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MALPRACTICE OF ELECTRICITY THEFT: A MAJOR CAUSE OF DISTRIBUTION LOSSES IN HARYANA

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ABSTRACT

This paper addresses the scenario of distribution losses in the Sonepat district of Haryana, India for last three financial years. The utilities in the State of Haryana are facing severe financial distresses and the prominent reason is the distribution losses. These distribution losses are mainly due to the gap between billed units and supplied unitsdue to billing irregularities on account of system inefficiency, tampering with the energy meters, electricity theft etc.Distribution losses in the State also get affected by the socio-economic factors like literacy, income, urbanization etc. The State of Haryana has 65.21% of its population living in rural areas and 34.79% in urban areas. Consequently, there is high level of distribution losses in the State. In this work, losses' analysis has been undertaken based on the secondary data received from the distribution company in the district (Uttar Haryana BijliVitran Nigam Ltd). Particularly, six blocks of the district like Ganaur, Gohana, Rai, Kharkhoda, Murthal and Sonepat have been focused with regard to distribution losses. The authors have also used the primary data collected through structured questionnaire from the electricity customers of district

Sonepat, to analyze their attitude towards losses and their suggestionsas the panacea of increasing distribution losses.

KEYWORDS -Distribution Losses,Electricity Theft, Socio-Economics, Utilities.

1. INTRODUCTION

Distribution companies have been always the weakest segment in the power sector. The fragile health of distribution sector is affecting the complete power sector. One of the major reasons behind such condition of distribution sector is distribution losses. Distribution losses have become whip for the electric utilities across the globe.All the developing and developed countries are facing the distribution losses. Though, the amount of losses is substantially lower in developed countries like US, Europe etc. and higher in developing countries like India, Malaysia, Bangladesh etc. (Yurtseven, 2015). In India, Haryana is one of the northern States having high distribution losses. Distribution losses in Haryana, has been more

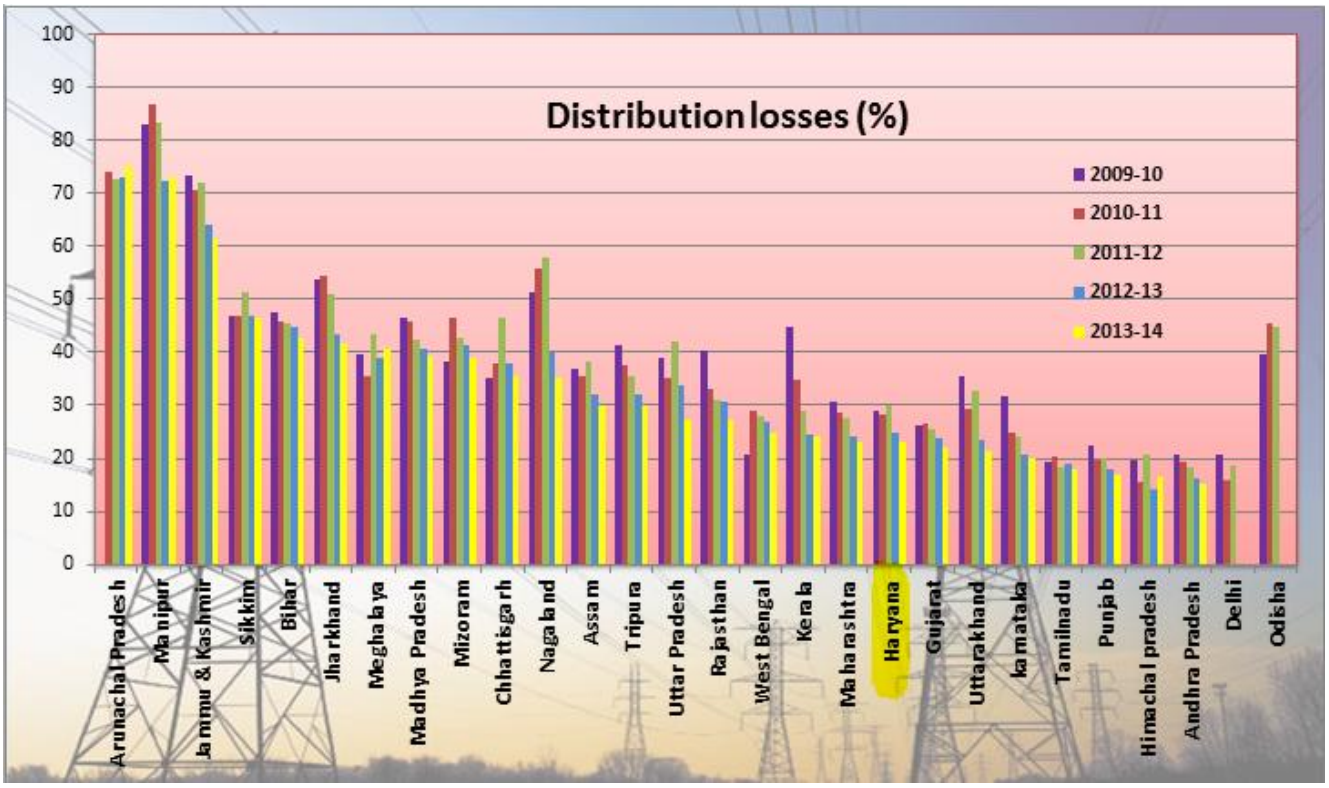

Figure 1. Distribution Losses in Indian States

Source: Annual Report (2013-14) on the Working of State Power Utilities & Electricity Departments, by Planning Commission, GoI

than 20% in financial year (FY) 2013-14, as presented in Figure 1 (Planning Commission, 2014). Haryana, the eighteenth largest State by population (as per Census 2011), is having a lengthy distribution network. On account of its socio-economic background, geographic reasons and the highest density of agricultural connections, the State is facing high distribution losses. The power distribution in Haryana is being handled by two distribution companies (DISCOMs), i.e., Uttar Haryana BijliVitran Nigam Ltd. (UHBVN) and Dakshin Haryana BijliVitranNigam Ltd. (DHBVN). The operational areas of UHBVN and DHBVN are north Haryana and south Haryana respectively. Both the DISCOMs are reeling under financial stress due to distribution losses. At the end of the FY 2014-15, both the DISCOMs were having accumulated losses of Rs. 29029 Crores. Additionally, DISCOMs are having huge amount of outstanding debts with high interest burden. These situations have made average revenue recovery (ARR) only 92.11% of the average cost of supply (ACS). Thereby, Haryana Government has signed the MoU with the DISCOMs in FY 2014-15 under UDAY scheme for taking over their 75% debt and 50% debt in FY 2015-16 to enable financial turnaround of the DISCOMs. In lieu of the financial grant, the DISCOMs are endeavoring to reduce AT&C (Aggregate Technical and Commercial) losses to 15% by FY 2018-19. Particularly, Sonepat district of Haryana has the loss reduction targets of 25.85% in FY 2016-17, 23.15% in FY 2017-18 and 16.73% in FY 2018-19 (MoU, 2016).

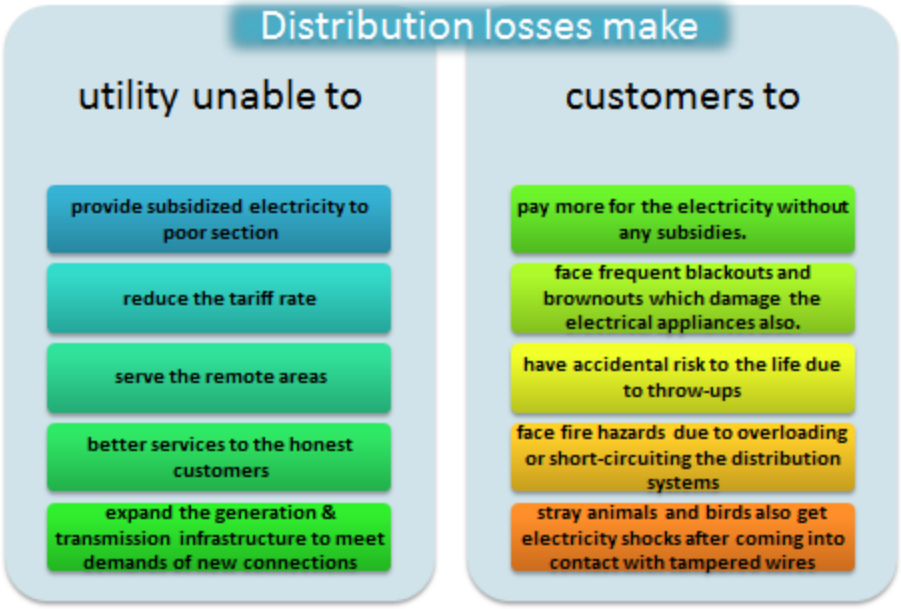

Figure 2.Effects of Distribution Losses on the Utility and Consumers

Today, the utility companies all over the world are annually losing approximately $25 billion, of which $4.5 billion are lost by Indian utilities only (S. S. S. R. Depuru, 2011). Even 10% of this amount, if recovered, could conserve about 83,000 GWh of electrical energy (Pyasi and Verma, 2008). Thegraveness of the distribution losses can be estimated from the fact that these losses are around 10-40% of the complete generation (Smith, 2004). Distribution losses cost India's economy 1.5% of GDP each year, putting more burden on precarious finances of the utilities (Bhatia and Gulati, 2004). Distribution losses are equally detrimental to the interests of consumers, as highlighted in Figure 2.

