

HOUSEHOLDS ELECTRICITY USAGE ANALYSIS AND THE EFFECTIVENESS OF CHANGING TARIFF GROUP

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After the introduction of the Energy Law in 1997, many enterprises started to operate in the power industry, which is translated into the electricity prices competitiveness. The further household tariff extension with more expensive rates at peak times, and favorable lower rates during the night and off-peak hours, did not result significantly change among users belonging to the most generic household tariff G11 with a single electricity rate per kWh (Kilowatt hour) regardless time of use. The article analyzes the electricity purchase and supply costs of the largest households group belonging to G11 tariff and simulates the effectiveness of moving from existing tariff group to the offered competitive tariff according to electricity suppliers.

Keywords: tariff group, electricity price, electricity distribution rate, kWh

1. Introduction

Participants of the electricity retail market comprise, along the end-users (both households and businesses), undertakings managing distribution network, including Distribution System Operators (DSOs) and electricity suppliers (trading companies). In total, there are approximately 17,05 million of end-users and among them 90,3% (15,4 million) are the customers in G tariff group, with a great majority of household consumers (over 14,5 million). The rest of end-users are customers belonging to A, B and C tariff groups [4]. Groups A (top, strategic clients) and B (big, key clients) include the customers supplied from the high and medium voltage

grids, whereas group C are the customers connected to the low voltage grid, consuming electricity for the purpose of business activity and they are referred as commercial customers.

For the households, powered at low voltage, the business entities have created couple of different tariff groups, which differ by time zone (single or two time zone meters) and whether electricity is used for heating or not. The most generic household tariff group is G11 – customers having single-time zone meters with a single electricity rate per kWh (Kilowatt hour). The remaining tariff groups, G12 and G12w, are time and weekdays dependent. G12 is effective between 10pm and 6am and between 1pm and 3pm while G12w is additionally effective during the weekends (between 10pm on Friday and 7am on Monday).

The variety of households is large. The main division can be observed between the urban and rural households. A typical urban household is defined as a household located in a block of flats and using district heat. In 2015, this household group comprised 38.1% of all households in Poland. In relation to households residing in urban areas, this was 58% [3]. The average dwelling floor area amounted to 50.5 m² while the average annual consumption of electricity per 1 m² is amounting to 32.6 kWh. Urban Households did not use solid fuels, heating oil, or any form of renewable energy.

A typical rural household residing in a single-family house with a floor area amounted to 108 m², heated with solid fuels [3]. The average consumption of electricity was by 17% higher than the national average for all households, but the average consumption of electricity per 1 m² of the house floor area was however low, amounting to 24.2 kWh. This results from using a large average house area, plots and different structure of refrigeration equipment for own food needs. Rural households are often included in two zone tariff group (Fig 1).

Assigning individual household into a tariff group, the DSO uses developed load profiles (Fig 1,2). The main criteria taken into account are: customer type, historical or planned annual electricity consumption, technical connection point parameters - such as phases number, and finally the use of a metering and settlement system.

After the market liberalization, as users exercise their right to change electricity suppliers, the number of TPA (Third Part Access) customers grows dynamically every year, at the end of 2013, it reached 92,600 for business customers and 135,600 for individual customers. This number remains still lower compared to the majority of European energy markets. Poland is lagging far behind developed markets, where the average number of customers switching electricity supplier varies from a few to about a dozen percent annually, whereas on the most developed markets, e.g. in the UK, it is over 20%. The article analyzes the electricity purchase and supply costs of the largest households group belonging to

G11 tariff and simulates the effectiveness of customers' traffic within tariff groups offered by electricity suppliers.

