TARIFF DEVELOPMENT FOR CONSUMER GROUPS IN INTERNAL EUROPEAN ELECTRICITY MARKETS

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ABSTRACT

KEYWORDS: *European Internal Electricity Market, Emergent Consumers, Consumer Load Profiles, Responsive Tariff Development, Competition, Supplier Business Opportunities.*

Competition in electricity supply markets throughout Europe as a result of Directive 96/92/EC of the European Parliament and Council concerning the European Internal Market in electricity will stimulate Energy Suppliers to develop distinctive tariff and value-added products for targeted consumer groups. Emergent and rapidly changing businesses represent a challenging area for the development of new market opportunities by electricity suppliers.

The content of this paper also lies within the guidelines of European Commission Framework 5 – ENERGIE, which specifies "*…pooling of data would facilitate common interpretation of facts and contribute to the development of harmonised standards, procedures, methodologies, process or common research instruments*": in this case referring to electrical load profile data used in tariff construction.

Load Profiles describe the pattern of electricity use (MW-time) by a consumer, or group of consumers, over time. Electrical Load Profiles provide a means of understanding how much electricity is being used by consumers at different time intervals, hourly, daily, weekly, seasonally or annually.

The need for speedy design of new tariff and service products for competitive market conditions, coupled with lack of historical load data for newly emergent businesses, suggests a non traditional approach to these areas with potential for market growth. Responsive tariff development, enlisting the co-operation of selected consumers as partners in relatively short-term load research projects, can generate the load shape data needed for new tariff and service package design and aid rapid evolution of new electricity supply products into the market place.

The consumer partners benefit from energy services and incentives in return for their collaboration. The electricity supplier gains up to the interval measured load data for new tariff developments for emergent business groups and also intelligence about the acceptability of different energy services for consumers.

Experimental responsive tariffs, developed as a result of collaborative supplier-consumer load measurement projects, can contribute to bringing new tariff-service products to the market quickly. These could include innovative tariff-service packages for thermal storage, products for Auto-Producer Consumers, real time pricing and dynamic tariffs and a variety of "Green Tariffs".

Load data is obtained by load research surveys in which metering of a representative sample of consumers takes place. The selection of the consumer sample needs to be statistically sound and additional end-use data are collected on site. Data from the research sample is used to develop and end-use load shapes for each consumer which can be aggregated to give a load profile for a population of such consumers.

The commercial sector is believed to be of particular significance in Romania. Here are particular preocupations to investigate representative commercial consumer load profiles, to developpe new electricity tariffs structure. The Romanian working Group ROMTELM is formed to explore and identify the future needs, in Romanian context, for the provision, processing and use of load profile data to support the developments expected in the liberalised Romanian Electricity Market.

Analysis, using existing tariffs on a real, measured consumer Load Profiles will be used to develop a cash-time sequence which can enable comparisons between tariffs of the effectiveness of cash generation to be made for the selected consumer type.

A range of consumers representative of their market sector would be selected for this analysis. The analysis will allow comparisons of profitability, for the electricity supplier, of a variety of tariffs for the representative consumer types and hence give insights into tariff design.

The paper also shows how new analytical solutions can provide a foundation for the development of tariffs for consumers, which offer choice and promote competition.

European wide electricity market would benefit from developing a common approach and methodologies to the construction of tariffs from measured consumer load data.

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ABSTRACT

Competition in electricity supply is being introduced in Europe, as a result of the Directive 96/92/EC of the European Parliament. The liberalisation of electricity markets will benefit consumers if energy supplier companies can develop distinctive tariff-service offerings for consumer groups.
Emergent and rapidly changing businesses represent challenging new market opportunities for electricity suppliers. Rapid design of new tariff and service products for competitive market conditions, suggests a non-traditional approach. Experimental responsive tariffs, developed as a result of collaborative supplier-consumer load measurement projects, can contribute to bringing new tariff-service products to the market quickly. These could include innovative tariff-service packages for thermal storage, products for Auto-Producer Consumers, real time pricing and dynamic tariffs and a variety of "Green Tariffs".

1. EUROPEAN LIBERALISED ELECTRICITY MARKETS

Competition in electricity supply is being introduced throughout Europe, as a result of the Directive 96/92/EC of the European Parliament (1), which provides a framework for EC member states to begin to open their electricity markets to competition.

The liberalisation of electricity markets will fully benefit consumers only if energy supplier companies can develop distinctive tariff and service offerings for consumer groups to make the electricity market truly competitive.

