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Classification and performance analysis of primary energy consumers during 1980–1999

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Abstract

Five primary energy consumer classes, namely Super, Major, Big, Medium and Small, are proposed, depending on the polymodal characteristics of the frequency distribution curve of their share of the total. The total primary energy consumption and its annual additions decrease, whereas the rates increase steadily from the Super to the Medium consumers. Since the frequency distribution histogram of additional primary energy consumptions of the Medium and above consumers during 1980–1999 is a typical bell shaped curve, the additional amounts and rates are used together to evaluate the performance levels of the countries in both parameters. The most successful countries are the USA, China, South Korea, Thailand, India, Indonesia, Taiwan, Turkey and Iran. The reason why the Super consumer USA and the Major consumer China are the biggest energy markets is because they are the first two biggest economies in the world. The success of the developing Asian countries is mostly related to their economic ties with the Super consumer USA. Among the other emerging markets, Turkey's primary energy demand has grown more rapidly than that of Iran and is expected to continue growing in the future. The emerging Medium and Big consumer markets will continue to play a significant role in the world's energy sector during the first two decades of the 21st century.

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1. Introduction

Regional distribution of the world's primary energy consumption has never been uniform in the past. For instance, while North America consumes around 30% of the world's total primary

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energy, Africa's share remains at only 3% recently. About half of the world's total has been consumed only in North America and Western Europe together and the rest in the other five regions. On the other hand, the major energy producing regions, the Middle East, Central and South America and Africa, consume only about 13% of the world's total energy. The primary energy consumption of each country is even more scattered than their regional distribution. They range from values close to zero to 97.5 QBtu with an average of 1.74 QBtu in 1999. Such distribution patterns usually prevent us from generalizing the consumer behavior and market performances of related countries and investigating the factors affecting them.

Therefore, the aim of this paper is to first classify the countries according to their primary energy consumptions based on their frequency distribution histograms of 1999. The performances of the primary energy consumption classes in developing their demand capacity from 1980 to 1999 are also evaluated. With this purpose, the annual increase of primary energy consumptions is studied together with its rate of change. Finally, a few of the most significant factors influencing energy market performances are discussed.

The abbreviations "TPEC", "RPEC" and "APEC", which will be used throughout the paper, stand for "total primary energy consumption", "rate of primary energy consumption" and "additional primary energy consumption", respectively. TPEC denotes the total amount of primary energy consumed in a year, whereas RPEC and APEC are the annual rate of change and the amount of change in that particular year, respectively. Unless otherwise indicated, the data used in this study are obtained from the USA Energy Information Administration's (EIA) electronic data banks [1].

2. Primary energy consumer classes

The frequency distribution histogram of 1999 TPEC values of 219 countries is significantly irregular (Fig. 1). A total of 211 countries, out of 219, consume less than 10.0 QBtu.² Furthermore, the consumptions of 168 countries, out of the 211, are less than 1.0 QBtu, and the consumptions of 104 countries, out of the 168, are less than 0.1 QBtu. Additionally, some significant clustering occurs within certain TPEC categories, forming a polymodal curve. The values of 191 countries are less than or equal to 2.2 QBtu (Categories 1–2). A total of 13 countries are clustered within the 2.47–4.74 QBtu range (Categories 3–5), 11 countries are clustered within the 5.23–13.98 QBtu range (Categories 6–11), 3 countries are clustered within the 21.71–31.88 QBtu range (Categories 14–32) and only 1 country has 97.05 QBtu (Category 98).

The polymodal nature of the frequency distribution diagram provides sufficient data to group the countries according to their 1999 TPEC values. In order to classify, however, using the share of world TPEC rather than the TPEC itself appears to prevent the dependency on one single year. The five primary energy consumer classes, which are presented in Table 1, are: (1) *Super consumer* (greater than 25.4%), (2) *Major consumer* (between 5.6% and 8.3%), (3) *Big consumer* (between 1.3% and 3.2%), (4) *Medium consumer* (between 0.6% and 1.2%) and (5) *Small consumer* (less than or equal to 0.5%). The Small consumers may be further divided into subclasses, however the data

² Please note that 1999 consumptions of 41 countries are given as "less than 0.01 QBtu" in EIA's list. QBtu (also called "quad") equals 10^{15} Btu in customary units and approximately 10^{18} J in SI units.

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