2. Household pricing policies

According to the regulation of the Minister of Economy dated on 18th August 2011 on detailed rules for calculating tariffs [5], The President of Energy Regulatory Office (ERO) retains the obligation to annually submit electricity tariffs for approval with regard to consumers of G tariff group (composed mainly by households) connected to the grids of the DSO, and who have not switched supplier. Electricity prices for these consumers are included in the DSO and supply companies tariffs, approved by the President of ERO and published in "Branch Bulletin of Energy Regulatory Office – Electricity". Prices for other consumer groups are shaped by the market. Tariff structure for householders contains two main categories of pricing and rates [4]: network rates and electricity purchasing price. The network rates include energy transmission and distribution (T&D) services, expressed in PLN (polish currency) per kWh and the fixed component concerning electricity measurement and billing systems for invoice settlement. The second, energy pricing component contains electricity prices expressed in PLN per kWh, which should cover the energy production costs, and the transitional fees (or terminating long-term contracts). Electricity prices can be varied due to time zones or seasonal period.

The household segment (G tariff) contains mainly G11 tariff group with a fixed electricity price regardless the day and time of use (so-called single zone), applied and G12 tariff group, with lower rate at night and higher in the day (so-called two-zone) (Tab 2). Two other sub tariff groups are used: G12r for those using in addition electricity for promises and water heating. G12w tariff group with economical fare nights and weekend rates [1].

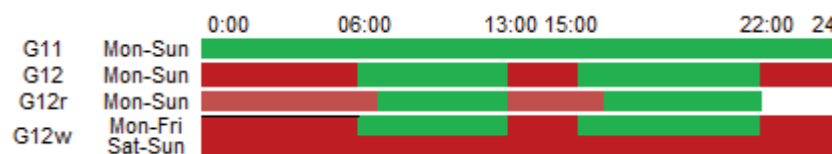


Figure 1. Household segment tariff zone

Depending on the tariff plan the customers can benefit from lower prices per kWh if the usage falls between certain time zones. In tab.1 both sales and T&D

rates for G11, G12, G12r and G12w are presented according to operating on the polish market DSO [1]. G11 tariff has fixed price of 0.30 PLN/kWh for electricity sale and 0.22 PLN/kWh for electricity T&D. G12r tariff plan has lower rate of 0.18 PLN/kWh between 10pm and 7am and between 1pm and 4pm while the higher rate of 0.40 PLN/kWh is applicable outside these windows. The electricity T&D rates fixed as 0.24 PLN/kWh during peak hours and a lower rate of 0.06 PLN/kWh when off-peak. G12w has lower rate of 0.24 PLN/kWh for electricity purchasing during the weekends and Monday – Friday between 10pm and 6am and between 1pm and 3pm while the higher price of 0.36 PLN/kWh is applicable outside these windows. For this tariff group the T&D rates set respectively 0.26 PLN/kWh and 0.05PLN/kWh during the peak and off-peak period.

Table 1. Electricity prices and T&D rates in individual tariff groups
(1 Polish PLN ~ 0.25 Euro)

Tariff group	Fixed price	Peak	Off-peak
Electricity prices			
G11	0.2969		
G12		0.3464	0.2247
G12w		0.3625	0.2358
G12r		0.3980	0.1801
T&D rates			
G11	0.2296		
G12		0.2510	0.0580
G12w		0.2632	0.0583
G12r		0.2383	0.0615

Source: own preparation on the basis of EDO materials [1]

3. Dataset characteristics

An extensive research conducted since 2002 by the Polish Power Transmission and Distribution Association PTPiREE [2] has produced a directory of electricity consumer characteristics, and on this basis the so-called standard profiles. The research finally conducted to the conclusion that, households settled according to G12 tariff group do not use a significant more amount of energy during the off-peak load zones than households settled in line with single zone rate. A working day and weekend day average load entities profiles are presented in Figure 2 and Figure 3.

