



ELECTRICITY THEFT – A PRIMARY CAUSE OF HIGH DISTRIBUTION LOSSES IN INDIAN STATE

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ABSTRACT

Electricity theft has become the main factor responsible for distribution losses in Indian States. It has become troublesome for both the consumers as well as for the utilities which supply electricity to the consumers. Due to the electricity theft, utilities are suffering from huge losses especially in the rural areas. This paper puts emphasis on the major consequences that the common people & the utility are facing due to such thefts. Various socio-economic factors have been taken into account as well. In the state of Haryana, Gurugram has been reported to have very high electricity theft cases. Sohna, a tehsil of Gurugram district, has been considered for the case study of distribution losses. Three types of feeder lines have been analyzed in this work, i.e., urban, rural & industrial. Secondary data of distribution losses clearly shows that losses in the rural areas have been tremendously high for the period 2015-2017. Electricity theft has become a major issue of concern and its rate needs to be lowered so as to bring down the high losses that the utility is suffering financially.

KEYWORDS - Electricity Theft, Distribution Losses, Customer's Attitude;

1. INTRODUCTION

Today's world cannot be imagined without electricity. Electricity has become the foremost requirement for the sustainable development of human race [1]. Another reason is the feasibility in usage of an electricity source. That's why electricity has gained so much importance. The per capita consumption of electricity has been growing ever since the inception of electricity networks in India [2]. Haryana is one of the highest electricity consuming states of India. As per the figures of planning report commission, the electricity consumption in Haryanawas about 1208 KWh in 2006-07 which rose to 1678 KWh in 2011-12. Along with the consumption, the losses have also gone up. These losses are called aggregate technical and commercial losses. The transmission & distribution losses (T&D) & the commercial losses, if combined, constitute the aggregate technical and commercial losses (AT&C). The losses in Haryana became 10273 MKWh in 2013-14 and it is increasing day by day. As a result, the cost of power supply increased. Electricity theft is one of the major causes of these commercial losses. It is burdensome for both the consumers and the utility companies.

Haryana Vidyut Prasaran Nigam Limited (HVPNL) came into existence in August, 1998. As a result of the unbundling of Haryana electricity board after Haryana electricity reforms on July 1st, 1999, HVPNL was further divided into sub-divisions named, Uttar Haryana Bijli Vitran Nigam (UHBVN) and Dakshin Haryana Bijli Vitran Nigam (DHBVN). DHBVN handles power distribution in Southern districts of Haryana, among which Gurugram is a major district. As per the statistics of 2015, Gurugram is reported to have very high theft cases. Out of five tehsil of Gurugram, Sohna, consisting of a total of 61 villages, has been taken up for the case-study in this work. In 2009, AT&C losses in Sohna were reported around 60%, which is a tremendously high figure. It was predicted to reduce to 26% in 2014 but the problem still continues causing severe adverse effects on the consumers & the companies.

There are various factors responsible for AT&C losses, among which the primary reason is electricity theft causing huge loss to company. Electricity theft is exhibited in many ways which includes hooking for tapping distribution lines, unpaid & under-paid bills of the consumers, unwillingness of the Labor union leaders, politicians, farmers & slum dwellers to pay the bill [3]. There have been many incidents recorded where the distribution companies are unable to collect wholesome price of the supply they provided because there is illegal usage of

the electricity by the consumers & incorrect reporting by their own employees. Hence, the due payment is not received & the company's revenue falls short. Company is also responsible behind this attitude of consumers due to its poor service quality and low satisfaction level [4-5]. Mainly, there are two types of people who are mainly responsible for the electricity theft – employees & consumers.

This paper revolves around the analysis of distribution losses to the utility owing to electricity theft at sub-division level. The area of Sohna, i.e., a tehsil/sub-division of Gurugram district of Haryana, has been particularly taken under consideration in this work. This analytical work is based on secondary data of losses to the utility on account of electricity theft particularly in the area of Sohna. The secondary data has been collected from the substation office at Sohna. This analysis has been aimed at studying the impact of various socio-economical factors behind the electricity theft and indirectly behind distribution losses. The losses percentage has been studied for various rural, urban and industrial feeders. The losses analysis for different feeders has been carried out for the period of 2015-2017. The customer's attitude behind these losses has also been focused as the analysis part. Section II briefs different researches hitherto undertaken for analysis of electricity theft. Consequences of the electricity theft both for the utility and customer are illustrated in Section III followed by the socio-economical determinants of electricity theft and customers' attitude towards electricity theft in section IV and V respectively. The bar charts of the feeder losses in the year 2015 to 2017 have been provided with their elicitation in section VI. Section VII provides suggestions collected by the electricity consumers of district Charkhi-Dadri to reduce the problem of electricity theft in their area.