Few countries world-wide have fully liberalised electricity markets at present, but in Europe most are in the process of deregulating as a result of EC Directive 96/92. Liberalisation on a European level is challenging because different national structures are based on traditional history contained in present electricity supply industries of the member states (2). Some member states have already implemented measures to create more competition within their markets (3), for example UK, Sweden and Finland.

According to the European Commission the average Community share of electricity market opening, in 2000 is 30% (4). The path of free market evolution begins with competition in generation and in supply for larger consumers and moves progressively to smaller consumers. Competition between traditional suppliers and new suppliers entering the market needs to be fostered. New supplier entrants to the electricity market need information on consumer loads but may have limited access to detailed long term measurement-based load shape data which can be used to characterise particular consumer groups for modelling and market predictions.

Deregulated electricity markets need large quantities of data measured, processed and distributed to users. The development of measurement methodologies and data handling processes for the electrical load information that underlies both electrical/financial markets and supplier tariffs/contract formulation, contributes to a pan-European market perspective. The exploitation of new computer and communication technologies is vital in developing optimal processes for such markets.

Consumer Load Profiles are needed for tariff and contract development for Electricity Suppliers and to provide base data for the financial trading in electricity and power exchanges as well as for forecasting.

Electricity suppliers need to develop innovative tariffs to gain new market share. In consequence electricity tariff and contract development has a different, more consumer orientated, dimension in the context of the Competitive Electricity Markets developing across Europe. Responding to consumers' means matching their requirements by the development of a variety of new tariffs and service products.

2. CLASS LOAD PROFILES AND EMERGENT CONSUMERS

Deregulation and competition change the dynamic of energy pricing. Construction of tariffs for large numbers of consumers is usually based on statistically sampled, measured consumer load shapes, which allow the development of class load profiles for whole customer groups (Figure 1). For smaller consumers, historical load research data, corrected for weather related factors, is used as the reference data to provide load profiles for classes of consumer.

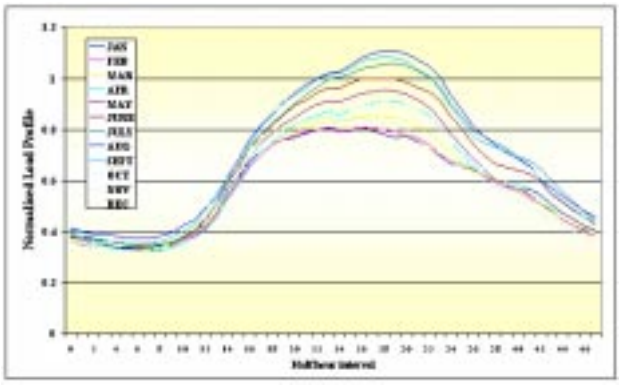

Figure 1. Mid week daily commercial Class Load Profiles by month. Summer cooling peak load.

This tariff design process provides for the fact that small consumer metering is energy related and not interval based. Direct access of consumers to distribution networks, which is a key element of competition in deregulated electricity markets, requires either interval metering or means of balancing monthly meter readings against reference load data. A primary application of load profiles is to account for the demand based energy usage of non-interval metered customers in tariff design.

For any particular electricity supplier in the market, characteristic populations of load profile customers will define his market share (5). In general, these customer populations will differ from the overall population class load profiles. In order to develop better pricing strategies and ensure competition, energy suppliers should be able to encourage these differences through marketing programmes for distinctive tariff-service packages. Tariffs that would benefit consumers might include, for example, remote load control, equipment upgrades, green tariffs or real-time tariffs.

Emergent Consumers

Emergent and rapidly changing businesses represent a challenging area for the development of new market opportunities by electricity suppliers. The need for rapid design of new tariff and service products for competitive market, coupled with lack of historical load data for newly emergent businesses, suggests a non traditional approach to these areas with potential for market growth. These emergent business, initially small in number, have new characteristics in their load shape which lies buried in the class load profiles within the traditional tariff groups assigned to them.
Load research strategies with a more market orientated emphasis, are needed to address the requirements of competition in the European liberalised electricity marketplace.
In particular load profile data are needed to help identification of business opportunities for electricity suppliers in new market niches and allow development of innovative service-tariff packages to facilitate strong market competition .

