SCENARIO OF DISTRIBUTION LOSSES – A CASE STUDY FROM HARYANA

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Abstract

Power theft, a primary cause of distribution losses, has become a major issue. It has become troublesome for both the consumers as well as for the utilities that have to supply electricity to these consumers. Due to these thefts, utilities are suffering from huge losses especially in the rural areas. This paper gives 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, Bhiwani has been reported to maximum such cases. Charkhi-Dadri a district of Bhiwani has been considered for the case study of losses. Three types of feeder lines have been analyzed in this work, i.e., urban, rural & industrial. The current pattern of losses has also been taken up for the consideration. The data clearly shows that the losses in the rural areas have been tremendously high for the period 2015-2017. The suggestions for prevention of power theft have also been discussed in this work. Power theft has become a major issue of concern and its rate needs to be lowered so as to bring down the hefty amount of losses which the utility is suffering financially.

Keywords: power theft, distribution losses, suggestions.
Introduction:

Today's world cannot be imagined without electricity. Electricity has become the foremost requirement for the sustainable development of human race (Singh et al., 2016). Another reason is the feasibility in usage of an alternate 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 (Singh et al., 2017). Haryana is one of the highest electricity consuming states of India. As per the figures of planning report commission, the electricity consumption in Haryana was about 1208 KWh in 2006-07 which went upto 1678 KWh in 2011-12. Along with the consumption, the losses have also gone up. These losses are called aggregate technical losses. The transmission & distribution losses (T&D) & the commercial losses, if combined, constitute the aggregate technical and commercial losses (AT&C) (Saini, 2017). The losses in Haryana became 10273 MKWh in 2013-14, one of the highest recorded values in the North-Indian region. As a result, the cost of power-supply increased. Power 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 Bhiwani is a major district. As per the statistics of 2015, Bhiwani is reported to have maximum number of theft cases. Among the districts of Bhiwani, Charkhi-Dadri, consisting of a total of 184 villages, has been taken up for the case-study in this work. In 2009, AT&C losses in Charkhi-Dadri were reported around 52.19%, which is a tremendously high figure. It was predicted to reduce to 26% in 2014 but the problem still continued causing severe adverse effects on the consumers & the companies.

There are various factors responsible for the AT&C losses, among which the primary reason is power theft causing huge loss to company. Power theft is exhibited in several ways which includes illegal connections 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. 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 potential price is not received & the company's revenue falls short. 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 power theft. The area of Charkhi-Dadri, a sub-division of Bhiwani 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 power theft particularly in the area of Charkhi-Dadri. The secondary data has been taken from the executive engineer of the substation at Charkhi-Dadri. This analysis has been aimed at corroborate of impact of various socio-economical factors behind the power theft. The losses percentage has been studied for various rural, urban and industrial feeders. The losses analysis for different feeders has been undertaken for the period 2015-2017. The customer's attitude behind these losses has also been focused as the analysis part. Section II briefly different researches hitherto undertaken for analysis of electricity theft. Consequences of the power theft both for the utility and customer are illustrated in Section III.
followed by the socio-economical determinants of power theft and customers’ attitude towards power 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 elicitations 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.

Literature Review:

Various notable works have been undertaken by renowned analysts in the paradigm of commercial losses particularly power theft. Depuru et al. (2010) 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 prompt peoples to do electricity theft along with the influence of power theft on genuine customers. They have suggested the existing constitution for punishing the illegal consumers to be revised. The consumers should be made aware about the benefits of using electronic meters in a neighborhood, working of harmonic generator and possible damages to their equipment in case of theft (Singh et al., 2017). Many authors have proposed the advanced techniques for detecting the abnormality in power quality in which electricity theft is also a major culprit (Saini and Kapoor, 2012; Kapoor and Saini, 2007; Saini et al., 2011; Saini et al., 2010; Saini and Beniwal, 2018).

Katiyar (2005) 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 electricity distribution subdivision 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. Lewis (2015) 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 overall economy and its various sectors. As, Jamaica island is frequently affected by power interruptions and theft level is relatively high as compared to other countries, author has taken Jamaica for analysis. This study shows how to examine the effects of direct losses borne by the respective economies due to electricity disruptions.

Gaur et al. (2016) work upon the determinants of power 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 power theft as a serious crime and strictly punishable act rather than a socially acceptable norm. Golden et al. (2012) 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.

Min et al. (2014) show that line losses are present everywhere in India, where losses mean power that is supplied but not billed and unfortunately, third of electricity in India is lost each year. It is analyzed that for the period 2000–09, higher line losses have occurred just prior to the 2002 and 2007 state elections, therefore the proposed study also focuses the politics of electricity losses. Mirza et al. (2015) have worked upon the model to consider the impact of different determinants of electricity theft in case of Pakistan, a developing country where a large population belongs to lower income groups. As in Pakistan, electricity price is determined
separately for different sectors of the economy, the authors have analyzed household sector price because most of the incidence of electricity theft is concentrated in household sector.