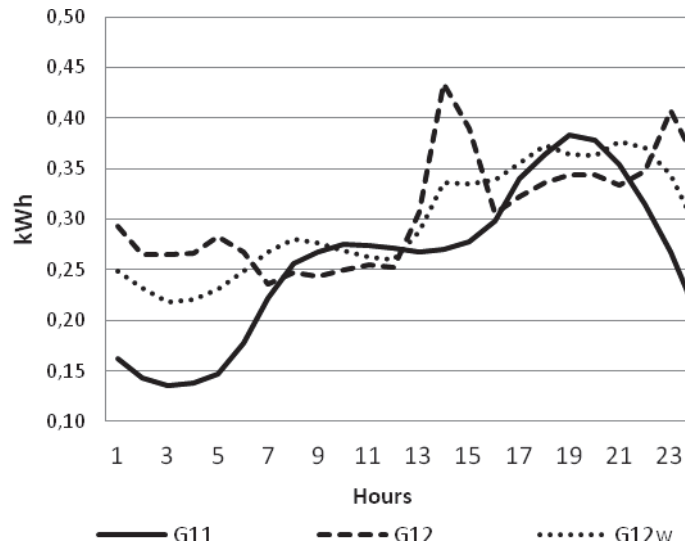


Figure 2. Working day hourly average load profiles according to G11, G12 and G12w tariff

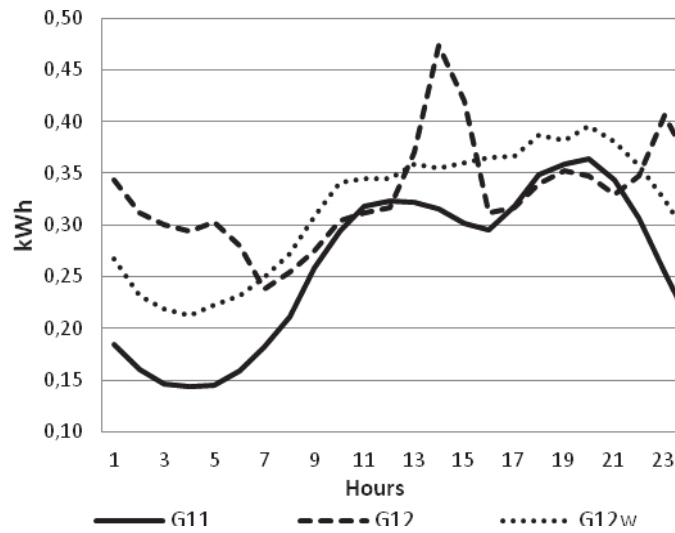


Figure 3. Weekend day hourly average load profiles according to G11, G12 and G12w tariff

It would seem that by choosing two-zone tariff group, customer should use electric devices in such way that the maximum electricity consumption falls during periods of cheaper electricity rate. While electricity consumption structure does not show any significant difference between individual group users, the electricity consumption and the network T&D costs in different settlement zones are significant. This paper will compare individual hourly both consumption electricity purchasing and T&D cost applying various tariff rates in accordance with available DSO tariff groups (G11,G12, G12w and G12w) [1].

This study was performed based on historical data representing energy consumption observed at 200 entities, including small and large households. The data set included hourly data covering the time window between 1 January 2015 and 31 December 2015. The daily load curves have different shapes depending on the day type (workday, Saturday, Sunday, or holiday) and the season. The analysis focuses on the simulation of electricity purchasing and energy transmission and distribution costs for households. Due to the fact that there were only a small share in the total bearing costs, the fixed component concerning electricity measurement and billing systems for invoice settlement and the transitional fees (for terminating long-term contracts) are ignored.

3. Simulation of households electricity consumption cost based on different tariff group rates

The G11 tariff is the most popular one used for households. The individual costs of using electricity by households according to acting in polish market DSO tariff are varied. Based on empirical analysis concerning electricity usage among 200 individual households belonging to G11 tariff, it results that in the analyzed period between January 1 and December 31, 2015, 77% of them would have lower bills concerning electricity purchasing, if they were moved to G12w tariff group, and further 7% of them were moved G12 tariff. Only 16% of the analyzed households should stay in their current G11 tariff. As presented in Table 2, the summarized electricity consumption cost for all the 200 customers reaches 2 409 013 PLN. If the customers would chose appropriate tariff the electricity cost would amount to 2 365 681 PLN what would give them savings of about 43 331 PLN (1.44%). The savings are mainly due to the switching the tariff from G11 to G12w – 34 862 PLN, and from G11 to G12r – 8 469 PLN.

