



Original research article

Value seeking, price sensitive, or green? Analyzing preference heterogeneity among residential energy consumers in Denmark

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ABSTRACT

This study examines the heterogeneous consumer preference for electricity products in the residential electricity retailing market. Based on consumers' trade-off decision making, we identified three distinct consumer segments: the value seeking consumers (53%), the price sensitive consumers (25%), and the green consumers (22%). We concluded that consumers are willing to pay extra for the increasing share of renewable energy. Consumer socio-demographic characteristics had also influence on their choices for electricity products. The findings of this study can help explain how different consumer segment can be affected by the change of electricity product attributes. Thus, it provides insightful knowledge on how to differentiate electricity products so as to satisfy specific consumer segments' needs. Finally, the findings of this study have implications for energy policy makers (regulators) on consumers' preference for electricity products assuming that consumers should make a choice among various products.

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1. Introduction

As a result of electricity market deregulation in many developed countries in recent years, electricity consumers have a wide variety of choice when purchasing electricity [1,2]. Deregulation has thus made product differentiation a potentially important strategy for the electricity suppliers, also policy makers have an interest in knowing consumers' needs and preferences in order to be able to stimulate competition in the deregulated market. Given the available choices, it is therefore important to understand how consumers make decisions about energy when those decisions necessitate tradeoffs, an important research theme that has been highlighted in energy research in social sciences recently [3]. Both academic scholars and energy practitioners to date have "very little knowledge of customers demand, tastes or preference" [3]. Therefore, understanding consumers' choice decision making can contribute to improve on understanding on human behavior regarding energy consumption. For electric utilities, understating consumer decision making can help identify consumers with

homogeneous needs and to segment them into specific groups, and afterwards to tailor-make offers to meet the needs of these consumer segments, and eventually get the consumers to take actions. Failing to understand the diversity of preferences that exist in the market, can lead marketers to develop ineffective marketing communications and thereby miss marketing opportunities. Therefore, to account for consumer preference heterogeneity is useful for marketers to segment the market. Moreover, understanding consumer preference heterogeneity gives rise to product differentiation and hence to deliver offerings that appeal to consumers [4–9].

The main objective of this paper is to investigate consumer preference heterogeneity among Danish households and to identify possible consumer segments. Specifically, how different consumer segments value different attributes of electricity products, and to identify the distribution of different consumer preferences on the basis of their valuations of attributes as well as individuals' social demographic characteristics. The managerial objective is to provide electricity suppliers with information on consumers' preferences and on how to adapt and differentiate electricity products in order to address the existing demand of green electricity. For energy regulators, this study adds knowledge on the consumers' willingness to choose green electricity that gives the great value for the society.

The research setting of the present study is Denmark. There are several reasons for doing so.

Firstly, the national goal for energy in Denmark is to become a fossil fuel independent nation in 2050 [10]. To achieve this, it

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requires not only a substantial expansion on renewable energy, but also getting more consumers to accept and buy renewable energy. This is because households' demand for renewable energy have significant influence on the expansion of renewable energy [11–16]. On the one hand, a household's understanding of the need for renewable capacity can strengthen their desire to purchase green electricity, which can then help reinforce the government's energy policy and eventually achieve the energy development plan [17]. On the other hand, a household's purchasing and consumption of renewable energy can foster investment in renewable plants because the societal demand for renewable energy becomes more attractive for private investors [18].

Secondly, Denmark has a well-established institution in the electricity market that encourages consumers to make choice decisions. After the deregulation of electricity market, institutional barriers that prevent competition were removed. The Danish electricity market is structured around generators, retailers, wholesalers, the distribution system operators and system operators [19]. Energinet.dk has the primary task of regulating and controlling the electricity market, see Energinet.dk. After the market deregulation, the supply function on both the generation and the retail sales side was removed from the earlier monopolies. Wholesalers and retailers (also known as "electricity suppliers") acquire electricity from the generators and sell to each other and to the end-users. Electricity is delivered from generators to end-users through generation, transmission, distribution [19]. As of 2011, there are around 60 electricity retailers in Denmark competing against one another, among which 33 are regional default suppliers³ [20]. Given this, consumers have great opportunities to shop for electricity products from a wide range of suppliers.