Smith (2004) examines that electricity theft is affected by governance indicators, political instability, low government effectiveness, with higher levels of theft in countries without effective accountability and high levels of corruption. The authors have discussed various financial impacts of electricity theft like need to charge more to consumers and reduced income from the sale of electricity. Additionally, they have proposed different ways to overcome electricity theft, for instance, technical solutions such as tamper-proof meters, and managerial strategies such as strict inspection and monitoring. Sharma et al. (2016) 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 power theft.

Ranganathan (2005) proposes the study to reduce transmission and distribution losses. Winther (2012) 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 core customer–provider relationship is a prominent factor to investigate how unsustainable energy practices, such as theft, may be stopped. Yurtseven (2015) reviews the determinants of socio-economic background of illegal electricity consumption. Through different econometric techniques, the author computes an energy theft equation. They have concluded that temperature index, education, income, social capital, rural population rate, and agricultural production rate are the important determinants of electricity theft.

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 all the states of India. But no one has yet covered the losses analysis in particularly a district of any state. Thence, this study has been accomplished to explore the various factors affecting power 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.

**Repercussions of Power 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. 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 disruption (i.e., a partial or full loss) in the electricity supply 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 the consumer appliances. There are many costly consequences of electricity theft for both utility companies and their genuine customers. The price of electricity for legitimate customers are unnecessarily raised if considered for a long term because both the costs of energy lost and the extra expenses incurred for their additional maintenance of the distribution systems is passed on to the consumers by the utility. Power theft unfavorably impacts the utility capability...
of re-investment as the utilities could not get the potential revenue from the legal consumers. These constraints limit the available finances for funding the development/expansion tasks. Consequently, this results into frequent load shedding. Eventually, utility companies have to raise the electricity tariff rates in order to maintain viability in supplying power, and this result into higher electricity rates for legitimate customers also. The increase in tariff rate is the long term effect of power theft, since the electricity prices in our country are not market determined. So, power theft has not any short term effect on the tariff rate. Deficiency in amount collected with utilities is also responsible for their poor service quality which also badly impacts the customer satisfaction (Saini, 2017; Saini, 2017). Last but not the least, fire hazards and the death of power thieves or even honest consumers who are accidentally electrocuted after becoming entangled with illegally strung throw-ups, are also possible due to electricity theft.

**TABLE I. Socio-economical determinants of electricity theft**

<table>
<thead>
<tr>
<th>Positive variables</th>
<th>Negative variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tariff rate</td>
<td>Collection efficiency</td>
</tr>
<tr>
<td>Population</td>
<td>Literacy</td>
</tr>
<tr>
<td>Agricultural Loads</td>
<td>Urbanization</td>
</tr>
<tr>
<td>Unemployment</td>
<td>Income</td>
</tr>
<tr>
<td>Corruption</td>
<td>Probability of detection &amp; fine amounts</td>
</tr>
<tr>
<td>Political intervention</td>
<td>System efficiency</td>
</tr>
<tr>
<td>Temperature</td>
<td>Law &amp; order</td>
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</tbody>
</table>

**Socio-economical determinants of power theft:**

Various socio-economical factors impact the power theft, as given in Table I. The influence of these factors on the losses has been analyzed in the area of Charkhi-Dadri. Some of them are positive variables for power theft and some of them are negative variables. Few factors have been discussed in this section.

1. **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. It is because in crowded areas, there is a mesh of transmission lines which do not allow any hook connection to be visible.

2. **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 steal electricity, 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, power theft incidences will become less.
3. Unemployment

An unemployed person would not want to spend money on electricity bills but would still want 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.

4. Literacy

Literacy is the main factor which reduces electrical theft. Illiterate people don't know the negative factors behind stealing electricity and they do it just to save money. Thus, they turn doing theft of electricity into a habit. In Charkhi-Dadri, male literacy is around 90.33% while female literacy is around 76.20% which supports their habit of stealing power.

5. Corruption

Corruption is the devil behind electricity theft. Employees of the utility take bribe from the people indulged in power 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.

6. 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.

7. 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.

8. 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.

9. 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.

10. Probability of detection and fine amounts:

Probability of getting caught reduces the chances of electricity theft. Also, large fines and strict actions act as a 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.

Customer attitude towards power theft:

Some factors affect the rate of power theft which influences the people to a great extent to steal electricity. Few of the factors impacting consumer attitude towards power 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 the 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 are as follows:

1. It is dishonest to steal something from neighbors but it is legitimate to steal from the utility.
2. Why should I pay the electricity bills if I can avoid it?
3. Many people do it and get away with it.
4. Utility robs us by charging higher tariff, so we should rob them too.
5. Why can't I do what every next person is doing freely?
6. My dear ones and I don't incur any loss if I steal electricity, only utility bears the cost of stolen electricity.

These different viewpoints of different customers about power theft generate from their socio-economic background having factors like education, unemployment, income and other factors.

Results and Analysis:

In this work, losses for the industrial, rural and urban feeders supplying power in different areas under Charkhi-Dadri 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. GHIKARA ROAD, M/G ROAD, DADRI and DADRI URBAN are the four urban feeders considered for the analysis. Six rural feeders have been analyzed, namely, Achina DS, BINDRABAN DS, Mandila DS, Manheru DS, Bijna DS and Badhwana DS.