The nature of commercial and retail loads has evolved significantly. Out of town shopping centres, innovative lighting for displays, the increase of computer technology in banks and shops, fast food outlets, 24 hour shops associated with petrol filling stations which include microwave warmed food, give but a few examples of new or changed consumer electrical load shapes. As the number of emergent consumers in a subgroup grows, the influence of their new consumption patterns will eventually be seen in the overall load profiles. These consumer types will, in the longer term, be absorbed into the overall class load profile as the business types thrive or expire.

Measured load data for new target groups of consumer will need to be acquired comparatively rapidly. Load profiles developed to plan and market service-tariff products should be solely for the use of the energy supplier and treated as competitive market intelligence.
Samples of the emergent consumer types can be monitored and load profiles developed to generate tailored tariff and service products for development of new market segments by electricity suppliers. The design of attractive tariff-services packages specifically targeted at emergent consumer categories provides a competitive edge for electricity suppliers.

Partnership

Load data on which to develop new tariffs for emergent business types will need to be acquired rapidly rather than by the traditional slower evolution of research metered load profile data on statistically balanced samples over a historic period. Relatively short life targeted consumer load investigative projects using temporary and more permanent metering installations provide a vehicle for this process (Figure 2).

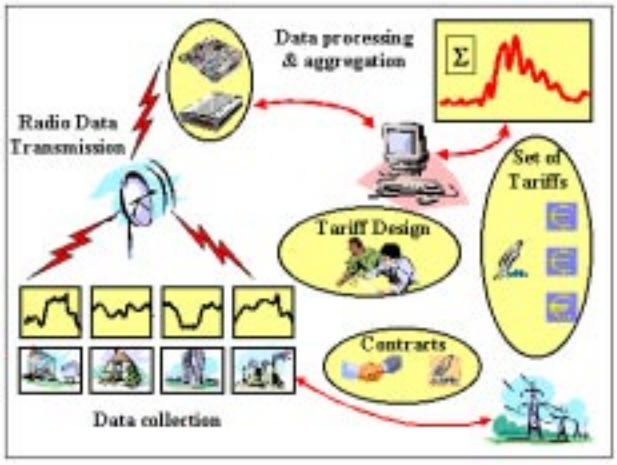

Figure 2. Electrical Load shape aggregation for Tariff and Contract design.

The first stage in responsive tariff development projects is to identify the emergent consumer types from their *business*, rather than electrical load, characteristics. Recent examples of emergent consumer types in Europe might be, out-of-town shopping complexes (with large load including weekends), luxury leisure-sports clubs,(with peak load in the early evening), 24 hour opening of some supermarkets giving a new load patterns, or internet service providers.

In developing a partnership with an emergent consumer to gain market intelligence, data and to develop tariff–service packages, an electricity supplier can offer services or financial incentives, energy management, consultancy to benefit the consumer partner. In return, the consumer provides access to primary data and the opportunity for more detailed investigations of equipment, plant and electricity consumption. The load data measured would become the property of the Supplier for use in generating tariff – service packages.

3. RESPONSIVE TARIFFS

The experimental responsive tariffs can include for example dynamic tariffs and tariffs for energy efficient technology installations. Green tariffs are already becoming established but new tariff designs, for example CHP and small hydro power plant, also have prospects. Dynamic tariffs related to wholesale Power Market prices provide a particularly interesting opportunity coupled with risk management services. Interval metering would be necessary together with price forecasting . Tariffs which respond to consumer needs could include credits or rebates in relation to real-time wholesale electricity prices which could benefit the cash flow of smaller consumers growing their businesses.

CHP and Auto-Producers

Combined Heat and Power plant (CHP) for medium sized consumers may operate because they have a requirement for heat.

In the past the main activity of the auto-producer has been the prime determinant of when there is sufficient electricity to export to the grid since electricity export was a subsidiary goal. Progressively, new CHP plant installations will be sized with the prospect of electricity exports as a part of the overall cost equation. The production activity *in combination* with the role as electricity exporter will be optimised for profit. Smaller CHP plant is finding a new range of applications. Responsive tariff-service packages can encourage growth of this sector. Carefully structured electricity Buy-Sell/Import-Export tariff-service packages, responding to the needs of smaller Auto-Producer Consumers (APCs) provides a business development area for competitive energy suppliers.