Distribution loss is the loss of units that have been supplied but not billed by the utility. The electricity units lost in between the way are attributed to different practices (Smith, 2004). The distribution losses have both technical and non-technical facet. The distribution losses are mainly attributed to electricity theft, which has been made a punishable offense by the Section 135, Electricity Act, 2003. Still, practice of electricity theft is visible at many local lines, though, after certain policies and changes in regulatory framework, there has been high decrease in the losses. For instance, in Chile and Argentina, the distribution losses got reduced by half in seven and three years respectively, due to the deregulation of the electricity sector (Rudnick and Zolezzi, 2001).

District Sonepat is supplied electricity by UHBVN. Despite of several measures adopted by UHBVN, the utility is still not getting the invested amount back from the customers leading to financial crunches. Even if, somehow collection efficiency of the UHBVN reaches 100%, then also precarious strain is there on the accounts of the utility due to these distribution losses. The scenario is that some feeder lines even have zero percent units billed resulting into complete loss to the utility at that feeder. Focusing on the main issue of DISCOMs in the State of Haryana, the presented work revolves mainly around the distribution losses in the district Sonepat whose primary data have been collected from the distribution company for last three financial years, i.e., FY 2014-15, 2015-16 and2016-17.In this work, distribution losses at rural, urban and industrial feeders have been investigated as all these feeders are having different extent of distribution losses due to different socio-economic factors. The socio-economics of the area in the form of power tariff, literacy rate, income, corruption level, population etc., has also considerable role in the distribution losses. Therefore, this paper has also covered the analysis of secondary data collected from the electricity customers of UHBVN, focusing on the role of socio-economics in the distribution losses. Various suggestions to eradicate the problem of distribution losses have also been collected from the respondents.

In this paper, Section 2 presents some significant explorations and investigations about the phenomenon of distribution losses. The primary reason behind distribution losses, i.e., electricity theft has been mainly focused.The exploratory study has been undertaken in Section 3particularly for the district Sonepatof the State of Haryana for last three FYs 2014-15, 2015-16 and 2016-17. Analysis of primary data collected from electricity consumers, have been posited in Section 4. Section 5 followed by conclusion, briefs certain major administrative endeavors to curb the distribution losses.

2. LITERATURE REVIEW

Distribution losses have become the primary concern for the utilities all over the world. Few studies have explored about the multifaceted phenomenon of distribution losses (Saini, 2017).Distribution losses have also been studied from the angle of socio-economics. B. Min and M. Golden (2014) have corroborated that during elections, electricity distribution is manipulated for favoring political connections. They have examined and compared the line losses (1970-2010) with the timing of electoral cycles. Consequently, they found that electricity losses

increased by 3% in period prior to elections in Uttar Pradesh, the largest state of India. The results of the study state that the political parties are more likely to retain their seats if more unbilled electricity is supplied to the people before elections (Golden and Min, 2012).

Yurtseven (2015) has analyzed the socio-economic background of illegal consumption in Turkey by estimating an electricity theft. He has come to the point that education, income, social capital, rural population rate, temperature index, and agricultural production rate are crucial components that determine electric theft and thus thedistribution losses. Gaur and Gupta (2016) gives the extent of power theft at all-India level which is varying due to varying socio-economic and governance factors. They have empirically evaluatedthat lesser poverty, lesser corruption, higher literacy and higher income, are accounted for lower distribution losses. Sharma et al. (2016) have emphasized on the need of understanding the interaction of social factors such as employee morale, motivation, capacity, organizational culture and processes, and technical factors namely improved transformers, smart cards, high voltage distribution system etc.

Distribution losses cause precarious situation of utilities and several adverse consequences like power disruptions to legitimate consumers, overloading/short circuiting of power distribution systems, poor quality of supply, and higher electricity price (Lewis, 2015).Many countries have progressed further in direction of zero distribution losses by bringing paradigm shift in billing systems. F. M. Mwaura (2012) has taken initiative towards suggesting pre-payment billing system for Uganda as a strategy to reduce the non-technical losses. He has analyzed this strategy with some lessons learnt from Rwanda where this strategy has been favorably implemented to reduce the non-technical losses on account of pilferage and theft. Consideration of different possibilities and challenges in the adoption of pre-payment billing system in Uganda provides that its success will depend on the capital available with the company, number of targetable customers, energy use and revenue of targetable customers etc.

In Uganda, the practices of bulk metering for micro and small enterprises and prepaid metering for households have been analyzed with the extent of their success (Never, 2015). Tasdoven et al. (2012) discuss the applicability of four governance tools (economic regulations, grants, privatization and public information) to the issue of energy theft. Depuru et al. (2011) have depicted a worsening scenario of electricity theft in different countries like Malaysia, Mexico, Canada, Brazil and many others. So, they have provided a conceptual design for punishing the illegal consumers by using the harmonic generator in the feeder lines.

Jamil and Ahmad (2013) have employed principal-agent-client linkages in electricity theft in Pakistan. They have investigated the role of different control variables like tariff rate, wages, probability of detection and enforcement process, punishment and deterrence, reputation, morality and fairness cost of pilferage. Jamil (2003) has investigated the effect of electricity theft on electricity outages and electricity price through Johansen approach.

Different areas have different socio-cultural and electricity governance structures; hence they have different scenario and factors of distribution losses (Winther, 2012). There are many areas having marginalized layer of society which doesn't have proper access to electricity (Silva and Rosa, 2008). In those areas, e.g., rural and agricultural areas, electricity theft is regarded as money saving activity rather than a criminal activity (Katiyar, 2005). L. M. Mimmi and S. Ecer (2010) have studied about illegal electricity connections particularly in the low income urban favelas of Brazil. They have sketched out

Figure 3. Location of Sonepat District in Haryana (in red)

certain factors like low income, incorrect usage of electricity appliances, sub-standard energy provision and equipment, using domestic electricity for in-house business etc. which further triggers the illegality. The authors have analyzed the effect of energy demand on energy related illegality and suggested some measures like awareness of energy usage, improvement of equipment, promoting energy saving behavior of customers, good metering and maintenance and consumption based energy subsidies to mitigate the illegal access to electricity. Drawing from the literature, the analysis of distribution losses has different results for different areas. And it also demands the consideration of various socio-economic factors of the area.

3. CASE STUDY OF SONIPAT

In this work, case study of district Sonepat, Haryana has been undertaken for the analysis of distribution losses in the rural, urban and industrial areas. This analysis is based on the secondary data obtained from the utility operating in the district Sonepat, i.e., UHBVN. The analysis covers the distribution losses in the duration of three financial years from April, 2014 to March, 2017. Sonipat was made district in December, 1972. Earlier, it was a part of Rohtak district. Now, it falls under Rohtak division of Haryana State. It is shown in red in Figure 3. It has eight numbers of blocks – Sonipat, Ganaur, Kharkhoda, Rai, Gohana, Kathura, Mundlana and Murthal. As per Census 2011, the population of the district is 14.50 lacs. The literacy rate in Sonepat district is only 89.12% where female literacy rate (69.80%) is lesser than male literacy rate (87.18%) (Census, 2011).

This district has more than double population in rural areas (9.97 lacs) as compared to urban population (4.15 lacs) (Census, 2011). All the blocks of district Sonepat have higher rural population as compared to urban population. Consequently, distribution losses are comparatively higher in Sonepat district. Thereby, the case study of district Sonipat has been undertaken in this paper for the analysis of distribution losses. Different blocks of Sonepat district like Gohana, Kharkhoda, Rai, Murthal, Ganaur and Sonepat have been chosen for the case study.