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 manpower 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 peak with the highest humidity level. This signifies the impact of temperature on losses due to power theft and other reasons.
Fig. 1. Percentage losses at urban feeders in Charkhi-Dadri during 2017

Fig. 2. Percentage losses at urban feeders in Charkhi-Dadri during 2016

Fig. 3. Percentage losses at urban feeders in Charkhi-Dadri during 2015

Fig. 4. Percentage losses at rural feeders in Charkhi-Dadri during 2017

Fig. 5. Percentage losses at rural feeders in Charkhi-Dadri during 2016
Losses in rural feeders are generally on the range of 80% to 90% all over the year, as shown in Figure 4 to 6. Rural areas are more prone to electricity theft, as discussed in section 4.

**Fig. 6.** Percentage losses at rural feeders in Charkhi-Dadri during 2015

**Fig. 7.** Percentage losses at industrial feeders in Charkhi-Dadri during 2016

**Fig. 8.** Percentage losses at industrial feeder- Oil Mill Badhra during 2016

Losses in rural feeders are generally on the range of 80% to 90% 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 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 want to 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 ±5% range, which are neglected by the utility because of being small. Many a times, huge negative losses occur in the industrial feeder like in Oil Mill Badhra 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 Charkhi-Dadri. 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.
Table II: Suggestions of electricity consumers in the district Charkhi-Dadri to put check on electricity theft

<table>
<thead>
<tr>
<th>Suggestions</th>
<th>Frequency</th>
<th>Percentage</th>
<th>Suggestions</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regular vigilance raids in every area</td>
<td>49</td>
<td>8.4</td>
<td>More duration of supply</td>
<td>22</td>
<td>3.8</td>
</tr>
<tr>
<td>Strict action &amp; imprisonment for theft</td>
<td>46</td>
<td>7.9</td>
<td>publicly announce name of defaulter persons</td>
<td>21</td>
<td>3.6</td>
</tr>
<tr>
<td>Low and affordable electricity tariff</td>
<td>42</td>
<td>7.2</td>
<td>Theft informer should be secretly rewarded</td>
<td>21</td>
<td>3.6</td>
</tr>
<tr>
<td>Replace old meter with electronic &amp; smart meter</td>
<td>39</td>
<td>6.7</td>
<td>Reconstitute vigilance teams on rotation basis</td>
<td>18</td>
<td>3.1</td>
</tr>
<tr>
<td>Public awareness programmes (street plays)</td>
<td>37</td>
<td>6.4</td>
<td>Pre-paid electricity meters</td>
<td>17</td>
<td>2.9</td>
</tr>
<tr>
<td>No cut/joint in service cable from pole to meter</td>
<td>32</td>
<td>5.5</td>
<td>Subsidy to customers who pay their bills</td>
<td>15</td>
<td>2.6</td>
</tr>
<tr>
<td>Electricity meters outside customer premises</td>
<td>31</td>
<td>5.3</td>
<td>No extra taxes in electricity bill</td>
<td>14</td>
<td>2.4</td>
</tr>
<tr>
<td>Honest employees</td>
<td>30</td>
<td>5.2</td>
<td>Strict action against corrupt employees</td>
<td>13</td>
<td>2.2</td>
</tr>
<tr>
<td>Strong and insulated cables</td>
<td>29</td>
<td>5</td>
<td>Adopt latest technology to detect theft</td>
<td>11</td>
<td>1.9</td>
</tr>
<tr>
<td>Correct meter reading</td>
<td>26</td>
<td>4.5</td>
<td>Energy saving equipments at subsidized rates</td>
<td>8</td>
<td>1.4</td>
</tr>
<tr>
<td>Underground distribution cables</td>
<td>25</td>
<td>4.3</td>
<td>Meter should not run too fast</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Place common meter for a street at pole</td>
<td>24</td>
<td>4.1</td>
<td>No electricity connection to defaulter person</td>
<td>4</td>
<td>0.7</td>
</tr>
</tbody>
</table>

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 power 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.

Suggestions:

This work also encompasses the analysis of suggestions (about theft reduction measures) collected from Charkhi-Dadri residents through a primary survey. Table II lists different suggestions given by the electricity consumers that should be adopted at priority basis to check upon the issue of electricity theft. Frequency and percentage of people are also mentioned in the Table II. As per the percentage, the most suggested measure is raise in frequency of regular
vigilance raids in all the areas whether rural, urban or industrial. The inspection visits should also be supported by the law and order mechanism.

Conclusion:

The scenario of losses to electricity utilities in Charkhi-Dadri, a sub-division of Haryana, has been showcased in this paper. The key player in losses to utility in feeder lines is power theft. Receivables from consumers aren't provided to utility companies due to illegal tapping of feeding by illegal customers known as 'little Devils' and tampering in meter by legal customers. Therefore, due to difference between billed and receipt account 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 real feeder losses in Charkhi-Dadri. The tendency of power theft is greatly impacted upon by different notions of consumers towards power 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 power 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.

Reference:


