Developing Trend of Domestic Electricity Tariffs in Great Britain

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Abstract- **Household flat rate electricity tariffs have been ongoing for decades in the UK. The fitness of this type of tariffs is challenged in the new smart grid and smart metering environment, where demand responses are expected to play an important role to support the energy markets and the network. Generally speaking, most advanced electricity tariffs to date aim to reduce energy prices in a competitive electricity market. This paper reviews a range of electricity tariffs exercised by major suppliers in the UK and their associated drawbacks. The need for further development in electricity tariffs is analyzed with an aim to support suppliers undergoing innovations to provide various tariffs for different types of customers to maximize their participations.**

***Index Terms*-- dynamic pricing, tariff design, domestic tariff, demand response, smart metering**

I. Introduction

Household tariffs are set based on 8 classic customer patterns [1] developed in 1960s. The tariffs reflect the total cost of energy generation, transmission, distribution and supply. These patterns and their respective customer volume are generally used for settlement and tariffs. At present, neither time-of-day nor time-of-year tariffs has been widely used in Great Britain, the vast majority of consumers purchase their electricity from suppliers at flat rate tariffs, with no price variations throughout the day and throughout the year.

So far, two types of flat rate tariffs are provided to domestic consumers:

A. Standing-charge tariffs

A standing charge is a fixed amount of cost paid annually to electricity suppliers. The costs of meter reading, maintenance, network connection and energy cost are all included in it. Then, the actual consumption is charged at a fixed unit price. The annual standing charge is averaged at £54.35 across the GB's 6 suppliers [2].

B. Two-tier tariffs

Consumers under this tariff are subject to two tier unit prices, where the fixed cost is thus built into the unit rate instead of a stand-alone charge.

Tier 1 unit price is applied to the first block of consumers' energy use, recovering the suppliers' fixed cost. Tier 2 unit price is applied to electricity usage at and above the first tier of consumption, recovering suppliers' total operational costs. Generally speaking, Tier 1 unit price is higher than that of Tier 2. On average, Tier 1 and Tier 2 unit charges are 17.06p and 12.46p respectively. For households with average consumptions, the first threshold accounts for 768 kWh [3]. Between the two types of tariffs, Two-tier tariffs account for 65 percent of the total population.

In addition to flat rate tariffs, all suppliers offer Economic 7[4] or Economic 10 [5] tariffs which have significantly less customer volume of around 9.7%. These tariffs introduce cheaper night or afternoon rate in order to shift load from peak to tough time, thus reducing energy consumption during peak period. The "seven" in the definition means 7 hours of lower rate electricity, and the time period of the economic rate may slightly differ from one supplier to another, by large they are between 10pm and 8 am. EDF, E.On and SSE also introduced 3 more hours with cheaper rate during afternoon between 12-4pm, in addition to the 7 hours with lower rate between 7pm and 5am. Therefore, the 10 low-rate hours are usually reflected as Economy 10.

Economy 7 and Economy 10, representing the simplest Time of use (TOU) products, have attracted residential consumers who have electrical storage heaters.

II. Current Electricity Prices Tariffs Review

Nowadays, in addition to the standing charge tariff and the two-tire tariff, a range of energy products based on flat rate are supplied by large energy companies in retail market to mass consumers. In this section, we will discuss how these tariffs provided by different suppliers benefit consumers and what consumers are encouraged to do so that their energy saving plan could have a noticeable effect. The portfolio of energy products from three electricity suppliers will be described in the following paragraphs.

A. Southern Electric

✧ 1. Review of tariffs

A tariff with a distinguishing feature in Southern Electric(SE) is named "**Batter plan**"[6]. The chef aim of the product is to reduce energy consumption together with protecting the environment. Once the consumption decreases below 90% of usual household usage, the tariff is geared for providing customers a cash credit reward of £15. As an online account with paperless billing, **Go direct** [7] is managed through internet and paid via direct debit. However, there is an

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exit fee of £50 if the contract is ceased within 14 months. **Fix priced product** [8] provides 10% discount from the electric tariff for up to 14 months without any standing charge. Other energy products based on SE standard tariff, such as **Energyplus Argos tariff** which could offer 10% off purchases at Argos and Homebase, provide cost saving for consumers or made donations to the charity on behalf of the consumers.

✧ 2. Ways to save money with the tariffs

For Southern Electric, incentive scheme is boosting its market share by helping their clients to reduce their energy bills. Firstly, customers who sign up online will be rewarded a voucher worth £40 from M&S. Moreover, monthly direct payment debit will bring a 5% discount on the bill. Besides, it can be seen that a dual fuel plan will be cheaper than tariffs only with electricity or with gas.