5.1. GOHANA

In the FY 2014-15, all the urban feeders of Gohanahave more or less equal losses. The losses on the urban feeders ‘Old AnajMandi’ and ‘Samta’ have been very high in the month of January, 2015 Figure 4. Subsequently, these losses have been brought to zero by implementing theft proof strategies and realizing the correct and timely billing process. Some feeders, for instance, ‘Old AnajMandi’ and ‘Sect-7’ have negative losses in Sepetmber-2015, November-2015 and January-2016 due to absence of billing process in August, October and December-2015

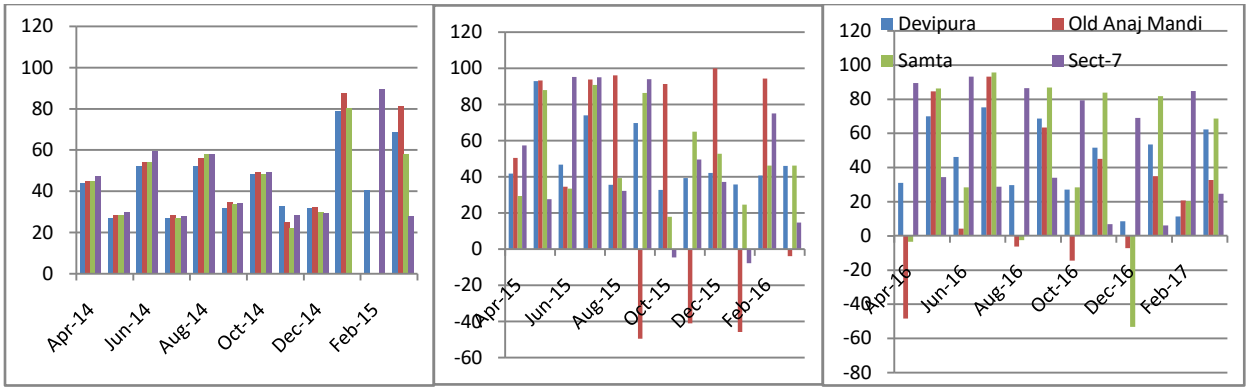

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Figure 4.Losses at Urban Feeders of Gohana(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

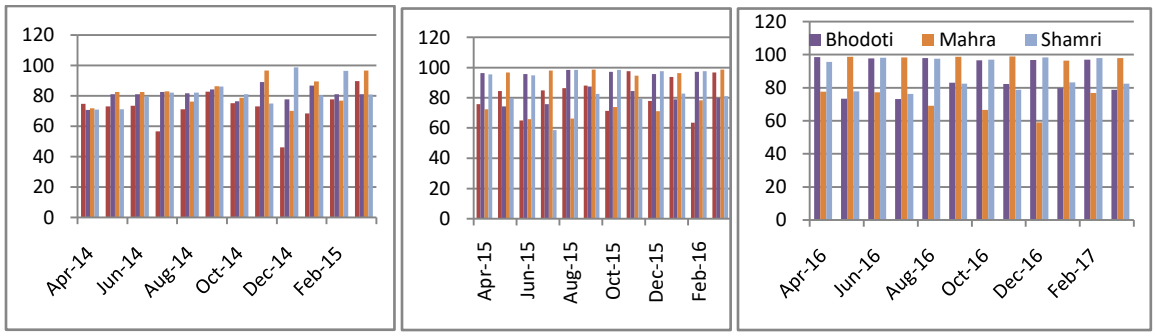

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Figure 5.Losses at Rural Feeders of Gohana (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

Figure 4. In FY 2016-17, despite many policies to check upon theft and other distribution losses, loss at the feeder 'Sect-7' in Gohana has high losses throughout the year Figure 4. Similarly, feeder 'Samta' has also high losses approaching 100% except few months where it has small negative losses. This feeder has regularly high units' consumption but in the month of December, due to seasonal consequences, consumption is less. But due to billing on the basis of average reading, unit billed gets larger than the unit received leading to negative losses. Observing the losses graph over last three financial years, losses have been continuously increasing.

The Block of Gohana has 82.34% population living in rural areas (Census, 2011). Large population in rural areas further increases the chances of distribution losses. Being the feeders serving the rural areas, the losses are very high at all the feeders throughout the years, as shown

in Figure 5. In the rural areas, phenomenon of electricity theft occurs more due to low level of income and literacy. Low system efficiency in the rural areas is also responsible behind the soaring losses at all feeder lines in rural area of Gohana. In FY 2015-16, losses at all feeders have increased in comparison with the previous year. This increase in losses is attributed to continuous increase in population. More the population more is the occurrence of electricity theft. Parallel, the chances of detection of theft also decreases with the rise in population. Next year also, all the feeders have the increment in losses. Losses at many feeders are soaring high to 100%. The utilities are facing huge financial losses due to the feeders which

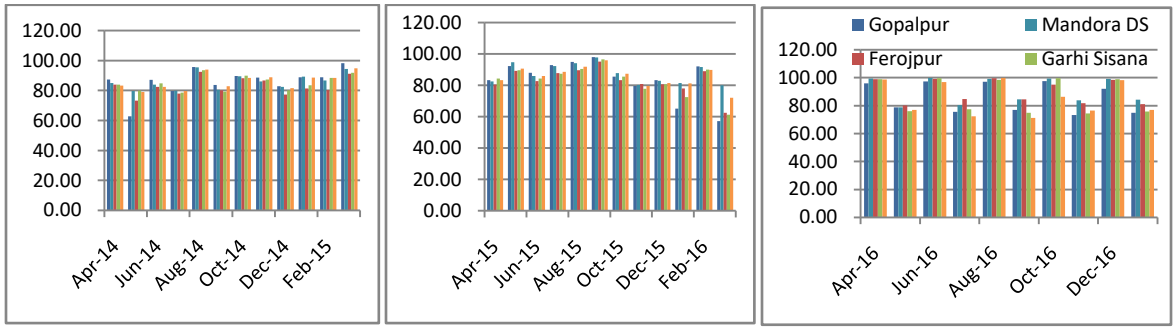

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Figure 6.Losses at Rural Feeders of Kharkhoda(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

have losses even higher than 90%. The block of Gohana has no industrial feeders. Only rural and urban feeders have been studied for the distribution losses in Gohana.

5.2. KHARKHODA

In the rural areas of Kharkhoda, every feeder has very high losses. All the feeders have annual average losses of 80% ,Figure 6. Being the rural area, no scheme or strategy could be implemented successfully to bring the losses down. In rural areas, customers have different attitude towards electricity theft due to their literacy level and low earnings. Those people don't consider the theft as the illegal activity rather they consider it as the way of saving their money. They think that if the utility is making the profits by highly charging from them, they can also cheat the utility rightfully. The losses on all the feeders of rural areas of Kharkhoda have increased in FY 2015-16, as shown in the Figure 8. There are no large seasonal variations in the losses. In FY 2016-17, there are drastically high losses in all the feeders, Figure 8. Even in other

months, there is large number of hooking activities going on in the rural areas causing the billed units very small as compared to actual received units by the utility.

In the block of Kharkhoda, there are only two feeders serving the industries. The industrial feeders have very small losses throughout the FY 2014-15, Figure 7. For the industrial feeders, utility provides two meters installed, one at the substation and other at the customer premises. Both the meters show approximately equal reading making the billed units equal to received units by the utility. Generally, the losses at the industrial feeders are in the range of ±5%. In the month of April in 2014, due to meter reading issue, no units were billed resulting into huge amount of losses at both the feeders.In FY 2015-16, there were around 4% losses throughout the year. The cases of electricity theft are comparatively very negligible in the case of industrial customers. The negative losses at the feeder line 'Ind. Ferojpur' are due to the faulty meter and resultant average billing. These result into negative losses, i.e., larger units billed than units received at the industrial feeders.

