



# Comparison of Two Different Electricity Tariffs for a Residence in Sivas, Turkey

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## Abstract

In this study, single- and multi-rate electricity tariffs for a residence in Sivas province were compared. Consumption in the residence was determined by examining the 5-year electricity bills of the house calculated based on pricing for the single-rate electricity tariff and the cost was calculated based on pricing for the multi-rate electricity tariff. The calculations revealed that monthly electricity consumption in the residence ranged between 220 kWh and 280 kWh. If the current consumption is priced using a multi-rate tariff, the energy cost will be reduced by only 7%. Electricity consumption habits should be supported by awareness-raising programs, and peak and day time electricity demand should be reduced by shifting electricity consumption to night hours.

**Keywords:** Single-multi time rate tariff, Electricity consumption, Energy efficiency

## 1. INTRODUCTION

In recent years, there has been a significant increase in demand for electricity both in the world and in our developing country. Meeting this demand with regional and national means plays an important role in terms of Turkey's energy security and energy policies. The demand for electricity in Turkey increased by 100%, from 125,000 GWh in 2000 to 275,000 GWh in 2016 [1]. Total electric energy consumption which was 554 kWh per capita in 1980 increased to 3288 kWh per capita in 2014 [2]. Therefore, to meet electricity demand, it is very important not only to install new electric power systems and renewable energy systems such as solar, wind and biomass but also to efficiently use electricity generated at present and to save energy. Consumption of electricity energy varies from one hour to another during the day. Energy investments and distribution of power should be designed so as to meet the highest demand during the day. To achieve this goal, additional power plants should be installed, or electricity consumption should be shifted from the hours when the demand is highest to the other hours of the day when the electricity is cheapest. The analysis of the hourly electricity demand demonstrated that the demand increased up to 38000 MW between 6 a.m. and 12 noon, and was 33000 MW between 6 p.m. and 11 p.m [3]. In order to reduce the changes in electricity demand, the Electricity Market Law published in the Official Gazette dated August

10, 2002 changed the tariffs in the Electricity Market Tariff Regulations to shift the consumption of electricity to the hours when demand for electricity was low [4]. Electricity generation companies price electricity bills on one- and three-rate tariffs. In the three-rate tariff, the period between 6 a.m. and 5 p.m. was regarded as daytime, between 5 p.m. and 10 p.m. as peak time and 10 p.m. and 6 a.m. as nighttime [5]. In the three-rate tariff, the electricity price is approximately equal to that in the one-rate tariff during the daytime, is the highest during the peak time, and is the cheapest during the nighttime. Figure 1 shows the amounts of peak-time demand and the increase rates according to years. The peak-time demand for electricity increased more than twofold from 2000 to 2016. As shown in Figure 2, 24% of electricity (51,085,627.94 MWh) is consumed at homes [1]. Therefore, it is clear that if electricity consumption at homes is shifted to night time, households can significantly reduce their energy bills.

## 2. MATERIAL METHOD

According to the data released in 2016, in the province of Sivas, 1,099,824.54 MWh of electricity was consumed [1]. Of this amount, 49,993.17 MWh was consumed for lighting, 318,070.88 MWh at homes, 29,683.25 MWh for agricultural irrigation, 396,653.72 MWh in industry and 305,423.52 MWh in places of business [1]. In Sivas, the amount of electricity consumed at homes accounts for 28.92% of the total

