Assessment of the Non-Technical Loss in Electric Power System of Isabela II Electric Cooperative (ISELCO II)

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Abstract: - Non-technical loss (NTL) is one of the problems in distribution utilities and electric cooperatives, comprising electricity theft, malfunction or broken meters, and arranging false meter readings. This paper assessed the level of electricity fraud activity in the Isabela Electric II Cooperative (ISELCO II) system and helped identify and detect non-technical loss activities and abnormalities. Findings of the study revealed that the forms and natures of practice of non-technical loss (NTL) in ISELCO II are jumpering, direct tapping, tampered meter, broken glass, defective meter, tilting of meter, and separate grounding. The study utilized mixed-method research, and an interview method was conducted to support the quantitative data gathered from the cooperative. The findings further revealed that the two primary sources of NTL are the kWhr meter and the billing procedure. The Pearson Product Moment Correlation was used to test the relationship between the cooperative's reported non-technical losses (NTL) and the measurement of the monthly power rate per kilo-watt-hour (kWh) consumed by the customers. The results showed that as non-technical losses increase, the monthly power rate per kWh increases. Hence, there is a direct effect of NTL on the monthly bill the consumer pays off. Likewise, the t-test revealed that the non-technical loss and technical loss have no significant relationship with each other despite their nature. The increasing number of people involved in electricity theft has a direct impact on consumers and the system of ISELCO II.

Key Words*: — Non-Technical Loss, Electricity Theft, Electricity Fraud.*

I. INTRODUCTION

Losses exist in all systems, no matter how carefully they are designed. These have also been an eternal dilemma in an electric industry. Electricity theft has been the primary cause of complementary non-technical losses (NTL). These non-technical losses (NTL) are a common occurrence and a significant problem for electricity distributors (Messinis, et al., 2018). NTL can lead to problems such as lower reliability, voltage drop, damage to network infrastructure, possibility of a power outage, public safety risks, and income loss which in most cases leads utilities to charge benign consumers via tariffs (Yip, 2017; Depuro, 2011; Kadurek, 2010; Dos Angelos, 2011; Lo, 2013). Non-technical losses can concern serious consequences directly or indirectly for everyone involved. (Villar-Rodriguez E. et al., 2017). Although the most harmful effects of NTL are implicated in middle and low-income countries, high-income countries also need to find ways to mitigate the damage caused by this type of problem (Viegas JL, Esteves PR, Melício R, Mendes VMF, Vieira SM. (2017)).

However, the main consequence of NTL for society is the increase in electricity tariffs for paying consumers. This is a complex and often necessary problem, which occurs because the distribution concessionaires amortize the costs of non-technical losses in the paying consumers (Obafemi FN, Ifere EO. 2013; Amin S, Schwartz GA, Cardenas AA, Sastry SS. 2015; de Oliveira Ventura L et al. 2020; Manito ARA et al. 2019; Lewis FB. 2015; Salinas SA, Li P. 2016; Puig BC, Carmona J.2019; Henriques HO et al. 2014).

Electricity theft is a universal problem in the power system, it is a major problem that has been known to power utilities, and

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is defined as, "a conscience attempts by a person to reduce or eliminate the amount of money he or she will owe the utility for electric energy". (Hoda El Halabi, 2012) Furthermore, the consequences of theft are critical to the viability of the services provided. The combined losses (including non-payment of bills) in some systems have severe consequences, resulting in utilities operating at a loss and raising electricity charges regularly. The electricity utilities struggle to provide dependable service because they are trapped in a culture of inefficiency and corruption.

Technical losses are associated with the power dissipation in the different elements of the energy distribution system, in the processes of transformation, transport and energy measurement, representing energy losses that occur in delivering energy from the transmission system and substations to final consumers. These losses cannot be eliminated due to the associated physical phenomena, but their minimization is a constant study subject aiming at the optimization of the distribution system (Sallam, A.A.; Malik, O.P. 2011).

Technical losses are unavoidable as these occur in the equipment during the transmission and distribution (T&D) process, whereas non-technical losses are labeled as administrative losses that occur because of non-billed electricity, malfunction of the equipment, error in billings, low-quality infrastructure, and illegal usage of electricity (Sharma, T., Pandey, K.K., Punia, D.K., Rao, J. (2016).

Financial losses are critical for many electric power companies. Lost earnings can lead to a loss of profits, a lack of funds for investment in power system capacity and improvement, and the need to increase generating capacity to compensate for power losses. Some power systems in the worst-affected countries are on the verge of failure. Corruption grows and becomes entrenched as favors can be obtained from power sector employees in the form of incorrect billing and the acceptance of illegal connections.

In the Philippines, the Republic Act No. 7832, also known as the "Anti-electricity and Electric Transmission Lines/Materials Pilferage Act of 1994," was enacted to strengthen and protect Distribution Utilities and consumers from electricity theft. Republic Act (RA) No. 7832 was enacted during the 9th Congress in 1994 with the legislative aim of reducing unlawful energy consumption and theft of electric power transmission lines and materials, as well as providing sanctions to deter perpetrators from committing these acts. Any individual found guilty of breaching Section 2 hereof shall face prision mayor or a fine ranging from ten thousand pesos (P10,000) to twenty thousand pesos (P20,000), or both, at the discretion of the court.