In the urban areas of Kharkhoda, cases of electricity theft are lesser as compared to the rural areas, but still electricity theft occurs. There is only one urban feeder in Kharkhoda which has almost same losses throughout the

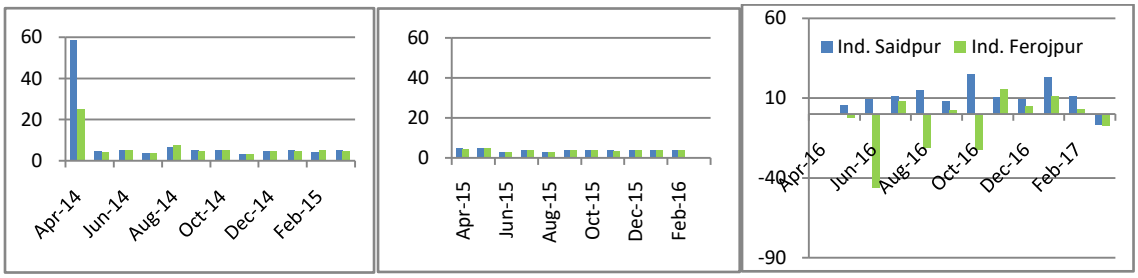

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Figure 7. Losses at Industrial Feeders of Kharkhoda (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

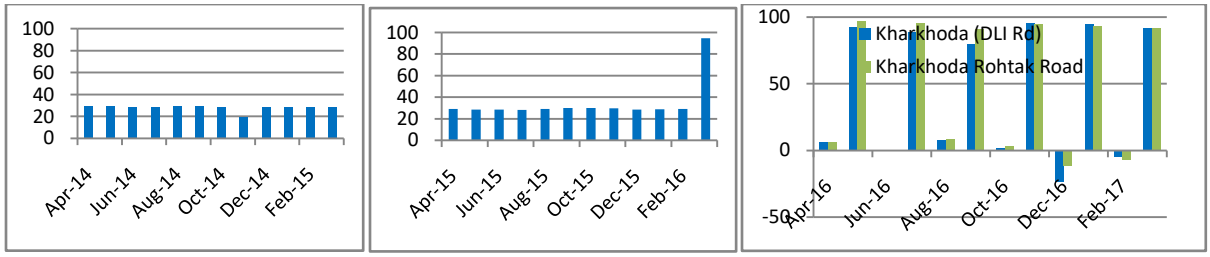

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Figure 8. Losses at Urban Feeders of Kharkhoda (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

FY 2014-15, Figure 8. People living in urban areas illegally tap electricity for running their heavy loads like air conditioners, coolers etc. This results into billed units lesser than the received units on the feeder. In FY 2015-16also, the losses at the urban feeder of Kharkhoda are same, i.e., approximately 30%. Due to lack of man-power, meter reading process was not done completely. This resulted into negligible units billed causing the large gap from the received units at the feeder line. Consequently, the feeder had large losses in the month of March, 2016, Figure 8.In April 2016, the units due for billing for the month of March, 2016 were billed by the utility, resulting into small losses.

During FY 2016-17, utility had the billing process bimonthly. So, in the alternate months, the billed amount is very less as compared to the received units at the feeder. This amounted to huge loss at the feeder. Small losses in the alternate months are due to the occurrences of electricity theft and small negative losses are due to the faults in billing process.

5.3. RAI

Almost all the industrial feeders in Rai have average loss of 2-12% throughout the FY 2014-15, Figure 9. These losses are generally ignored by the utility. These losses occur due to the illegal tapping of the electricity which is lesser in industrial areas as compared to urban and rural areas. Meter fault at industry end also causes the billed units lesser than the received units amounting to small losses at the feeder line. In August 2014, due to issues

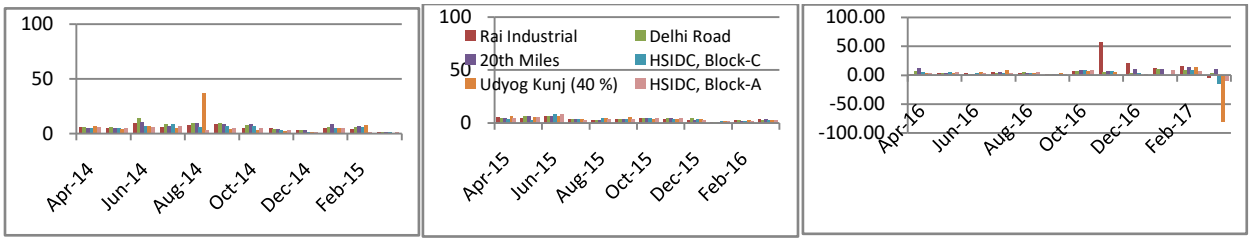

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Figure 9.Losses at Industrial Feeders of Rai(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

in correct billing in the area of UdyogKunj, the utility didn't have the units billed leading to large loss at that feeder, Figure 9. In FY 2015-16 also, there is same scenario of losses at all the industrial feeders. These feeders have less than 10% average losses, Figure 9. As the billing and metering process is timely undertaken for all the industrial feeders, there are no significant losses at the feeder lines. In FY 2016-17, the condition of the feeder losses got improved. The losses at all the industrial feeders decreased as compared to previous year. In November 2016, losses at the feeder 'Rai Industrial' shoot high because the utility didn't record the billed units due to some fault in billing software, Figure 9. Same issuecontinued for next few months but continuously improved with negative loss at the end in the month of March, 2017. At the feeder line 'UdyogKunj', due to faulty meters at the substation end, received units were not metered correctly and the bills were generated on the average basis leading to negative losses, Figure 9.

In FY 2014-15, being the feeders of rural areas, these feeders have very high losses throughout the year. The cases of electricity theft are common at every corner of the rural areas. Consequently, billed units could never become equal to the received units resulting into huge losses to the utility. All the rural feeders of Rai showed improvement in the losses due to the strict actions taken by the utility squads to check upon the theft cases. Losses reached below 30%. But slowly the losses again reached to the heights due to failure of utility policies and action strategies in the rural areas. The same increasing pattern in the losses continued for the FY 2016-17, Figure 10. Some feeders like 'Jakholi II', 'Pritampura' and 'NangalKalan' showed good results of utility efforts to reduce the electricity theft. But in the next few months, again the utility didn't have the billed units equal to the supplied units due to increasing cases of electricity theft. Some feeders were having losses even approaching 100% bringing the complete loss to the utility.

In Rai, urban feeders supplied the developed colonies like TDI andAnshalSushant City during FY 2014-15. Very few customers of these feeders used to illegally tap the electricity. Otherwise, there were very less cases of electricity theft. This resulted into very small losses at the feeder line that was also due to faults in metering

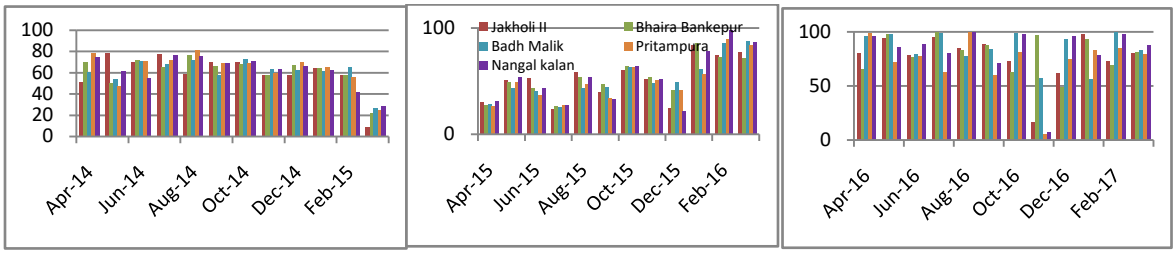

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Figure 10.Losses at Rural Feeders of Rai(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

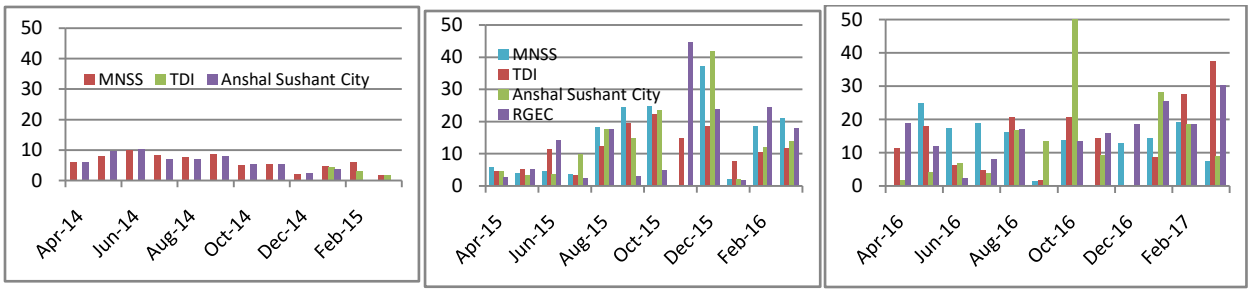

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Figure 11.Losses at Urban Feeders of Rai(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

process. The feeder line 'TDI' had also 0% losses till December 2014, Figure 11. In FY 2015-16, as the population grew, number of connections increased. With rise in number of connections, occurrences of electricity theft also increased. Subsequently, the losses also became higher in all the feeders. The feeder 'AnshalSushant City' had high losses as this feeder supplies many commercial units which do not have regular operation. Consequently, there could not be regular metering process amounting to large losses in some months. The losses to the utility at these urban feeders are irregular due to the type of consumers being supplied by these feeders. Losses at the urban feeders are not as high as rural feeders but they are significantly around 20%. Some feeders have sudden increase in losses which are due to meter faults.