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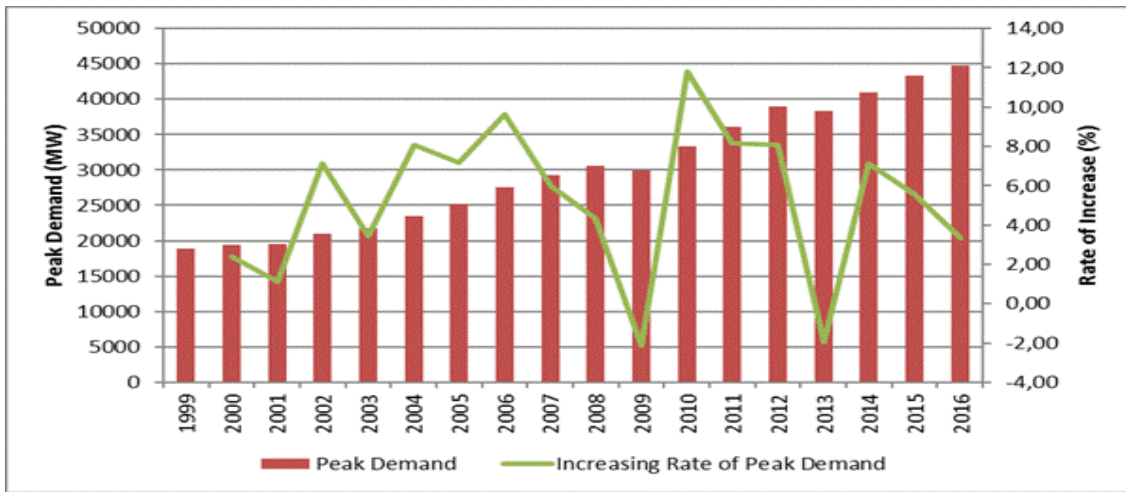


Fig. 1 The amounts of peak-time demand and the increase rates according to years [1]

consumption. The study was conducted in a standard family residence where 4 people live in the province of Sivas. In the house, there was a washing machine, a dishwasher, a television, a built-in set, an oven, an iron and a computer. There is no cooling system. The house is heated with a natural gas heating boiler. The electricity meter is a smart meter and can measure electricity consumption for 3 different times (daytime, peak time and nighttime). Although the electricity consumption is measured with a 3-rate meter, the electricity bill is charged on the single-rate tariff. Calculations were based on the 60-month electricity consumption values measured between 2012 and 2016 and on the amount of money paid for the electricity bills during that period. The amount of money to be paid was also calculated according to the multi-rate tariff and it was compared with the amount of money paid according to the single-rate tariff. It was also checked how electricity consumption differed between nighttime, daytime and peak time for 5 years.

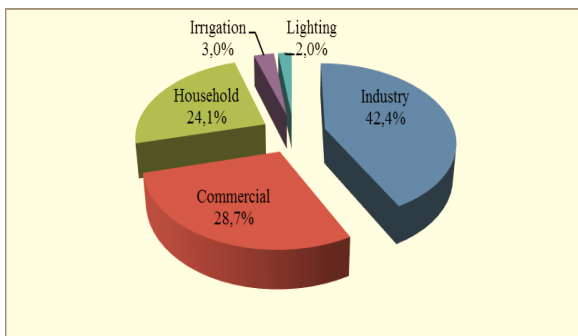


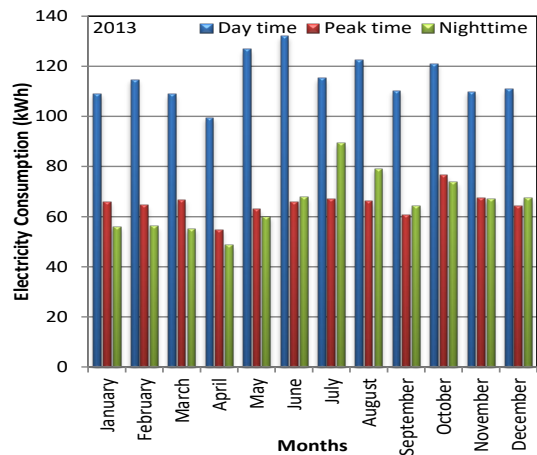
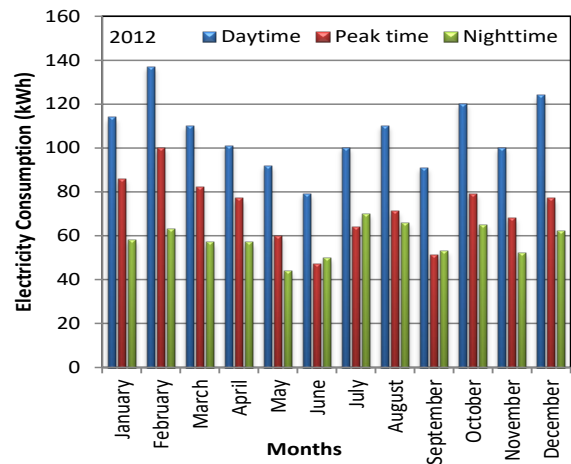
Fig. 2 Distribution of invoiced consumption by consumer type in 2016 [1]

### 3. RESULT AND DISCUSSION

Distribution of electricity consumption in three different periods in the house for all the years is shown in Figure 3. The highest daytime electricity consumption (between 6 a.m. and 5 p.m.) was in February, July and August in all the years and was generally between 100 kWh and 150 kWh per month.