B. Eon

✧ 1. Review of tariffs

Actually, at least nine tariffs of Eon are available as options for mass consumers. A number of energy products, including **Standard tariff**, **Fixed Price [9], Go green [10]** and **Energy Saver Capped product [11]**, are associated with collecting Tesco clubcard points. In another word, selecting these tariffs means customers can benefit from it if they shop in Tesco. For **Standard tariff,** bill saving is only available through the payment of direct debit. **EnergyDiscount 5** could help to save a further 2% from the bill for up to 15 months. However, customers may wonder if there's any possibility that price increase in the following months. Truthfully, consumers need have no anxiety on that because **FixOnline [12]** fixes the rate of the electricity for 15 months and 0.5% is saved on the bill. Through online account management, terminations within this period require £10 as a penalty. **Fixed Price** is another kind of product based on standard tariff, but £20 is required for termination in this case.

The tariff of **Energy Saver Capped product** not only limits the bill within a certain amount, but also provides a free monitor as a premium. Terminations should be charges for £30 with the product. **Track and save [13]** guarantees that users of Eon will pay less than British Gas users if their consumptions are above the average value in Great Britain(3300kWh per year). **Warmassist** is mainly designed for pensioners and senior class and 15% discount will be available for them on the standard price.

✧ 2. Ways to save money with the tariffs

Being the best way of payment, direct debit could lead to an additional 8% off the monthly bills whatever the types of the tariffs are. Because of the diversity of the tariffs in Eon, it will be easier for customers to find the tariffs suit them best.

C. British Gas

✧ 1. Review of tariffs

Usually, **standard tariff** of British Gas is paid monthly by direct debit for 18 months without any cancellation. **Websaver 4 and 5 [14]** give 6% discount off the energy bill for a 12-month contract and standard tariff will be available for a further 3-month at the end of the contract. In such a case, cancellation will cost £30 fee. **OnlineSaver** provides a 3% discount for up to 16 months without any cancellation.

✧ 2. Ways to save money with the tariffs

The approaches of getting the best deal from British Gas are managing account online and paying the bill via direct debit. Selecting a dual tariff including both electricity and gas will be more economic for household consumers.

Generally speaking, similarities between the tariffs which are provided by all the suppliers mentioned above are rather obvious. In the first place, nearly all the online account management are accompanied with an efficient way of electricity bill payment. Then, most suppliers have their cooperative partners to realise combination between strong companies and the association between strong enterprises is capable of taking advantage of each other's strengths. The premium of helping Eon users to collect Tesco clubcard point will attract more consumers because their household expenditures will be reduced on both energy and basic living goods. At the same time, these two enterprises will be competitive enough to induce business in their industries. Similarly, SE is associated with Argos and M&S in their energy products by introducing discounts for long-term energy bills contracts. By and large, a long-term contact will cause a bigger discount together with less termination fee. In addition, some expensive tariffs, such as **future tariff** and **zero carbon tariff** which are mainly designed to reduce carbon emission, focus on the application of renewable energy. These tariffs are being accepted by an increasing number of customers gradually and they are expected to be more popular in the next decade. Last but not the least, a number of energy products are related to raising funds for charity as well.

Up to now, a lot of British Gas Tariffs, such as **Online saver (3% discount from standard tariff), Track and save, Standard tariff, Zero carbon tariff** and **Future energy tariff,** are available under the energy smart scheme. In fact, the information of the tariff could often be displayed by smart monitor, but the **websaver** tariff which provides a 6% discount over the standard tariff is not applicative so far.

To sum up the above arguments, the main purpose of the most existing flat-rate tariffs is to attract number of customers by lowering supply cost. In another word, it means that these tariffs are not designed to dynamically follow energy market or reduce network peaks. Smart tariffs are intended to limit the consequences of imbalance between generation and demand sides. Therefore, tariff structure optimization is expected to stimulate demand response to support the supply system.

III. Smart Tariff Types

Tariffs should play significant roles in stimulating demand response, the present tariff structure is not sufficiently dynamic to reflect the inherent uncertainties in the supply system, hence, is not effective in following intermittent

generation or shaving peaks. There are a number of advanced tariffs that are better placed to adjust load.

A. Time of use (TOU)

This approach provides a number of pre-defined peak periods with an intention to reduce peak demand thus peak energy prices. Fig. 1 shows a price distribution under a TOU schedule where it can be seen that a day is separated into several peak and off-peak hours, and the prices of different types of periods could vary dramatically [15] [16]. At present, it is the most commonly implemented tariff in smart pricing scheme and the time based rate has been applied by a large number of domestic customers in the US and Canada.