5.4. MURTHAL

At the industrial feeders of Murthal, there were negligible losses within the range of 10%. Industries being supplied by these feeders have fewer chances of electricity theft and non-metering of the consumed units. Therefore, industrial feeders have only small losses throughout the year. In industrial feeders, rate of change in number of connections is also very less. So, the same industries at the industrial feeder line cause less losses to the utility. In FY 2015-16, the losses decreased to even lesser value due to utility policies, Figure 12. Sudden increase in losses in September, 2015 at the feeder 'Raj Dhani Farm' is attributed to the lack of manpower for meter reading.

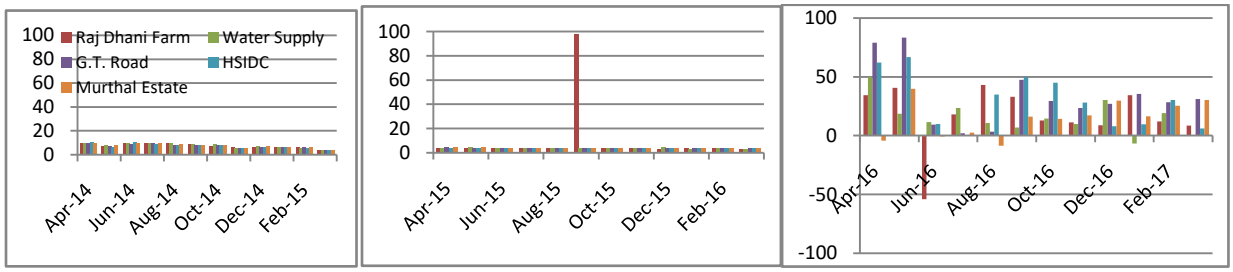

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Figure 12.Losses at Industrial Feeders of Murthal(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

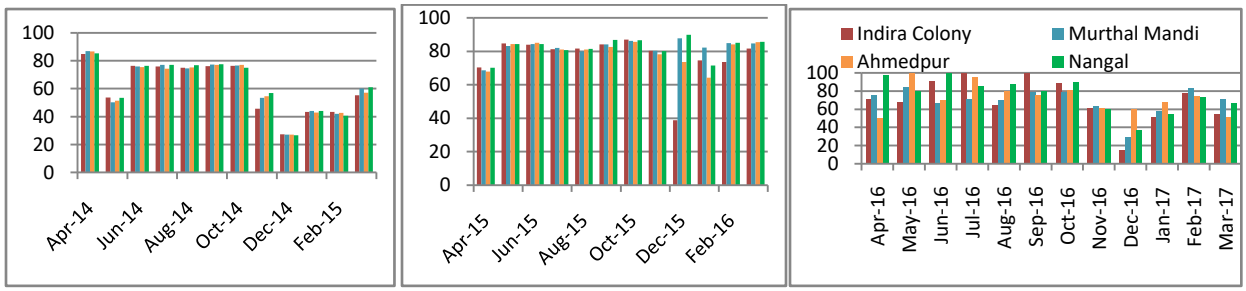

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Figure 13.Losses at Rural Feeders of Murthal(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

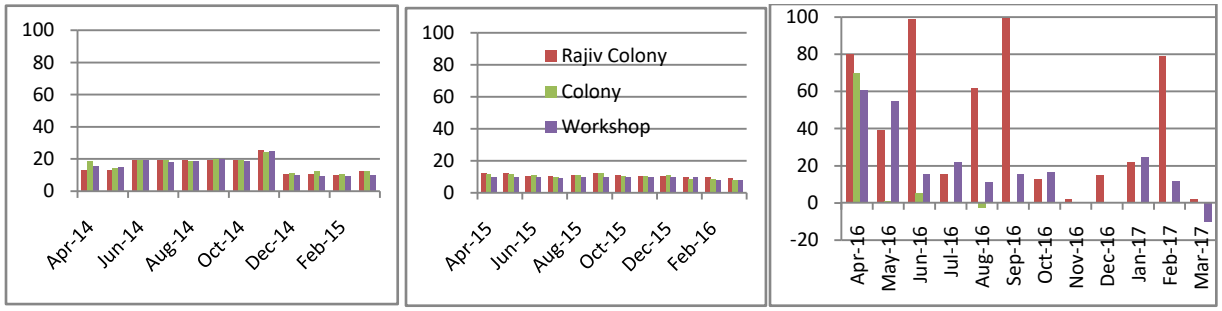

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Figure 14.Losses at Urban Feeders of Murthal(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

But in FY 2016-17, there was huge increase in number of connections in the industrial areas which consequently increased the billing irregularities and losses also. The phenomenon of illegal hooking increased drastically leading to large losses even at the industrial feeders.

At the rural feeders of Murthal, losses are significantly high in some months. The low income, poor literacy and awareness level, absence of regular inspection visits are few factors behind the large amount of electricity being stolen in rural areas. These losses were particularly very high in the summer months. With some strict vigilance activities, electricity theft was somewhat controlled leading to the decrease in the level of losses in the rural areas, Figure 13. The losses at the rural feeders of Murthal again reached to the heights. All these losses are attributed to the illegal hooking activities found frequently in the rural areas. In FY 2016-17, some feeders (Indira Colony, Ahmedpur and Nangal) even had 100% losses due to the unchecked growth of electricity theft which increases drastically during peak summer season and to a lesser extent during peak winter season, Figure 13.

In the urban areas of Murthal, there are three feeders supplying the area. Customers supplied from these feeders have comparatively higher income and literacy level. Therefore, they have less tendency to steal electricity resulting into smaller losses at all three feeder lines. During FY 2015-16, the losses to the utility got improved with proper implementation of certain mitigating strategies in the urban areas, Figure 14. Therefore, the losses at all the feeders remain around only 10% throughout the year. But in FY 2016-17, the losses at some feeder lines increased drastically due to increased illegal tapping of electricity lines. Another reason of high losses at the feeder lines ‘Rajiv Colony’ and ‘Workshop’ was the unavailability of meter readers. Due to incomplete meter reading in the urban areas of Murthal, there were only small units billed. Consequently, both these feeders had high losses.

5.5. GANAUR

The industrial feeders of Ganaur have losses within 10% throughout the FY 2014-15, Figure 15. The industrial connections have regular meter reading and billing process. Moreover, fewer units are stolen from the industrial

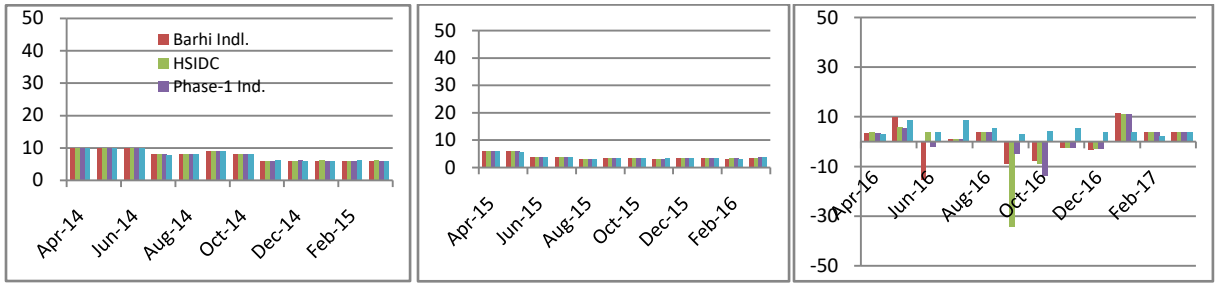

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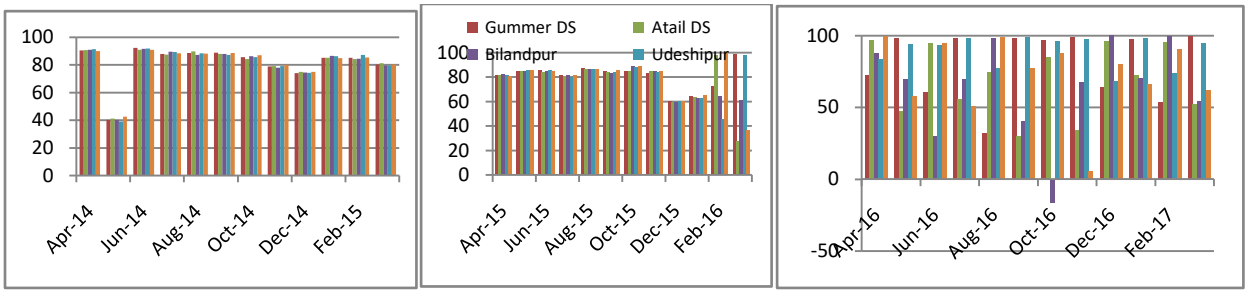
Figure 15.Losses at Industrial Feeders of Ganaur(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17