2. LITERATURE REVIEW

Various notable works have been undertaken by renowned analysts in the paradigm of commercial losses particularly electricity theft. S. S. S. R. Depuru et al. [6] elaborate electricity theft in terms of various factors, for instance, social factors, economical factors, regional factors, politics, literacy, criminality and corruption. They have also discussed many reasons which entice people to do electricity theft along with the influence of electricity theft on genuine customers. They have suggested that existing rules and regulations for punishing the illegal consumers should be revised. The consumers should be made aware about the benefits of using

electronic meters in their premises, working of harmonic generator and possible damage to their equipment due to theft.

S. K. Katiyar [7] examines the official policy and practices related to distribution losses in Rajasthan. The study presents comprehensive analysis done by Prayas, an NGO, in a primarily agricultural area in south Rajasthan. The study has proved that the distribution losses are very high and most of them could be clubbed under the category of commercial losses. The results of the study focus on the fact that the solutions to inefficient performance of public services have to be comprehensive and not merely technological. F. B. Lewis [8] puts emphasis on the results of electricity theft like power disruptions, increment in the price of power, poor quality of supply, reduction in re-investment fund with the company, unemployment and other effects on the distribution companies. As, there is severe problem of power interruptions and theft in Jamaica island as compared to neighbor countries, author has taken the case of Jamaica island for analysis. This study shows how to examine the effects of these losses on the national economy due to power disruptions.

V. Gaur et al. [9] work upon the determinants of electricity theft in India. Authors have highlighted the privatization of power sector in a State as the potential solution of line losses in the system. The study suggests that the consumers should be educated about the negative effects of thieving power. Authors have advised to consider electricity theft as a serious crime and strictly punishable act rather than a socially acceptable norm. M. Golden et al. [10] posit that the electoral cycle of the state of Uttar Pradesh impacts the extent of electricity theft. Authors have shown that electricity theft is increasing with the usage of tube-wells which accounts to unmetered electricity use by farmers.

B. Min et al. [11] show that line losses are present everywhere in India, where losses means power which is provided to the consumers but the company does not get the due payment in lieu of power supply. Unfortunately, we lose one-third of electricity generated in India each year due to these distribution losses. It is analyzed that during 2000–09, there were very high line losses especially in the period which was just prior to the state elections, i.e., in 2002 and 2007. Therefore, the proposed study focuses on the politics of electricity losses. F. M. Mirza et al. [12] have studied the effect of various determinants of electricity theft using a designed model for Pakistan, a developing country where a large population is having low income. As in Pakistan,

electricity price is different for different sectors, the authors have analyzed household sector price because the household sector has most of the incidences of electricity theft.

T. B. Smith [13] examines that electricity theft is affected by governance indicators, political instability, and low government effectiveness as there are more cases of electricity theft in those countries which do not have effective accountability due to high levels of corruption. The authors have discussed various financial impacts of electricity theft like need to charge more from consumers due to less income from the revenue collected from consumers. Additionally, they have proposed different ways to overcome electricity theft, for instance, technical solutions like properly sealed meters, and some managerial strategies also like stringent inspection and vigilance rules. T. Sharma et al. [14] illustrate the value chain of the Indian power sector having focus on its distribution segment. They have pondered over four types of theft in all power systems, namely, deliberate deception by consumers, stealing electricity, billing irregularities, unpaid bills etc. They have also focused on the inefficiency of technical measures as proved by disuse of automatic meters in Haryana and efficiency of psychosocial factors in reducing the electricity theft.

V. Ranganathan [15] proposes the study to reduce transmission and distribution losses. T. Winther [16] examines the phenomenon of theft in two different developing contexts. They have conducted study on the data that has primarily been obtained through ethnographic fieldwork in Zanzibar, Tanzania and the Sunderban Islands, West Bengal, India. The study shows that the customer-supplier relationship is a prominent factor to investigate how illegal practices like electricity theft, can be stopped. C. Yurtseven [17] reviews the socio-economic determinants of illegal electricity consumption. Through different econometric techniques, the author computes an energy theft equation. They have concluded that temperature index, income, rural population rate, social capital, education, and agricultural production rate strongly impact the occurrence of electricity theft. Many authors have focused upon the quality of power which is being deteriorated by electricity theft. Different techniques are being devised to detect the abnormalities in quality of electricity supplied to consumers [18-22].

