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A comparative survey of the energy performances of dwellings across Cyprus

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ABSTRACT

Cyprus, due to a long-lasting political conflict, has been divided for nearly 50 years, Greek Cypriot community living in the southern and Turkish Cypriot community living in the northern part of the island. Research has been carried out on both sides of the island separately, to meet the requirements of the Directive 2002/91/EC on energy performance of buildings. In the present study, an attempt was made to characterize the energy performances of dwellings across Cyprus since the negotiations to settle the problem between the two communities are still in progress. The methodology and the results of a recent survey conducted in the northern part are presented together with an earlier data reported for the residential building stock in the southern part of the island. It is noted that the dwellings in the northern part had relatively smaller mean floor area and lower electricity consumptions. The utilization of central heating systems and double glazed windows were more common in the southern part. Nevertheless, similar house types with often poor external wall insulations, extensive use of solar domestic hot water systems, significant cooling energy consumptions and almost the same primary energy demand per total area appear to be the common features of most dwellings in both parts of the island.

1. Introduction

Republic of Cyprus was established in 1960 with the participation of two main ethnic communities, i.e. Greek and Turkish Cypriots. Long term intercommunal conflict resulted in the division of Greek and Turkish Cypriot communities in 1974, when the Turkish military forces intervened as one of the guarantor states along with Greece and the United Kingdom following a coup d'etat by the Greek junta to the Cyprus government. Since then, Greek Cypriot community has been living in the southern and Turkish Cypriot community in the northern part of the island.

Republic of Cyprus became a full member of European Union (EU) in 2004. Towards the end of EU harmonization process, the high contracting parties of EU stated in 2003 that the application of the acquis should be suspended in the areas of Cyprus (including the northern part) in which the government does not exercise effective control [1]. However, considering the results of the simultaneous referenda on the proposed Annan Plan [2] for the reunification of the island in 2004, EU Council decided to encourage the economic development of the Turkish Cypriot community to facilitate the reunification of Cyprus [3]. The studies started in the same year [4,5] and an instrument of financial support was established in 2006 [6]. The development and restructuring of infrastructure, particularly in the areas of energy and transport, environment, telecommunication and water supply were among the objectives. An approximate budget of 129.25 million Euros out of 259 million Euros was proposed for this priority objective in the first annual report [7]. The proposal on energy mainly included the supply and demand management issues of electricity.

The effective utilization of renewable and non-renewable energy resources is another major task to be achieved within this scope. It is known that the improvements in the residential building sector can be one of the largest cost-effective potential for energy saving [8]. The European Commission issued the Directive 2002/91/EC on energy performance of buildings [9] aiming to promote the improvement of effective energy utilization in buildings. The Directive 2006/32/EC was issued on energy end-use efficiency and energy services [10] which among others, requires the establishment and achievement of national indicative targets in energy saving within a community.

A number of studies have been carried out separately in northern and southern parts of the island for this purpose. Evcil [11] estimated the residential space heating energy requirement in the northern part of Cyprus by investigating the average archi-

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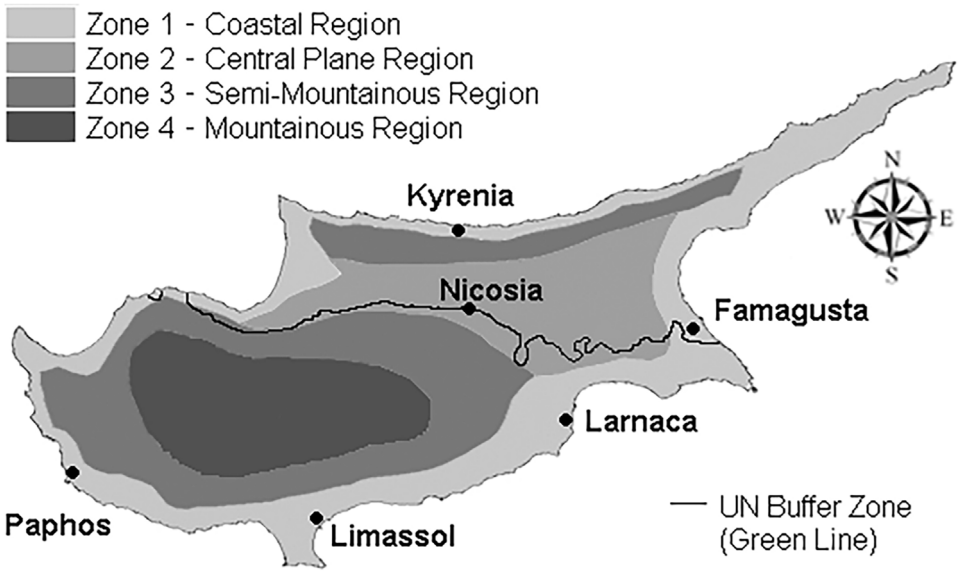