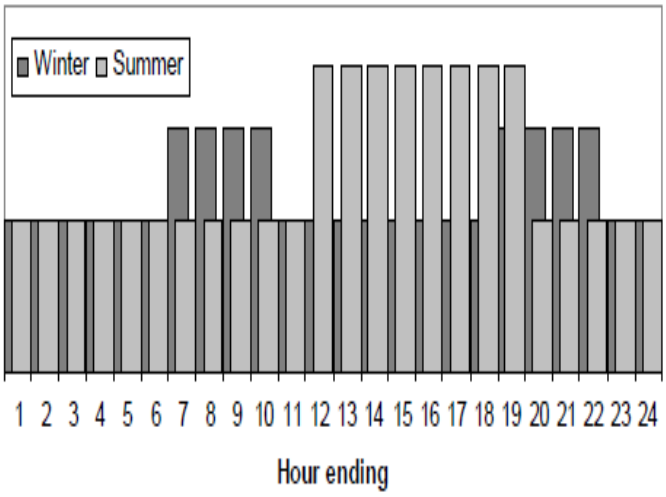

Fig. 1. An example of summer and winter TOU Schedule [17]

B. Critical peak pricing (CPP)

The peak and off-peak time periods for TOU are pre-defined and fixed for a long time, which can be a season. CPP is an improved TOU tariff [18] that traces critical supply period dynamically, the critical peak periods which are always associated with extremely high unit price thus can change from one day to another, and the periods are notified to consumers at least one day ahead. To illustrate the tariff structure comparison between TOU and CPP clearly, an example of CPP tariff is provided in Fig. 2. Until now, CPP is still tested by pricing pilots before its implementation on a large scale.

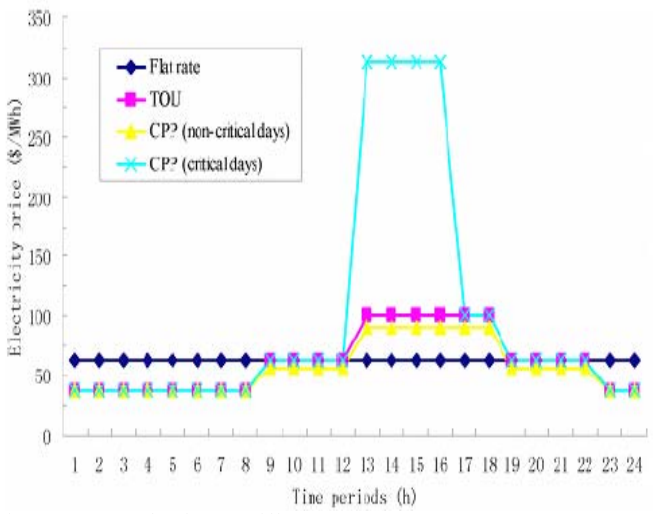

Fig. 2. An example of CPP tariff structure [19]

C. Real time pricing

Real time pricing provides the most direct way of reflecting dynamics of wholesale price variations throughout the day and throughout the year [20] [21] because the price of this tariff varies every hour or every half-hour generally. Some suppliers outside Great Britain, such as Illinois Power Company, manage household energy by hourly prices as shown by Fig. 3. So far, real time pricing is mostly applied in the sector of commercial and industry.

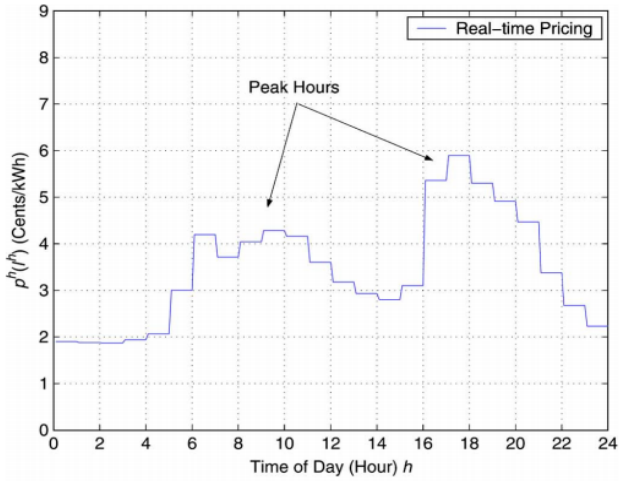

Fig. 3. The real-time prices of Illinois Power Company on 15 December 2009 [22]

D. Load control tariffs

Through the load control tariff [23], consumers allow certain items among electrical appliances to be controlled to realize the feasibility of the tariff with the existing (non-smart) metering infrastructure and the saving in electricity bill.

E. Maximum demand

The tariff, which is widely used in France and Italy [24], prices consumers according the agreed peak demand between suppliers and consumers.

IV. Assessment of TOU and CPP

As described in the last section, the tariffs of TOU and CPP are typically designed with a minimum two or three peak time periods, and the determination of the time windows are largely depend on the then generation capacity and load demand. The initial aim of the demand response programs is to realise efficient generation together with reducing the bills of end-users. Actually the benefit of basic demand response can be predicted, but their adverse effect of inefficient demand side response has been exposed with their implementation simultaneously.