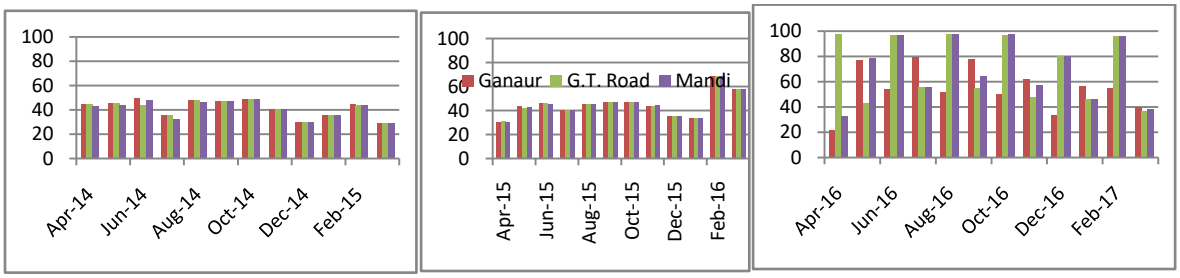
(i) (ii) (iii)

Figure 16.Losses at Rural Feeders of Ganaur (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

feeders. Consequently, the industrial feeders have very negligible gap between units billed and units received at the feeder lines. In FY 2015-16, the losses at industrial feeders further dropped down due to improvement in metering process and inspection process, Figure 15. FY 2016-17 saw the reduction in the losses at the industrial feeders. The reason for negative losses is the faulty substation meter. Faulty substation meter recorded fewer units as compared to actual received units. But the bills to the industrial customers were issued on average basis that resulted into billed units higher than the received units. That's why, the feeder line 'HSIDC' is having large negative losses in the month of September 2016, Figure 15.

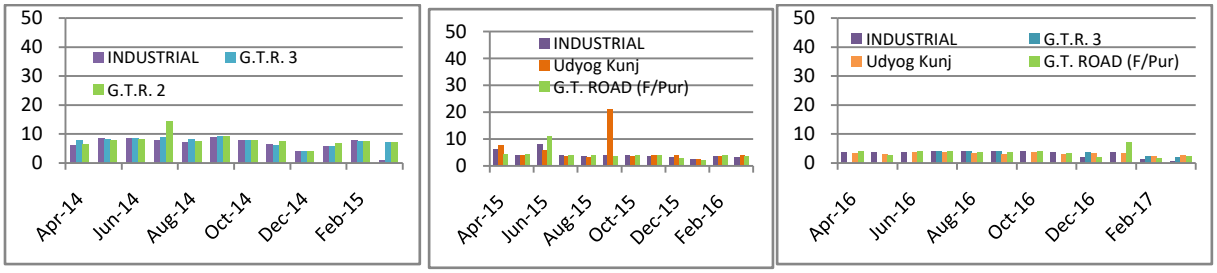
The rural feeders of Ganaur have very high losses throughout the year except the month of May. The large shortfall in losses in the month of May is attributed to the efforts of the utility

directed towards mitigation of electricity theft. During FY 2015-16, the losses at rural feeders have somewhat reduced. But still they were significantly high for the utility. The utility started regular raids at odd timings for checking electricity theft. These efforts produced the downfall in the losses from December, 2015 to March, 2016, Figure 16. The rural feeders had high losses during FY 2016-17 also. Some rural feeders have fewer losses also but only in few months. Due to the technical issue in meter reading of the consumers supplied from the feeder 'Bilandpur', the units were billed on average basis. Consequently, billed units were higher as compared to actual received units causing the negative losses in the month of October, 2016, Figure 16.



(i) (ii) (iii)

Figure 17.Losses at Urban Feeders of Ganaur(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17



(i) (ii) (iii)

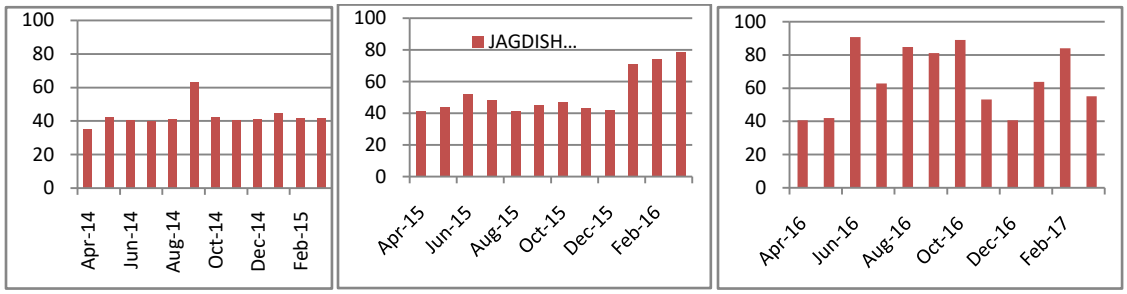
Figure 18.Losses at Industrial Feeders of Sonepat (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

The urban feeders of Ganaur have fewer losses as compared to the rural areas of Ganaur. The cases of electricity theft are comparatively lesser. All the feeders have more or less equal losses throughout the year. The average losses are around 30-40% in the FY 2014-15, Figure 17. During FY 2015-16, the losses were same for all the urban feeders in the initial months. But as the number of connections increased, cases of electricity theft also increased. Resultantly, losses at all the urban feeders also increased. The urban feeder of Ganaur, 'Gandhi Nagar' had the bimonthly billing process. In other alternate months, the feeder has very high losses, Figure 17.

At other feeders also, losses have been decreased in few months due to better vigilance for the electricity theft.

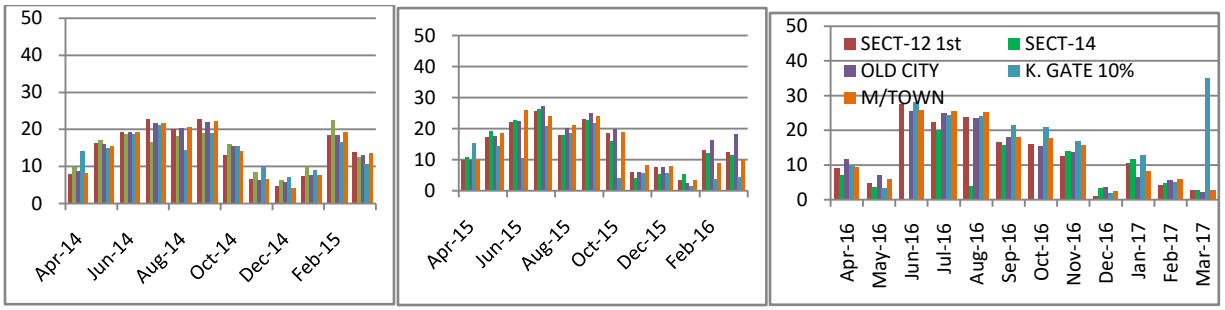
5.6. SONEPAT

All the industrial feeders of block Sonepat have very small losses throughout the year due to less units being wasted in theft. During FY 2015-16, losses at all the industrial feeders decreased except the feeder of UdyogKunj, Figure 18. At that feeder, meter reading was not done due to administrative and managerial issues. Consequently, no units were billed for the month of September leading to high losses at that feeder.During the FY 2016-17, the losses at the industrial feeders further improved. The cases of electricity theft also reduced leading to very negligible losses at the industrial feeders of Sonepat, Figure 18. There is only one rural feeder in the Sonepat. Being a rural feeder, it has comparatively lesser losses as compared to other rural areas due to higher income and literacy level of the customers. The occurrences



(i) (ii) (iii)

Figure 19.Losses at Rural Feeders of Sonepat (i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17



(i) (ii) (iii)

Figure 20.Losses at Urban Feeders of Sonepat(i) FY 2014-15 (ii) FY 2015-16 (iii) FY 2016-17

Of electricity theft depend on the attitude of customers towards electricity theft. The gap between the received units and the billed units is smaller due to the less units of electricity stolen by the rural customers. But during FY 2015-16, with the increase in number of connections, illegal tapping activities also increased causing larger gap between billed and received units. The losses at the rural feeder of Sonepat are varying as per the seasonal variations. In winter and summer season, high electricity theft occurs which causes high losses at the feeder, Figure 19.