Renewable Energy and Green tariffs

Some electricity suppliers in European countries are currently implementing “Green Tariffs” in response to consumer demand; these include suppliers in Germany, Holland, Switzerland and the UK. The electricity supplier guarantees to buy a proportion of his load from generators using renewable sources such as wind power or biomass.
This represents a way of promoting and supporting electricity generation from renewables, for which consumers are willing to pay a premium, and leads to the growth of the renewable sector based on consumer-led preferences. In this case the electricity supplier has designed and developed a “Green Tariff” product in response to consumer preferences for renewable energy stimulated by marketing.

Two types of green tariff structure are developing within a Green Electricity Market. The first category (Supply) matches the amount of renewable electricity bought by the supplier to consumers use, thus allowing a restricted set of consumers to take Green tariffs up to the limit set by the availability of renewable energy. Payment is usually in the form of a premium on top of a conventional tariff (Supply, Table 1). The second category, (Fund) allows the consumer to pay additional contributions to support future investments in new renewable electricity generation resources.

TABLE 1 - Examples of Green Tariffs.

Type of renewable	**Green Tariff type offered** (Supply or Fund)	Premium or cost	
Biomass and wind	**Supply** - Standard tariffs with premium Economy 7 or standard domestic	+ 8%	Yorkshire Electricity UK (8)
Solar	**Fund** - Standard tariff + supplement for a selected amount of electricity above a monthly threshold above 5 kWh		Badenwerk & EVS Germany
Biomass, Wind	above 20 kWh	1.60 DM/kWh	(6)
Hydropower		10 Pf/kWh	

In Germany, "Environment Tariffs" are offered by Badenwerk and EVS (6). Twelve electricity suppliers in the UK offer a range of Green Tariffs certified through the Energy Savings Trust accreditation scheme (7). The combination of renewable sources used varies with the supplier, for example Yorkshire Electricity (8) offers a tariff for accredited wind and biomass renewables, while PowerGen's Green Supply electricity covers all renewable sources. Independent "Green Certificate" systems, are being used to provide consumers with the assurance that the electricity supplier is supporting generation from renewables.

Photovoltaics and net metering. A further sector of the renewable electricity market for which the technical means is available, but still expensive, is solar photo-voltaics (PV). In future, the possibility of marketing Solar PV tariff-supply-installation packages exists in response to consumer-preference-led demand similar to the broader green electricity movement. Initially partnership with architectural designers could provide electricity suppliers with the route ahead through pilot projects pioneering tariffs for solar PV. One approach could be "net metering" where the meter is allowed to run backwards giving credits to the consumer for exports of electricity to the grid. Responsive tariffs would need to be designed based on net consumption in relation the sunlight regime in the region (9).

Small hydropower plant (SHPP). Suitably located, small scale hydropower plant (SHPP) can provide electricity for individual moderate-sized consumers, for example domestic groups or commercial / industrial establishments. Considerable potential for the development of SHPP installations exists across Europe (10). However the electricity generated from hydropower varies annually, seasonally and daily according to rainfall so a Hydropower Auto-Producer Consumer (H-APC) may, at some periods of time, need to buy power from the grid but will have surplus electricity to export at other times. As with the case of CHP auto-producer consumers, Buy-Sell, Import-Export electricity tariff and service packages, need to be designed responding to the needs of the H-APC.

Investment in new SHPP could be encouraged with the prospect of trading Certificated Green Electricity in the future. A further option for H-APC, depending on the extent of his water storage capability, is to monitor real time electricity prices and to give priority to generation for export to the grid when electricity prices are forecast to be high. This mode of operation allows the H-APC to optimise his costs.

Real Time Pricing and Dynamic tariffs

In developed Wholesale Electricity Markets, for example the UK, the Nordic countries and some states in the USA, real time electricity prices are available on a half-hourly or hourly basis. Prices fluctuate with demand and the cost of generation and, on occasion, the prices can show sharp peaks influenced by for example weather, the availability of generation capacity or market conditions (Figure 3) (11).

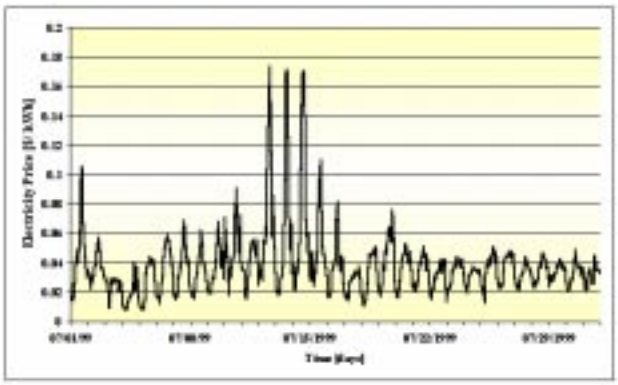

Figure 3. Real time prices variation for typical power exchange for a summer month.