Table 2. Simulation of households electricity consumption cost based on different tariff group rates

Tariff group	Electricity consumption costs [PLN]	Electricity consumption cost [in %]
Electricity cost in G11	2 409 013.47	100.00
Electricity cost in G12/G12r/G12w	2 365 681.60	98.56
Customer savings due to switching	43 331.88	1.44
Electricity consumption cost after switching the tariff	Electricity consumption cost [PLN]	Customer saving
G11 tariff group	34 859.97	0
G12r tariff group	257 121.63	8 469.40
G12w tariff group	2 073 699.99	34 862.48
Total	2 365 681.60	43 331.88

Source: own calculation on the basis of DSO [1] tariff rates

Concerning electricity trading, even the calculation indicates so many households can make benefit while moving from the popular G11 tariff to other available tariff groups like G12w and G12r, most of them remain at their current G11 tariff and users migration in this segment is limited. This is due to the insignificant value of bills reduction regarding electricity purchase. Another issue is the level of margins in the household segment (G tariff). Price regulation with respect to the G tariff group led to maintaining low margins on sale. For years they were at the level between zero and merely a few percent [4].

Table 3. Simulation of households electricity T&D cost based on different tariff group rates

Tariff group	Electricity T&D cost [PLN]	Electricity T&D cost [in %]
T&D cost in G11	1 862 948.78	100.00
T&D cost in G12/G12r/G12w	1 209 248.92	64.91
Customer savings due to switching	653 698.86	35.09
T&D cost after switching the tariff	T&D cost [PLN]	Customer saving
G11 tariff group	0.00	0
G12r tariff group	110.57	69.18
G12w tariff group	1 209 139.35	653 629.70
Total	1 209 249.92	653 698.88

Source: own calculation on the basis of EDO [1] tariff rates

However, the situation looks very favorable in the area of T&D fees. The analysis shows also significant differences in distribution fees for households belonging to different tariff groups. Almost 97% of households can reduce significantly their bills concerning energy transmission and distribution moving

from G11 tariff to G12w. The remaining users can slightly see profit in their bills prescribing to G12r tariff.

As presented in Table 3, the summarized electricity T&D cost for all the 200 customers reaches 1 862 948 PLN. If the customers would chose appropriate tariff the electricity T&D cost would be reduced to 1 209 249 PLN what would give them savings of about 653 698 PLN (35.09%). The savings are mainly due to the switching the tariff from G11 to G12w – 653 629 PLN, and from G11 to G12r 71 PLN.

Based on this empirical analysis concerning electricity usage among 200 individual households the share of revenues prescribed the network infrastructure amount to 56,4% compared to 43,6% prescribed to energy sales. Consequently, this policy limits in G11 tariff group both the households benefit from lowering electricity prices on the wholesale market and the threat of competition from contracts under the TPA mechanism.

4. Conclusion

This paper analyzes the electricity cost incurred by households and what would be the most suitable and cost-effective for the end users while switching tariff group. Although the most popular G11 tariff dedicated households named basic tariff means transparent rules – one rate for electricity regardless time of use, no need for planning and easy cost estimation, it remains the most expensive comparing to other available tariff in this segment. Comparing G12w, G12r and G11 tariffs, it can be concluded that increasing electricity consumptions during the peak-off or night zones by running for example some equipment like washing machines or dishwashers in the cheaper zone hours, will allow to change tariff group and consequently lead to significant saving. On the other hand, the tariff policy of dominant capital groups, accepted by the Energy Regulatory Office, currently leads to a situation where the price differential of electricity itself is small between them. Significant diversification of the whole cost of electricity use may appear only after taking into account the T&D costs of delivery. Unfortunately, individual household, are characterized – and hence blocked – by poor abilities to evaluate and compare offers, as well as by low awareness of the market and competitors.

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