At the urban feeders of Sonepat, there are fewer losses as compared to the urban feeders of the other areas. The urban customers of Sonepat are comparatively more literate and financially secured. So, they are less involved in the hooking activities. Consequently, the losses at the urban feeders are less. But the losses increase with the peaks in temperature, Figure 20. During FY 2015-16 also, same pattern occurred in the feeder losses. But the overall feeder losses increased in this financial year for all the urban feeders, Figure 20. The losses at urban feeders are continually increasing with increase in number of customers which thereby increases the chances of electricity theft. Consequently, losses for all the feeders highly increased in the month of June and July due to peak summer season. In the month of March 2017, the losses at K. Gate increased suddenly due to average billing of units, Figure 20. In this month, the

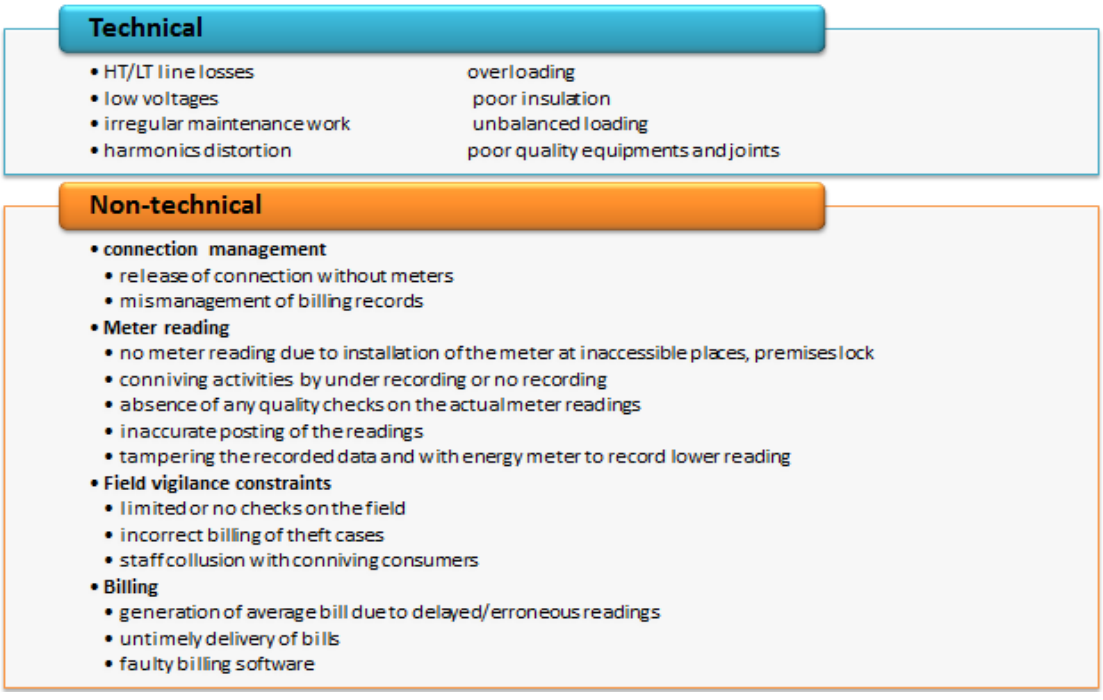


Figure 21. Factors Responsible for Distribution Losses

average bill of almost all the consumers of this feeder was greater than the actual bill. Therefore, this feeder has very high losses as compared to other normally operating feeders.

Apropos to the secondary data analysis of distribution losses in district Sonepat, it is inferred that the distribution losses in Haryana, particularly in the district Sonepat, are not engendered by one single cause. Among many causes, the major one is electricity theft followed by billing and metering irregularities. Overall causes of the distribution losses in the district have been listed in Figure 21.

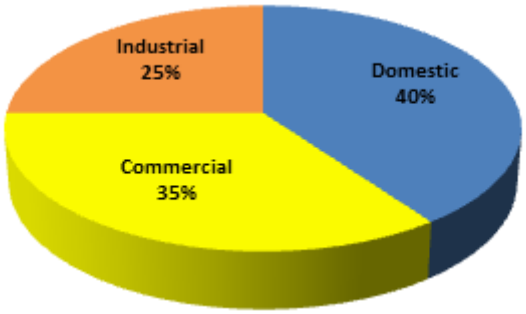


Figure 22. Ratio of Respondents of The Primary Data Collection

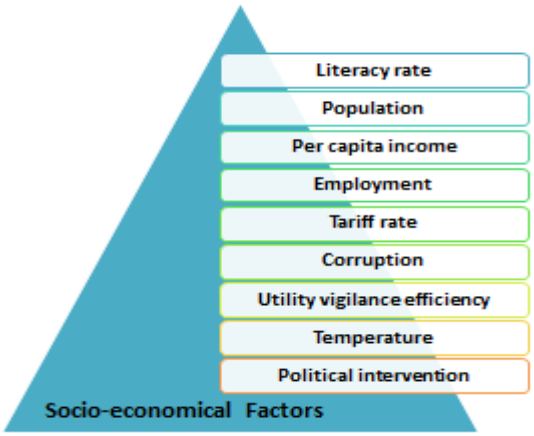


Figure 23. Socio-Economical Factors of Distribution Losses

4. PRIMARY DATA ANALYSIS

The major factor behind the distribution losses is electricity theft which highly depends on the customers'attitude towards electricity theft. For studying the customers' point of view towards the problem of electricity theft, a survey has been done to collect the primary data by using a structured questionnaire. The questionnaire is designed in a way to assess the impact of different socio-economic factors (e.g. income, literacy, corruption, awareness etc.) on the distribution losses. This primary data has been collected from 40domestic, 35commercialand 25 industrial customers, as shown in Figure 22.78% of the respondents are male and 22% are female. Demographic analysis of the respondents is given in Table 1.

Distribution losses are not merely dependent on technological loopholes. Socio-economics also plays a very important role behind the rise/fall in distribution losses. Distribution losses in a particular area depends on various socio-economic factors (Gaur and Gupta, 2016), listed in Figure 23. These factors influence the customers' attitude that highly affects the level of distribution losses (Saini et al., 2016). The empirical analysis of the collected data has been done by calculating the descriptive statistics of the data in SPSS Statistics Version 23. The results of the statistical analysis give following inferences:

i) Educated people are less involved in the illegal tapping of electricity as they know the after-results of these activities. They are comparatively less involved in billing irregularities also. This fact shows that more the educated people in the area, lesser are the distribution losses in that area.

ii) Poor people are more tempted towards stealing electricity either by hooking or tampering with energy meter to have financial gain even if it is little. Many poor people are unable to afford the electricity price and initial connection charges, so they have only one option of thieving electricity which results into distribution losses.

iii) Corruption facilitates both the consumers and employees to have illegal monetary benefits. Corrupt employees take bribe and connive with the consumers to allow them to stealthily do electricity theft. So, higher corruption level increases the distribution losses.

iv) Awareness among consumers regarding distribution losses, negative effects of electricity theft etc. deject them from using electricity illegally. Higher the awareness utility spreads among consumers, lesser are the distribution losses in that area.

v) Political intervention also increases the distribution losses. Political connections prevent the illegal consumers from being caught and fined, thus motivating him to steal electricity fearlessly.

vi) The most important factor, i.e., system inefficiency in taking stringent actions against consumers and employees involved in electricity theft, raids at odd timings, providing new connections with

Table 1.Demographic Profile of the Respondents

Demographics	Category	No. of respondents in category	Percentage %
Age	18-30 years	24	24
	30-40 years	38	38
	40-50 years	23	23
	50-60 years	10	10
	60+ years	5	5
	Total	**100**	**100.00**
Gender	Male	78	78
	Female	22	22
	Total	**100**	**100.00**
Education	Illiterate	8	8
	Matric	16	16
	Upto 10+2	19	19
	Bachelor's	33	33
	Master's	11	11
	Others	13	13
	Total	**100**	**100.00**
Income	UptoRs. 10000	22	22
	10000-50000	36	36
	50000-100000	15	15
	Above Rs. 100000	27	27
	Total	**100**	**100.00**
Area	Rural	31	31
	Urban	69	69
	Total	**100**	**100.00**
Category	General	42	42
	OBC	34	34
	SC/ST	24	24
	Total	**100**	**100.00**

less formalities and low cost etc. is responsible for unchecked growth of distribution losses, mainly in rural areas.