Many researchers have worked upon the paradigm of electricity theft and its effects on the consumers and distribution companies. Though, people have undertaken the studies regarding electricity theft in many States of India. But no one has yet carried out the losses analysis at micro level, i.e., in a particular district of any state. Thence, this study has been

accomplished to explore the various factors affecting electricity theft in a city having small area and the result of various factors on the distribution losses in three consecutive years from 2015 to 2017.

3. REPERCUSSION OF ELECTRICITY THEFT

Electricity theft has become a whip for the power distribution companies. It is causing huge financial losses to the utility resulting into precarious strain on their finances [23]. Due to electricity theft, the chances of overloading/short circuiting in the distribution systems increase because electricity is consumed more than the connected load. This generally results into partial or full disruption in the electricity supply which has to be borne by the legitimate customers. This kind of disruption produces loss in productive output. The overloading/short-circuiting of feeder lines also adversely impacts the quality of electricity supply which can be dangerous to

TABLE 1 SOCIO-ECONOMICAL DETERMINANTS OF ELECTRICITY THEFT

Socio-economical determinants	
Positive variables	Tariff rate, Population, Agricultural Loads, Unemployment, Corruption, Political intervention, and Temperature
Negative variables	Collection efficiency, Literacy, Urbanization, Income, Law & order, System efficiency, Probability of detection and Fine amounts

the consumer appliances. There are many costly consequences of electricity theft for the distribution company and their legitimate customers. The price of electricity for legitimate customers is unnecessarily raised (if considered for a long term) because the money lost due to electricity theft and money spent on the maintenance of the distribution systems damaged due to overload, is recovered from the consumers by the utility. Electricity theft unfavorably impacts the utility's capability of re-investment as the utilities could not get the potential revenue from the consumers. These constraints limit the available finances for funding development/expansion tasks. Consequently, this results into frequent load shedding. Eventually, utility companies have to raise the electricity tariff rates in order to continue the distribution operations, and this result into higher electricity rates for genuine customers also. The increase in tariff rate is the long term effect of electricity theft, since the electricity prices in our country are not market determined. So, electricity theft has not any short term effect on the tariff rate. Last but not the least, fire hazards and the death of electricity thieves or even honest consumers who are accidentally

electrocuted due to entangling with illegally strung throw-ups, are also possible due to electricity theft and consumers unawareness [24].

4. SOCIO-ECONOMICAL DETERMINANTS OF ELECTRICITY THEFT

There are many socio-economical factors which impact the electricity theft, as listed in Table I [25]. The influence of these factors on the losses has been analyzed in the area of Sohna. Some of them are positive variables for electricity theft and some of them are negative variables. Positive variables are meant by those variables with which electricity theft increases/decreases. Negative variables are those variables whose increase reduces the occurrence of electricity theft. Few factors have been discussed in this section.

4.1 POSITIVE VARIABLES

Population: Electricity theft cases are more probable in highly populated areas because the possibility of finding theft done by hooking techniques and other illegal methods is very less. As in crowded areas, there is a mesh of transmission lines which do not allow any hook connection to be visible.

Agricultural Loads: Illegal consumption of electricity takes places in most agricultural areas. Many farmers tend to have financial problems and for them, electricity theft is much easier than paying the electricity bills. Even though the tariff rate for agricultural connections is quite less, the farmers use electricity illegally, without being aware of the end results and its impact on others, by connecting high loads like tube wells, irrigational pumps etc. which lead to a high electricity consumption. If more industrialized sectors are present in the area, electricity theft incidences will become less.

Unemployment: An unemployed person does not want to spend money on electricity bills but he still wants to have the basic commodity of electricity. Thus, unemployment leads to greater electricity theft as an unemployed person will indulge others too in this act.

Corruption: Corruption is the devil behind electricity theft. Employees of the utility take bribe from the people indulged in electricity theft to prevent the culprits from getting caught. They may even extort money from electricity consumers not to reveal theft case to higher authorities. Absence of reporting about corrupt behavior & no strict vigilance motivates the people to steal electricity freely. Thus, high corruption index of the area encourages electricity theft.