Fig. 1. The climate zones in Cyprus.

tectural and thermal properties of the houses constructed in the area. In this respect, most common building components were analyzed in detail. Considerable amount of information about the dwellings including their walls, roofs, thermal insulations, windows and doors, the overall heat transfer coefficients (U-values) of the building components and also the distribution of habitation among different house types were gathered. It was noted that the energy requirement for residential space heating can be reduced more than 40% after utilization of the building components suggested. In a parallel work, suitable roof constructions were suggested after conducting experiments on 14 different roof combinations [12]. Katircioğlu [13] emphasized the increasing energy demand in northern part of Cyprus due to the population increase in the university education sector.

In the southern part, Florides et al. [14] conducted an energy consumption analysis of the modern houses and noted the importance of roof insulation. Panayiotis [15] investigated the effects of measures such as wall insulation, glazing, thermal mass and orientation of dwellings on energy consumption due to heating and cooling applications. Fokaides et al. [16] compared the measured and calculated energy consumptions of 10 dwellings. It was stated that in summer dominant locations such as Cyprus a large gap may exist between the calculated and measured values by a factor of up to 4. A similar deviation was reported by Serghides at al. [17] who concluded that it was due to the fact that the occupants were not using their heating and cooling systems as it was assumed in the software hence, the software needed modification.

The current work is actually a continuation of an earlier study of one of the authors [11], aiming to extend the work of Panayiotou et al. [18] that was carried out among nearly 500 houses, on the basis of a statistics conducted by Statistical Service of Republic of Cyprus. The work inspected the characteristics and energy behavior of the residential building stock of Republic of Cyprus were identified for the achievement of the targets set by the EU directives. However, the sample group included only the dwellings in the southern part of the island since no statistical data for the houses in the northern part was available in the Statistical Service of Republic of Cyprus.

In the present study, the characteristics and energy consumption behavior of dwellings located at the northern part of Cyprus were analyzed and the results obtained were presented together with the data reported by Panayiotou et al. [18] for the houses in the southern part. An attempt was made to provide more complete and a comparative view of the present situation across the island since the negotiations to settle the problem between the two communities are still in progress to reach a political solution of bi-zonal, bi-communal federal Cyprus.

2. Methodology

Determination of characteristics and energy behavior of residential building stock at the northern part of Cyprus was carried out mainly by a survey based on random sampling. Since the energy behavior was affected by the weather conditions of the climate zone where a house was located and also the type of the house, it was important to consider the percentages of sample distributions in the investigation.

According to Meteorological Service of Cyprus, the island can be divided into four climate zones. These zones indicate the coastal (Zone 1), central plain (Zone 2), semi-mountainous (Zone 3) and mountainous (Zone 4) regions of the island, as shown in Fig. 1. The United Nations Buffer Zone called Green Line between the northern and southern parts of the island is also indicated in the figure. The results of the population and housing census of 2006 in the northern part of Cyprus [19] in conjunction with the climate zones of Fig. 1 were analyzed to determine the distribution of the houses among the climate zones. The percentages of different types of houses constructed were examined using the results of the census. The distribution of houses constructed in the northern part among climate zones and their types are given in Table 1.

An extended version of the questionnaire given earlier by Evcil [11] was executed among randomly selected participants. Random sampling was carried out in conjunction with the data base available at the Electricity Authority of the northern part of Cyprus, which included all the dwellings with electricity connections. It is important to note that almost no dwelling without electricity connection existed in the area.

The questionnaire was prepared to classify the dwellings in terms of their floor area, the number of occupants per house, the year of construction, the type of house, the type of the primary heating system used, the type of main domestic hot water (DHW) system installed and the use of double glazing. The types of primary heating systems and the annual energy consumptions of the dwellings were also analyzed in the same questionnaire. The types