All these implications present the effect of socio-economics on distribution losses. Many instances from the secondary data can be taken to affirm the role of socio-economics in distribution losses. Feeders supplying theblocks like Sonepat where most of the consumers are literate and earning good income have comparatively lesser distribution losses even at rural feeders. Industrial feeders have very small distribution losses due to high income, high system efficiency etc. in all the areas considered in this study.

All the respondents were also asked to give the suggestive measures to put a check on distribution losses in their areas. The overall suggestions of the customers are listed in Table 2 along with the frequency of the suggestions. On technical side, several steps can stamp out the distribution losses, like tamper-proof smart meters, all electricity meters at pole (or transformer) instead of customer premises, prepaid electricity connections, automatic meter reading, underground distribution cables, use of low power consumption devices etc. The placement of electricity meters at the poles or transformers will disable the dishonest consumers in bypassing the electricity meters for their illegal electricity consumption. All the defective and electromechanical meters should be immediately replaced with new electronic meters. Only strong and properly insulated wires should be used for the distribution purpose so that no illegal throw-ups can be made from the wire. For instance, there is special drive going on in the Sonepat district by UHBVN which includes the preventive measures like shifting each and every electricity meter from the customer premises to distribution pole, replacing the cables with shielded cable from pole to meters.

The problem of distribution losses can't be tackled by technical measures alone. They have to be backed up by non-technical solutions also.The primary and the most frequent suggestion is to increase the frequency of sudden visits of vigilance teams at odd hours of day. Vigilance team should be reconstituted at rotation basis or should be constituted from interstate employees to prevent the collusion of consumers with dishonest employees.

Table 2: Primary Data Collected from Respondents from District Sonepat in form of Suggestions to put check on Electricity Theft

Suggestions	Frequency	Percent	Suggestions	Frequency	Percent
Regular vigilance raids in every area	49	8.4	More duration of supply	22	3.8
Strict action & imprisonment for theft	46	7.9	publicly announce name of defaulter persons	21	3.6
Low and affordable electricity tariff	42	7.2	Theft informer should be secretly rewarded	21	3.6
Replace old meter with electronic& smart meter	39	6.7	Reconstitute vigilance teams on rotation basis	18	3.1
Public awareness programmes (street plays)	37	6.4	Pre-paid electricity meters	17	2.9
No cut/joint in service cable from pole to meter	32	5.5	Subsidy to customers who pay their bills	15	2.6

Electricity meters outside customer premises	31	5.3	No extra taxes in electricity bill	14	2.4
Honest employees	30	5.2	Strict action against corrupt employees	13	2.2
Strong and insulated cables	29	5	Adopt latest technology to detect theft	11	1.9
Correct meter reading	26	4.5	Energy saving equipments at subsidized rates	8	1.4
Underground distribution cables	25	4.3	Meter should not run too fast	6	1
Place common meter for a street at pole	24	4.1	No electricity connection to defaulter person	4	0.7

All the unmetered connections should be regularized. Local groups – Panchayat/ Ex-service League should be engaged for correct metering, billing and collection management. Tariff should be revised and made affordable even to poor section of the society. Extra surcharges should be waived off in the electricity bills. Higher amount of electricity bills tempt the poor consumers to steal electricity instead of honestly paying their bills. Strict legal actions (or with imprisonment) should be taken against person found guilty in theft cases to deject other persons from doing theft. Other way is to award the honest consumers in form of any benefits or subsidy in the bill. The name of the defaulter persons should be announced publicly so that people would fear from doing theft due to social respect. Utility company should held awareness campaigns for spreading information about negative effects of electricity theft from all perspectives. To motivate the people to complaint against theft, theft informers should be secretly awarded or given incentives and FIR lodging process should be computerized.

But still, there are some setbacks which hinder the implementation of all these suggested measures. These are corruption, inefficiency of utility staff, political support to power mafia, weak infrastructure and lack of full Governmental supports (S. S. S. R. Depuru, 2011; Smith, 2004). These hindrances need to be first removed for making the distribution loss below the acceptable level.

5. ADMINISTRATIVE ENDEAVORS TO REDUCE DISTRIBUTION LOSSES

Since a long time, the administration is adopting several measures to limit the soaring distribution losses. But their efforts didn't succeed in bringing the level of distribution losses down to a much lower level. As showcased in the case study, many feeders have still

approximately 100% losses. One of the major steps towards eradicating the distribution losses was Section 135(1) of Electricity Act, 2003 (later amended by Electricity Act, 2007). This act empowered the vigilance officials for inspection and detection of electricity theft which was made a punishable offense. Mandatory imprisonment and penalties were imposed on offenders and corrupt employees also.

Then another prominent initiative in this direction was the launch of R-APDRP (Restructured Accelerated Power Development and Reform Programme) which was primarily aimed at sustained loss reduction and improvement in energy accounting. The utilities get the assistance from R-APDRP if and only if they are able to reduce the AT&C losses by 3% per year (if having AT&C loss above 30%) and 1.5% per year (if having AT&C loss below 30%). Several other such schemes have been launched by the Government, to name a few, Deen Dayal Uppadhyay Gram JyotiYojna (DDUGJY), Integrated Power Development Scheme (IPDS), Financial Restructuring Plan (FRP), UjwalDiscom Assurance Yojna (UDAY) and many others. DDUGJY was planned to segregate the agricultural feeders, strengthen the transmission and distribution systems (metering of the distribution transformers/ feeders/ consumers) and rural electrification. UDAY encapsulates the decline in distribution losses through reduction in interest cost, reduction of power cost, enforcement of financial discipline and improvement in operational efficiencies (Indian Express, 2016).

Apart from the Government schemes, there are many other initiatives taken by the utility companies in Haryana to check upon the practice of electricity theft. Major steps are automatic meter reading and billing of HT industrial customers, voluntary disclosure scheme for declaration of unauthorized loads, automatic meter reading of feeder meters and distribution transformers, use of tri-vector meters and CMRI meter reading of HT/LT consumers (HERC, 2015).Other possible panacea for the distribution losses is the entry of private players in the market or the privatization of the existing utilities (Ranganathan, 2005; Mirza et al., 2015). This solution benefits in two ways; firstly, private players are more profit oriented and secondly, privatization blocks the way between pandering politicians and corrupt employees. More stringent implementation of all these policies is the need of the hour to reduce the distribution losses.

6. CONCLUSION

Utilities are in dire straits owing to distribution losses in the feeder lines. These losses are progressing rapidly day-by-day despite of various administrative and regulatory policies and programmes. This work revolves around the distribution losses occurring in the district Sonepat, Haryana. Having the major part as rural area, the utility operating in this area, UHBVN is continuously facing large distribution losses. The problem has worsened much in the rural areas as compared to urban and industrial areas. This fact is corroborated by the socio-economic aspect of the distribution losses. Different feeder lines have different scenarios of distribution losses due to different socio-economic structure in that area. Therefore, the planning of mitigation strategies for the distribution losses also demands the socio-economic perspectives besides the technical advancements.

The main factor behind the distribution losses is the electricity theft that includes different manifestations for stealing electricity, for instance, tampering in the energy meter to record lower readings, intentional incorrect meter reading by conniving employees, illegally tapping electricity from the feeder lines bypassing the energy meters etc. Another significant factor behind these losses and electricity theft is the system inefficiency that exhibits in the form of lack of meter reading process and doing the billing on average basis, taking bribe to record wrong readings and hiding the illegal connections etc. All these factors need to be treated according to the socio-economic conditions and the economic structure of specific regions. Like, all the feeders should be segregated according to the targeted customers and power tariffs should be accordingly tailored. Various awareness programmes should be run to change the consumers' attitude towards the utility. This step should be assisted with the stringent vigilance checks both for the conniving consumers and employees. This work can also be extended by addressing the scenario of distribution losses in the agricultural feeders.

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