Political Intervention: During the pre-electoral period, the political involvement in the higher number of electrical theft cases becomes apparent. In the greed of large vote bank, political leaders give illegal advantages to the culprits. Due to their political connections, many culprits get saved from stringent punishments even after getting caught.

Temperature: One of the variables encouraging electricity theft is temperature. In summer season, the need of electricity for running coolers, air-conditioners etc. increases which increase the tendency of people to steal electricity to run their large loads.

4.2 NEGATIVE VARIABLES

Literacy: Literacy is the main factor which reduces electricity theft. Illiterate people don't know the negative effects of stealing electricity and they do it just to save their money. Thus, they turn doing theft of electricity into a habit. In Sohna, around 60% males are literate and only 40% females are literate which supports their habit of stealing power.

Collection Efficiency: Electricity theft also includes the non-payment of electricity bills. A company due to many factors like corruption, lack of man power, fear of going into criminal area etc. may not be able to collect all receivables due from consumers. Sometimes, company officers do not take strict action against people who have not paid their electricity bills due to various reasons like fear, corruption etc. Thus, low collection efficiency increases the cases of electricity theft by giving the opportunity to people who steal electricity fearlessly.

Urbanization: In urban areas, electricity theft does not happen as often as in the rural areas. People who live in urban areas are aware of the consequences of stealing power so they do not perform this act often whereas people who live in rural areas regard electricity theft as a routine activity and not as a criminal act.

Probability of detection and fine amounts: Probability of getting caught reduces the chances of electricity theft. Also, large fines and strict actions act deterrent for electricity thieves. But some lenient company officers do not take necessary actions on the people caught stealing electricity which encourages the electricity thieves for illegal usage of electricity.

5. CUSTOMER'S ATTITUDE TOWARDS ELECTRICITY THEFT

Some factors entice the people to a great extent for stealing electricity. Few of the factors impacting consumer attitude towards electricity theft are lower literacy rate, high electricity

tariff, weak enforcement of law against the theft, corrupt employees of the utility, high unemployment rate among the consumers, delays in getting new electric supply connections, etc. Attitude of customers, who are the key players in electricity theft, can change the scenario of electricity theft, either adversely or beneficially. Customers have many illegal notions which force them to indulge in electricity theft. Many people think that we should not steal something from our neighbors but there is no harm in stealing from the utility. Some people think that why they should pay the electricity bills if they can avoid it. Many people having such attitude towards electricity theft steal electricity and do not get caught or penalized. This also backs their thinking of doing illegal acts. They think that why can't I do electricity theft if every next person is doing freely.

They assume that the distribution utility robs them by charging higher tariff, so they should rob them too. There is no loss to me and my dear ones, only utility bears the cost of stolen electricity. These different view-points of different customers about electricity theft generates from their socio-economic background having factors like education, unemployment, income and other factors. Therefore, the attitude of customers towards electricity theft and the company needs to be changed using administrative strategies and awareness campaigns.

6. RESULTS& ANALYSIS

In this work, losses for the industrial, rural and urban feeders supplying power in different areas under Gurugram district have been analyzed. The difference between the electricity units paid to the utility and the electricity units supplied by the utility has been represented by these losses. In other words, electricity theft happening in different areas is indicated by these losses. SOHNA CITY-1, SOHNA CITY-2, SOHNA CITY-3 and SOHNA CITY-4 are the four urban feeders considered for the analysis. Six rural feeders have been analyzed, namely, LAKUWASDS, TEEKLIDS, KHORI BASAIDS, CHAMANPURDS, DOULADS AND PALRA FEEDER DS.