It is important that electric power suppliers analyze these losses and eliminate them wherever possible. Such goals serve as the foundation for this paper, which aims to discover reasons leading to the phenomena known as non-technical losses in ISELCO II's electrical power systems, as well as the underlying steps to reduce them and their impact on the system and consumers.

1.1 Technical and Non-technical Losses

The entire distribution system loses a substantial quantity of electric power, and the losses are categorized as technical or non-technical (Navani, 2009). Technical losses in a distribution network are well understood, and reducing them is a finite and primarily engineering issue. Non-technical losses, on the other hand, have evolved into an art form, and their reduction necessitates innovation and perseverance. Utilities all over the world are working hard to address the issues.

Technical losses are inherent to the transmission and consist mainly of the dissipation of electricity in transportation, transformation, distribution, and energy measurement (Viegas, 2017). Conductor loss, transformer core loss, and potential/current coils in metering equipment are all examples of this. For a given billing period, technical loss is calculated as the sum of hourly load loss and no-load (or fixed) loss in all distribution equipment, devices, and conductors. It is computed by running three-phase load flow simulations of the distribution system with the appropriate network and load models. Such load flow simulations capture all technical losses from the unbalanced three-phase distribution network's incoming and outgoing delivery points (i.e. from sub-transmission lines to the service drops of the distribution network customers).

Administrative loss belongs to the umbrella of technical loss. It includes the component of distribution network losses that accounts for the electric energy used by the distribution utility in the proper operation of the distribution network. Substations, offices, warehouses and workshops, and other essential electrical loads are usually considered as part of the administrative loss.

The difficulties in detecting non-technical losses are related not just to existing methodologies, but also to the complexity of implementing policies, corruption, an inadequate infrastructure, and unlawful consumer behavior (Ahmad, 2017). Although developing tools to detect energy fraud is critical, the solution is to prevent theft and implement technical measures to educate consumers and ensure they feel comfortable paying for services offered by suppliers (Kumar et al., 2017).

According to Millard (2009), the themes that emerge from a comparison of the practices employed in non-technical loss reduction around the world are the following: (1) Measurement and Estimation, (2) Detection, (3) Apprehension, (4) Monitoring, (5) Recovery, and (6) Utility Positioning.

Measurement and Estimation. All utility measures "top-down" losses as the difference between purchased energy and energy sold. All estimates of non-technical losses are based on the accuracy of the calculation of technical losses (assuming that administrative losses are accurately known) subtracted from an estimate of total system losses. The most common practices are as follows: resource allocation, large user inspections, large user off-cycle meter reading, community programs, anonymous reporting, pre-payment metering, communal metering, fines, and imprisonment.

Detection. It is common to find that dedicated employees are deployed in order to check large user metering and metering installations on a random but regular basis whenever electricity pilferage is having a significant impact on revenue. This staff are usually organized and trained under the aegis of a revenue protection department. It is important that this department reports at the highest level in the utility. Meter reading staff may also be trained to detect the most obvious cases of meter tampering and illegal connections, but this is not observed as a best practice or even a widespread practice.

Detection of illegal connections, in particular, and household meter tampering, is also dealt with by operations employees. The rationale for this approach is that these employees usually have links to the local community and social welfare groups. Once again, there is a risk that employees may be tempted to make arrangements with domestic customers, but this is less likely when these employees move about in teams.

Apprehension. Apprehension of customers who pilfer usually involves the support of the police who conduct joint raids on the customer's premises with the utility. The law enforces the rights of the utility with respect to access for the purpose of inspection of wiring and metering installations, and the utility takes advantage of their powers to protect their commercial interests.

Monitoring. Monitoring is undertaken through summation reconciliation of grid metering, communal metering, and metering at customer's premises. Check or temporary metering is used to detect electricity pilferage.

Another important source of monitoring data comes from the billing and collection system. However, utilities do not generally report that low consumption or sudden reductions in consumption provide reliable indications of electricity pilferage. Utilities monitor meter advances, and meter readers are used to report obvious signs of occupancy and/or electricity use in premises that have been disconnected.

Recovery. Recovery involves the customer paying for stolen electricity along with a fine commensurate with the amount of electricity stolen. It is also generally seen that a utility is able to recover the full costs of repairing meters, wiring, etc. The energy is estimated based on the customer's end use profile and the period of time over which it is believed that the energy has been stolen.

Utility Positioning. Utility positioning on non-technical losses is largely a function of the regulatory drivers and, to some extent, on ownership, i.e., government versus investor-owned. Where caps are applied to non-technical losses, it is evident that utilities focus effort on managing losses within the cap. In other cases, particularly where utilities are government-owned, higher levels of non-technical losses are tolerated. In general, however, there is a relationship observed between the level of losses and the manner in which the utility positions itself. The term positioning is meant to describe the attitude that the utility presents to external stakeholders.