Thirdly, only about 4% of the consumers have either switched their electricity supplier or electricity product in 2011 [20]. Several empirical work have been devoted to investigate the factors explaining why most consumers do not engage in electricity shopping given that there are many alternatives available in the market. Except for the fact that there is a lack of consumer interest in electricity since it is a basic necessity, lack of economic benefits, loyalty to current supplier, perceived high information search cost, unawareness of the alternatives, uncertainty about the consequences of switching were found to be important reasons for consumers to stay with their status quo [21–26]. Lewis et al. [27] claim that consumers see the price savings from switching often in very short-term also hinders switching. Apart from these empirical findings, the institutional factor that all customers will be supplied automatically by a default local electricity supplier, known as the 'default supplier' scheme, has also an unignorable influence on the low consumer responsiveness because consumers may think that the default supplier as an implicit recommendation from the authority [26,28]. These default suppliers take up approximately 90–95% of the total market share in Denmark [29]. This is unfortunate because an important assumption for the deregulation is that consumers will play an active role in trading with the supplier that can best satisfy their needs [23]. Thus, the disparity between the large number of offers and the low consumer activity in the market

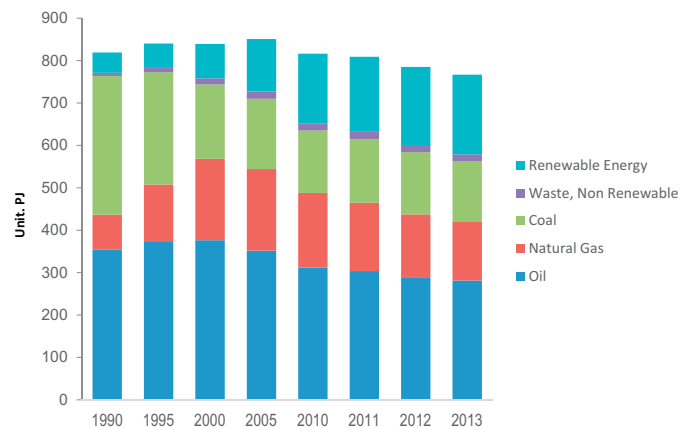


Fig. 1. Gross energy consumption in Denmark.

Source: [108].

may indicate electricity retailers' inability to design an effective target marketing strategy.

Fourthly, the consumption of renewable energy has been growing in the past decades in Denmark, see Fig. 1. Due to the geographic location, Denmark has very limited renewable energy sources except wind (and/or tides maybe in the future). It is therefore of interest for Danish energy policy makers to look into the public preference for renewable energy, which may serve as a foundation for future energy policy design.

Finally, the selection of Denmark, a small nation with a population about 5 million, as a case study allows for closer fit between policies and preferences on a national scale [30].

Because of the low consumer activities with respect to switching in the retailing electricity market, there is a lack of actual sales data for analyzing consumer preference. Instead, we decided to use a discrete choice experiment (DCE), a commonly used multi-attribute valuation method for eliciting consumer preferences [32–36]. In a DCE, a product is described as a combination of different product attributes, and respondents are asked to evaluate the attributes of different products and then make trade-off decisions. Preference heterogeneity can be assessed directly from respondents' stated choice on underlying (latent) segments.

The Random Parameter Logit model (RPL), also known as the mixed logit model, and Latent Class Models (LCM), also known as finite mixture models are two common methods for assessing consumers' preference heterogeneity [36–39]. Both models relax the Independence of Irrelevant Alternative (IIA) assumption and/or uncorrelated error terms [37–39]. The IIA property assumes that choice of alternative A or B is not influenced by the addition or exclusion of a third alternative C [37]. However, each method has strengths and weaknesses. For instance, RPL models are more flexible than LCM models, but LCM models have an advantage on computational simplicity. RPL models may produce inappropriate estimation for describing the continuous representation of preference variation when the sample contains discrete groups with several group-specific tastes, which LCM models cannot capture within-class heterogeneity [40]. Boxall and Adamowicz [31] noted that RPL is unsuitable for interpreting the sources of heterogeneity, such as the characteristics of individuals. In addition, RPL models can induce almost any behavioral distribution of the parameters but LCM models do not require any assumption on the distribution of the parameters [38]. Several studies have compared the performance of RPL and LCM, and concluded that both the LCM and the RPL provide improved statistical fit as compared to Multinomial Logit Models (MNL) [38,41–43]. With respect to the relative merits of RPL and LCM, there are no consensus. For example,

³ It should be noted that while electricity can be produced from various energy sources, it is not possible for consumers to purchase electricity from a specified source due to all electricity generated will be delivered to the outlets through the same grid and network. But when a consumer buys green electricity, s/he will receive a certificate issued by the electricity supplier, which is used to write off the amount of green electricity sold from the total green electricity generation account in the grid. This prevents the same amount of green electricity from being sold more than once. In Denmark, Energinet.dk, a state-owned enterprise, administrates and controls the issuing of green electricity products [19].

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