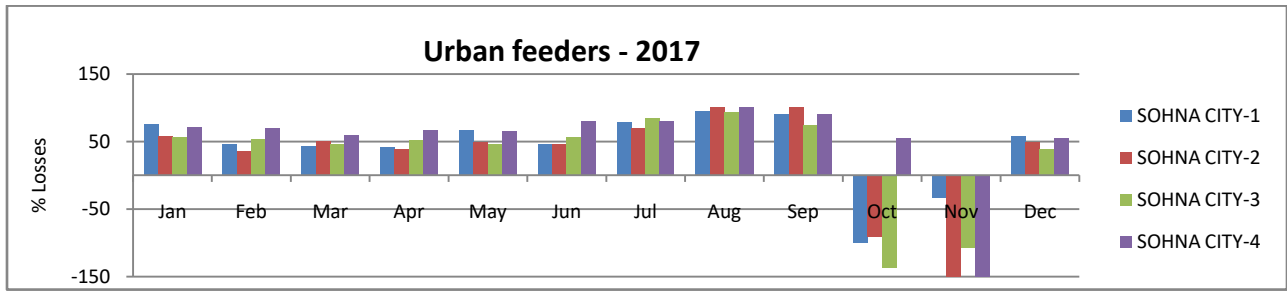


FIGURE 1. PERCENTAGE LOSSES AT URBAN FEEDERS IN SOHNA DURING 2017

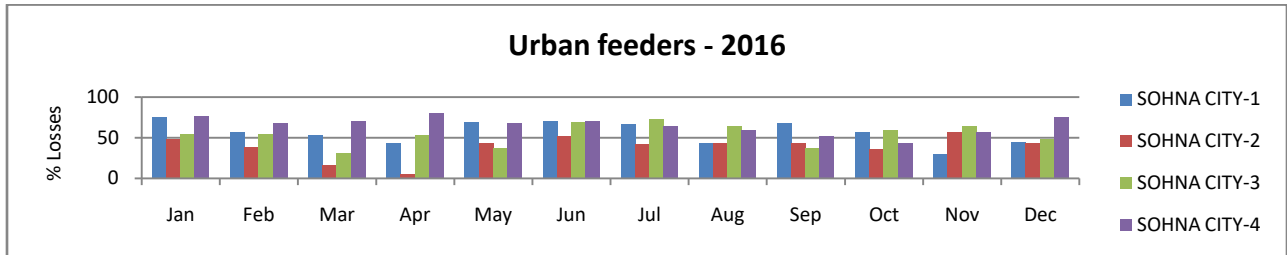


FIGURE 2. PERCENTAGE LOSSES AT URBAN FEEDERS IN SOHNA DURING 2016

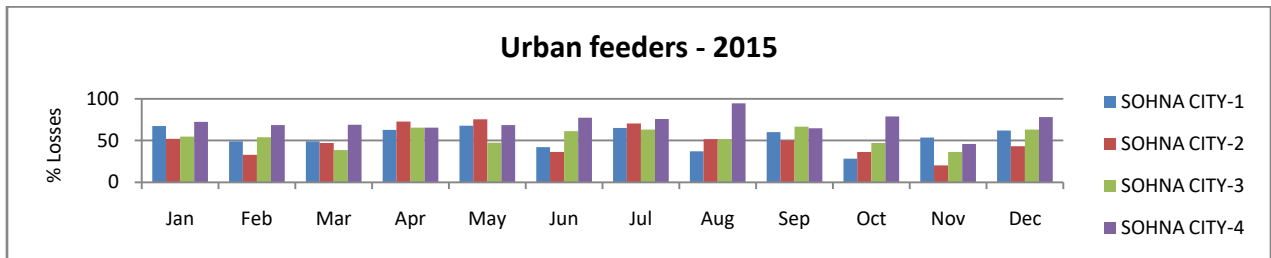


FIGURE 3. PERCENTAGE LOSSES AT URBAN FEEDERS IN SOHNA DURING 2015

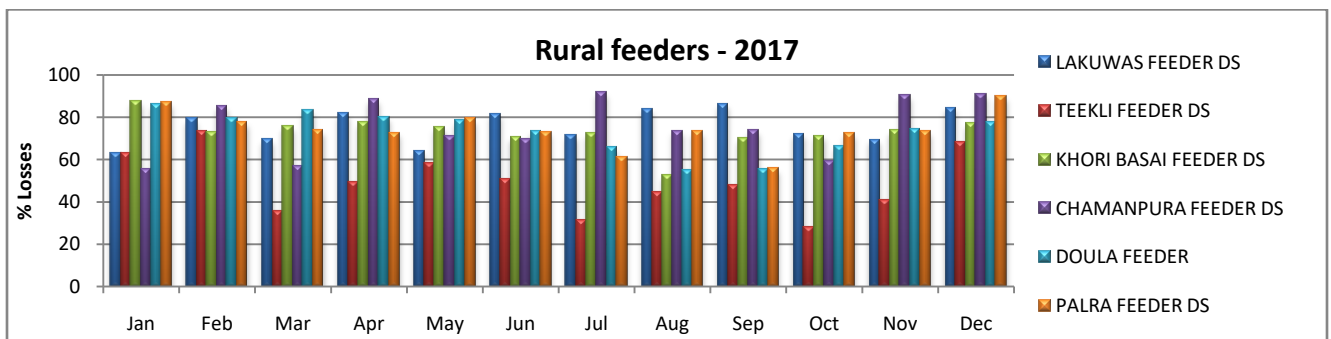


FIGURE 4. PERCENTAGE LOSSES AT RURAL FEEDERS IN SOHNA DURING 2017

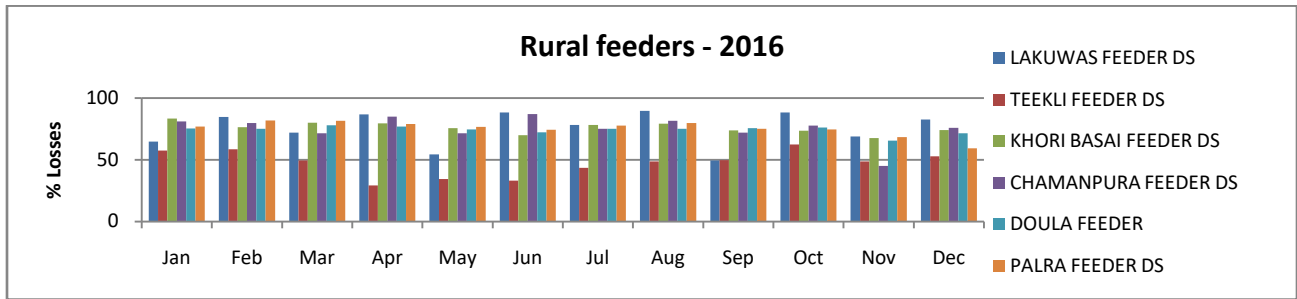


FIGURE 5. PERCENTAGE LOSSES AT RURAL FEEDERS IN SOHNA DURING 2016

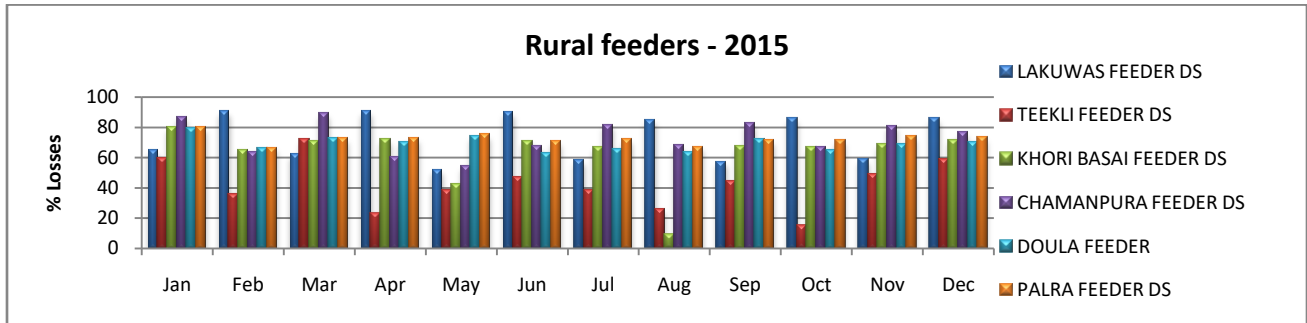


FIGURE 6. PERCENTAGE LOSSES AT RURAL FEEDERS IN SOHNA DURING 2015

In 2015 and 2016, all urban feeders have 50% losses on average throughout the year, as shown in Figure. 2 and Figure. 3. In all urban feeders, negative losses were seen in November 2017, as shown in Figure. 1. There are many possible reasons behind these negative losses. Sometimes the utility lacks man power which affects the meter reading process. Faulty meters are another reason. Electricity bill payment is done on average basis, which causes the receipt amount to be greater than the billed amount which is either very less or zero due to faulty meters. This leads to losses being negative in those days. In October, same conditions occurred for three urban feeders. In July, losses attained the highest heights as the summer season reached to the