The peak time electricity consumption (between 5 p.m. and 10 p.m.) varied between 60 kWh and 100 kWh per month. The nighttime electricity consumption (between 10 p.m.

and 6 a.m.) was a little higher than was the peak time electricity consumption. These consumption values indicate that the households consumed electricity in the daily life without any intention to save money. Approximately 45% of the total electricity consumed is consumed in the daytime, whereas the remaining amount is consumed during the 5-hour peak time and 8-hour nighttime almost equally.



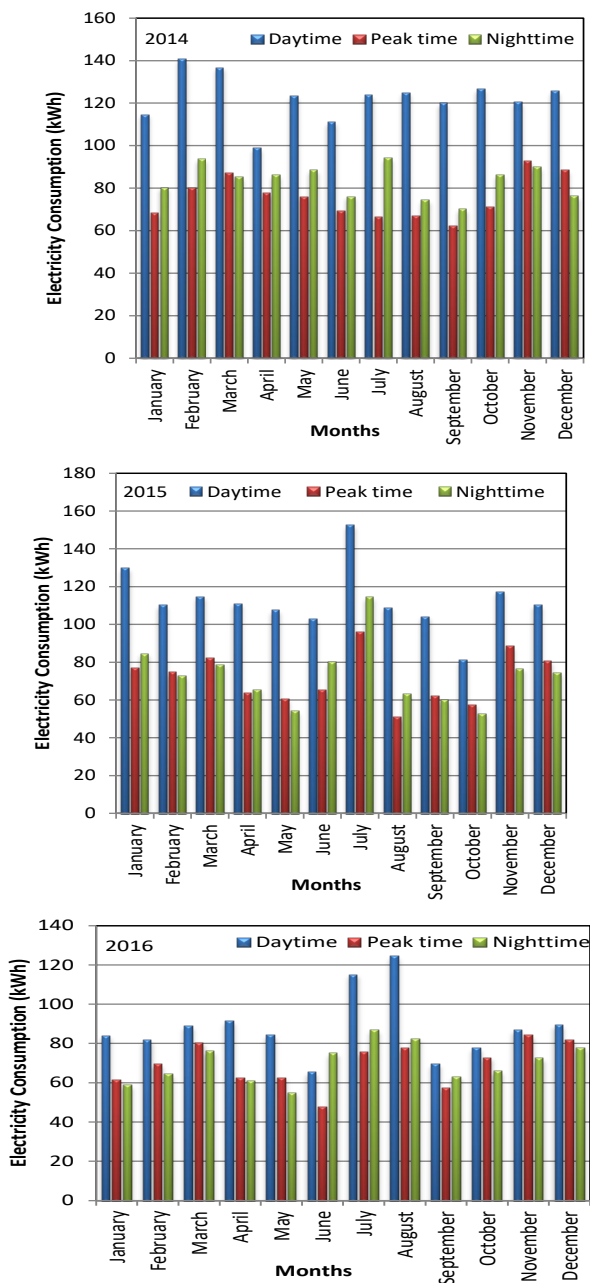


Fig. 3 Distribution of electricity consumption in three different periods in the house for all the years

Figure 4 shows the comparison between the actual monthly payments between 2012 and 2016 according to the single-rate tariff and the possible monthly payments if they were calculated according to the three-rate tariff. The bills cost from £60 to £100 in 2012 and 2013, and from £80 to £140 between 2014 and 2016. In all the graphs, it is seen that the billing amounts for single and three-rate tariffs were very close to each other but that the single-rate tariff was a little higher in all the years, except 2012 and 2016. In these years, three-rate tariff bills were higher.

The comparison of 5-year bills calculated according to the single-rate tariff with those calculated according to the three-rate tariff based on the smart meter measurements showed that if the households' current electricity consumption habits are not changed and their peak time and daytime consumptions are not shifted to nighttime, multi-rate

tariffs will not lead to any savings in bills. In fact, as noted in previous statements, the three-rate tariff might sometimes increase the cost of the bills.

