hong Kong. Fig. 1 shows the monthly electricity use from 1979 to 2001. Two variations can be observed—yearly and seasonal. Annual electricity consumption rose from 2099 to 9111 GWh, representing an average rate of increase of about 7% per year during the 23-year period [2]. A significant proportion of this consumption is for air-conditioning during the hot, humid summer months. Fig. 2 shows the monthly electricity use profile for 2001. To account for the difference in

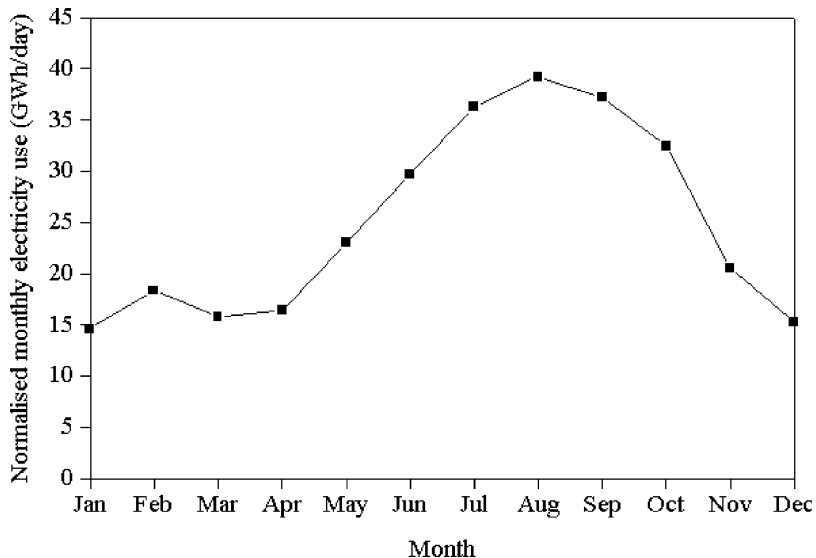


Fig. 2. Normalised monthly electricity use in the residential sector in 2001.

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