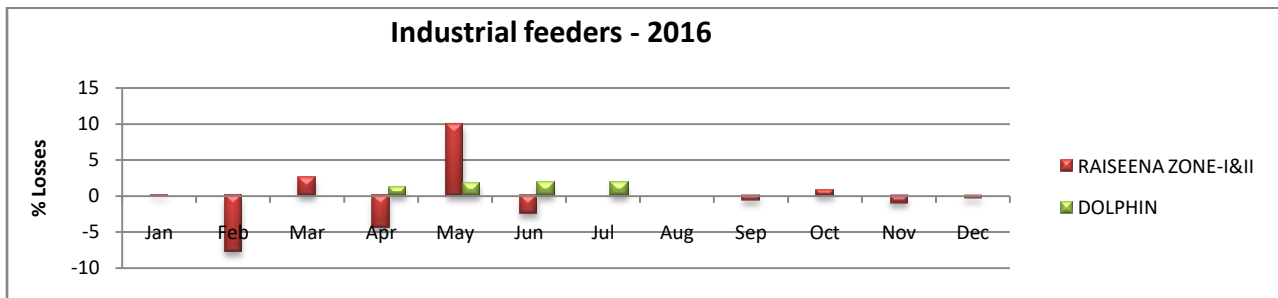


FIGURE 7. PERCENTAGE LOSSES AT INDUSTRIAL FEEDERS IN SOHNA DURING 2016

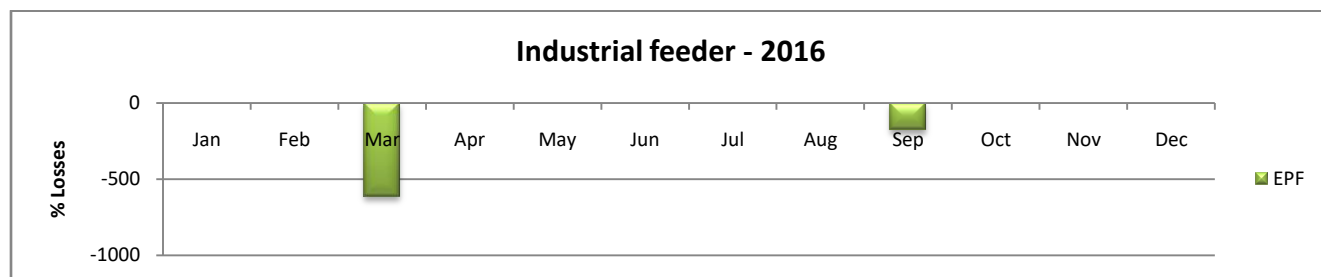


FIGURE 8. PERCENTAGE LOSSES AT INDUSTRIAL FEEDER- EPF SOHNA DURING 2016

peak with the highest humidity level. This shows the impact of temperature on losses due to electricity theft.

Losses in rural feeders are generally in the range of 70% to 80% all over the year, as shown in Figure. 4 to 6. Rural areas are more prone to electricity theft, as discussed in section 4. In rural areas, people see stealing as a legitimate way to save their money. The major determinants causing huge losses in rural feeders are unemployment, low literacy rate, poverty stricken people, poor per capita income, etc. Since the chances of detection are also very less, it provides encouragement to rural people to tap illegal power from feeder lines unhesitatingly. In rural areas, people have less access to new electricity connections which makes the poor people helpless and make them do anything, legal or illegal to get electricity supply.

Industrial feeders are independent feeders. In industrial feeders, two electricity meters are installed; one at sub-station premises, other at the premises of customers. Electricity bill is generated depending on the reading of meter installed at the sub-station. The total bill, as generated at the sub-station end, is paid by all the industrial customers. Eventually, the losses to the utility come approximately zero, as shown in Figure. 7. Some slight losses appear to the utility due to some meter faults but these are generally in the $\pm 5\%$ range, which are neglected by the utility because of being small. Many a times, huge negative losses occur in the industrial