Tariffs based on static load profiles derived from load research meters for consumer samples are predetermined and fixed in advance, albeit reflecting season, month and day type. A disadvantage is that static load profiles do not follow actual weather patterns. The correspondence between tariffs based on static load profiles and real time prices can be poor and designing new tariffs to align more closely with power exchange prices can reduce overall costs and benefit consumers.

Dynamic Load Profiles. Tariffs based on Dynamic Load Profiles give much better accuracy than those designed using static load profiles (12). Dynamic load profiles are developed by using daily interval readings from selected meters to produce load shapes for different consumer classes and segments within the classes. This requires rapid processing and verification of considerable volumes of data to make the dynamic load profiles available and communicate them to consumers ahead of billing.
Energy suppliers can use dynamic load profiles to create competitive **"**Dynamic Tariff" products to offer selected groups of consumers. Tariffs based on the dynamic load profiles allow costs to reflect demand more closely with benefits passed on to consumers in lower costs.

Real Time Pricing Tariffs. Real Time Pricing Tariffs related to Electricity Pool or Power Exchange (PX) prices on an hourly or half hourly interval basis also present market development opportunities to Electricity Suppliers responding to consumer needs for competitive pricing (13). Real time pricing (RTP) tariffs can be developed responsively for particular consumer types.
An example of an experimental RTP tariff is shown in Table 2 (14). The base tariffs E19-S or E20-S are maximum demand TOU thus the outcome of incorporating the real time elements is a complex tariff.

TABLE 2 - Example of an Experimental Real Time Pricing Tariff - based on Hourly Power Exchange Prices (14).

<table>
<tr><td>Base tariff
(Secondary voltage)</td><td>Real Time Price(RTP) customer charge per meter per month- $</td><td>RTP Demand Charge $/kWh of MD</td><td>RTP
Base Rate $/kWh</td><td>RTP
Variable Rate
$ /kWh</td></tr>
<tr><td>E19–S medium-commercial/ industrial (up to 499kW MD)</td><td>450</td><td>2.95</td><td>0.00346</td><td rowspan="3">RTP Variable Rate

The RTP variable rate changes hourly according to the suppliers cost of procuring energy from the Power Exchange. Costs vary by season & time of day.</td></tr>
<tr><td>E 20-S commercial/ industrial
(up to 1000 kW MD)</td><td>660</td><td>2.95</td><td>0.00346</td></tr>
<tr><td colspan="3">NOTE Before 4 pm consumers are informed of the hourly real time prices (RTP) for the next day running midnight to midnight. Prices change on the hour.</td><td>Base rate remains constant from hour to hour</td></tr>
<tr><td colspan="5">Supply- The monthly bills are calculated as if the consumer was still on a standard tariff (E19-S or E20-S) but the difference between the amount due under the standard tariff and the amount due under RTP appears as a credit or debit. Data showing customer energy consumption and RTP in the PX in each hour are given. The PX cost component is determined by multiplying corresponding PX unit cost and customer energy use for each hour.</td></tr>
</table>

Cost benefit is achieved through a RTP credit or debit against the standard tariff. The consumer load profile is measured and used with PX prices to assess the difference from the standard rates based on the class load profiles. On the basis of such an experimental tariff, a more refined RTP tariff can be developed responding to the consumer group characteristics.
Depending on the nature of the wholesale power market real time pricing tariffs can incorporate elements such as forward market costs, real time settlement costs and adjustments for factors (as distribution losses and service costs. The interval basis - hourly, half hourly or daily - will depend on the nature of the PX. Real time tariff package variants can include different levels of financial risk management using financial market tools. Distinctive PX and Electricity Market trading operations will develop across Europe as the influence of Directive 96/92 promotes opening of competition.

4. CONCLUSIONS

The progressive liberalisation of European electricity markets brings the prospect of new business opportunities for suppliers and reduced costs for consumers through innovative design of tariffs.
Responsive tariff development projects address the needs of new consumer types and can bring new tariff-service products to market, thus aiding competition. The approach provides scope for innovation by suppliers in rapid collaborative development of new tariff offerings for the European liberalised market .

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