In the pricing scheme applied in Great Britain most of the real-time options are suitable for families who are absence from their houses during peak hours. It means that this type of consumers is able to response for the transmissible price signals without changing their behaviours. However, the fact has reflected that families in Canada with more children will tend to 'lose' with time-of-use pricing compared those with less children [25]. Therefore, the negative correlation between the number of the children per household and the bill reduction may result in the negative correlation between household income and the average household cost change.

Firstly, there is always a conflict between the less flexible electricity consumption time for most customers, like cooking times and the consumption reduction during peak times. As shown in Fig. 4, the usage of most household appliances is not suitable during off-peak periods. It is therefore often not possible to shift load for families with children or members who have to go out for work at set times. In another word, consumers who are not able to change usage habits have to

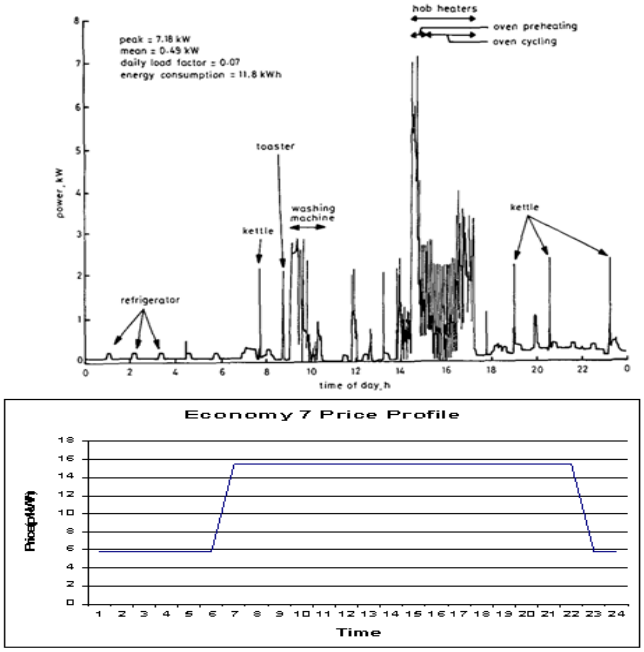

Fig. 4. Electricity demand profile from a individual household with electricity cooker [26]

pay for the high rate during peak periods. As a result, the high rate during peak time may become a burden for families that are not well off instead of being a motivation for shaving peaks. The key point here is that despite that families having differing habits, but the rates are the same. Smart tariffs should promote maximum response from families with differing habits.

Then, it should be noted that smart tariffs which help customers to manage their electricity bills by providing them with as much information as they need so they are aware of the current load and the retail price at anytime through smart meters. Therefore, the improvement of the smart meters requires advanced two-way communication technologies and new software program of pricing electricity. Since the cost of metering is so small compared with their electricity bill over the lifespan of the meter, the expected benefit is much higher than the cost of meter.

The tariff of CPP emphasizes the critically important hours of a year by introducing an extremely high rate so that the demand is attempted to be limited within the range of generation capacity. Thus, it could be concluded that the tariff which is linked closely to wholesale market price are usually more efficient in load reduction if this is the case, then dynamic price would be the best. In addition, even though there is no doubt that customers could respond on energy usage, prices and utility bills, the degree of their responses and the impact on peak demand remains uncertain. The impact of technology and social factors, such as web portal, in-home display, income, education and so forth should be considered in future tariff design as well. The key point is that there is lack of understanding that consumers' tolerance to prices, and price rises.

Broadly speaking, TOU is suitable for the circumstance that the amount of demand and generation could be predicted beforehand. CPP encourages customers' participation then there are uncertainties on peak period and dynamic pricing is attracting customers by cost-reflective and effective real-time consumption managements with price profiles.

V. Conclusion

The paper gave an overview of electricity tariff and energy saving options exercised by three major suppliers in the UK. They already represent significant departure from the current fixed rate tariffs and can be broadly classified into a number of categories by their main purpose, such as tariffs for carbon emission reduction, tariffs for attracting long-term benefits, tariffs for offering economic energy for vulnerable customers and so forth.

Although they are radical improvements over the current system, their main objectives are limited to reducing supplier cost in order to maximise its customer share, they do not fundamentally change the tariff structure for the purpose of promoting demand response to match the changing conditions in the supply system. The review calls for fundamental reform in the tariff structure that is able to recognize the inherent uncertainties in the supply system, and to maximize customer participation by recognizing the inherent differences in family's energy usage habits.

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VII. Biographies

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Furong Li (SM'09) was born in Shanxi, China. She received her B.Eng. in Electrical Engineering from Hohai University, China in 1990, and her Ph.D. in 1997 from Liverpool John Moores University. She took up a lectureship in 1997 in the Power and Energy Systems Group at the University of Bath where she is now Senior Lecturer. Her major research interests are in the areas of power system planning, operation, automation and power system economics.