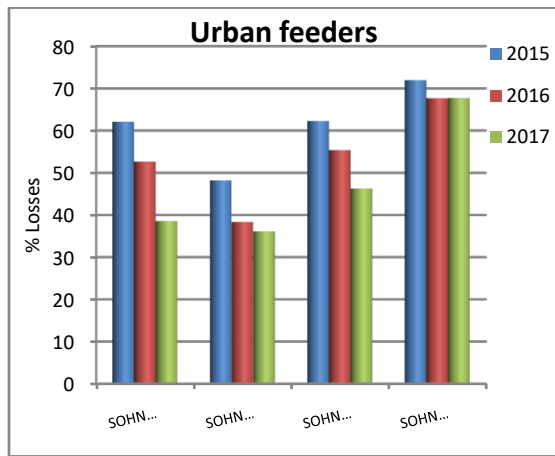


FIGURE 9. YEAR-WISE PERCENTAGE LOSSES AT URBAN FEEDERS IN SOHNA

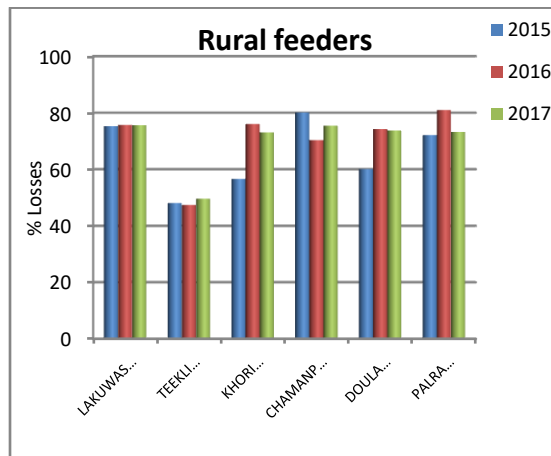


FIGURE 10. YEAR-WISE PERCENTAGE LOSSES AT RURAL FEEDERS IN SOHNA

feeder like in EPF feeder in 2016, as shown in Figure. 8. At this feeder line, electricity meters showed zero or negligible meter reading at the sub-station meters due to being faulty. Therefore, difference became very high.

In urban feeders, many different strategies adopted by the government, utilities and local people to reduce the losses have worked to some extent. The losses were less in 2017 as compared to previous years in all four feeder lines supplying the urban area in Sohna. The year wise losses for urban feeders are shown in Figure. 9. Even though losses have decreased, they have not decreased to a desirable level.

In rural feeders, no significant improvement on losses was seen in 2017 with respect to earlier years, as shown in Figure 10. Since people of rural areas have a poor literacy rate, low income and more factors, they are expected to have more losses on account of electricity theft as compared to urban areas. If more strategies, more awareness campaign, strict enforcement of laws etc. are adopted in the rural feeder lines, the amount of losses can be lowered.

7. SUGGESTIONS

This work also encompasses the analysis of suggestions (about theft reduction measures) collected from Sohna residents through a primary survey. All the suggestions given by the

electricity consumers that should be adopted at priority basis to put check upon the issue of electricity theft come under four categories: administrative, technological advancement, human resources management and law enforcement. The most suggested measures come under the administrative category. Some administrative actions are increase in frequency of regular vigilance raids in all the areas whether rural, urban or industrial, lowering down the tariff rate, organizing awareness campaigns for public, reconstitution of vigilance teams every month, subsidy to poor people etc. All these administrative strategies can surely bring down the cases of electricity theft in the district.

Some suggestions belong to the strengthening of law & enforcement department. The inspection visits should be supported by the law and order mechanism. The convicted persons should be stringently punished with both monetary fines and imprisonment. The names of defaulter persons should be publicly announced so that they get fear of reputation loss. On the other side, theft informers should be secretly given some benefits. Electricity connection of the defaulter person should be immediately dis-connected and should not be again provided. Another main step towards eradication of electricity theft is increase in awareness level of consumers so that they could know the side-effects of electricity theft. The employees of the company should also have high morale and they should not collude with the consumers for their illicit monetary gains. Company should take more strict action against corrupt employees so that common public could not get any freedom for doing electricity theft.

All these administrative actions should be backed up by technological advancements like use of smart & electronic tamper-proof meters, strongly insulated cables, theft detection devices, pre-paid electricity meters, energy saving equipment etc. Both technical and non-technical steps can collectively prevent the occurrence of electricity theft in the rural, urban and industrial areas.

8. CONCLUSION

The scenario of losses to electricity utilities in Sohna, a sub- division of Haryana, has been showcased in this paper. The key player in losses to utility in feeder lines is electricity theft. Receivables from consumers do not reach to utility companies due to illegal tapping of feeder lines by illegal customers known as 'little Devils' and due to tampering in meter by customers. Therefore, due to difference between billed and receipt amount, utility faces huge losses in feeder

lines. Various factors having considerable effects on the occurrences of electricity theft have been analyzed along with their effect on the feeder losses in Sohna. The tendency of electricity theft is greatly impacted upon by different notions of consumers toward electricity theft. The possible attitudes have been posited in this work. Customers should be aware of the consequences and impact of electricity theft. The steps towards minimization of electricity theft are high literacy rates, high probability of detection with strict enforcement of law and high morale of utility employees. Rural areas require special attention.

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