Despite the utility's best efforts, current NTL measures are frequently inaccurate because the estimates are mostly based on records of reported occurrences rather than actual measurements of the electric energy system. It is not recommended to measure or monitor the power system because the system structure, particularly system measurement, prevents accurate and thorough detection of losses.

II. METHODOLOGY

The purpose of this article was to examine the extent of electrical fraud activity in the ISELCO II system and to assist in the identification and detection of NTL activities and irregularities. The following sub-problems are outlined to stretch out details on the study:

- What are the nature and forms of practices that cause the non-technical system loss of ISELCO II?

- What preventive measures and management strategies should initiate by the power utility to address human interventions to electricity theft?
- Is there any significant relationship between the non-technical losses of the cooperative and the computation of monthly power rate per KWH consumed by the consumers? 4)Is there any significant difference in the recorded monthly data of technical loss and non-technical loss in the year 2018?
- What are the impacts of NTL on the power system and consumers?

In order to acquire important data, the key respondents of this study were the personnel from the Technical Department and the Anti-Pilferage Section of the ISELCO II. Metering personnel, as well as those who are assigned on the field, such as linemen and meter readers, were included.

The samples of the study were taken directly from the previous records of the ISECO II. Records taken were the data about the different natures and forms of NTL reported of 2018, the percentage distribution of NTL and technical loss in the last year, and monthly power rate differential due to NTL.

The observations and information obtained were organized according to the characteristics of data. The data were carefully analyzed where every variable was tabulated with its respective frequencies and percentages. Mean computations were applied to variables in the reported nature of NTL of ISELCO II. The Pearson Moment of Correlation was applied to determine the significant relationship between the cooperative's recorded non-technical losses (NTL) and the computation of monthly power rate per KWH consumed by the consumers. The T-test was also applied to determine the significant difference in the recorded monthly data of technical loss and non-technical loss.

III. RESULTS AND DISCUSSION

3.1 Nature and Forms of Practice Relative to NTL of ISELCO II

Among the factors contributing to NTL activities, the frequency distribution of forms and natures of practice of NTL related activities are listed in table 1. Further, the data which show the monthly power rate per kWhr with respect to the corresponding Non-technical Loss recorded of 2018 are shown in table 2.

Table.1. Frequency distribution of the forms and nature of practice of NTL related activities

Forms and Nature of NTL	Frequency
Jumper (at service drop wire/at the terminal of KWH meter)	290
Direct tapping/ Reposes KWH meter	60
Tampered meter/ Not moving	11
Broken Glass	54
Defective KWH meter	176
Differential billing	8
Uncalibrated Meter	8
Tilting KWH meter	64
Separate Grounding	95
Others	7
Total	773

Table 1 shows the nature and forms of practices that resulted in non-technical system losses at ISELCO II. The pilferage team, metering division, and technical department had identified these losses through the implementation of the existing strategies of the cooperative. The corresponding percentage distribution of ISELCO II' s total incident reports involving electricity theft is shown in figure 1.

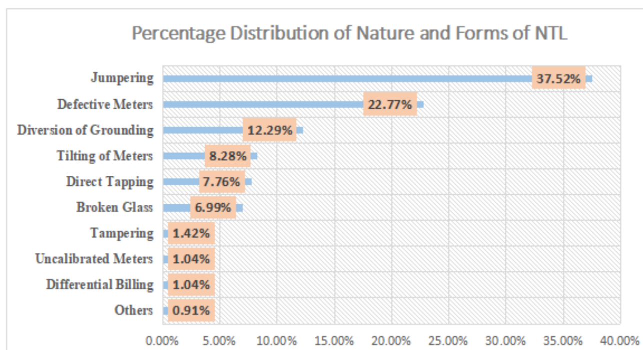

Figure.1. Percentage Distribution of the Total Recorded Incidents of Electricity Theft

Based from the figure above, the majority of the consumers were engaged in 'jumpering,' accounting for 290 occurrences or 37.52 percent of the total. The input and output terminals of the energy meter have been shorted with a wire, making this the simplest technique of stealing that anyone can do. As a result, energy cannot be recognized in the energy meter and is effectively bypassed. In some circumstances, jumpers are connected to street lights, service drop wires, kWHr meters, and other devices. It goes on to explain that consumer involvement in electrical interventions leading to illicit activities has become a hot topic in society as the cost of power in the market has risen - the accumulation of losses was paid for by consumers themselves. End-user awareness is lacking, which the cooperative must realize as part of their negligence.

The second reason is that 176 cases (22.77 percent) had defective meters.' This merely demonstrates how unbalanced the implementation of meter calibration appears to be. Since the days of employing electromechanical kWHr meters, the bulk of ISELCO II customers has continued to use them, making them prone to fraud. Actually, this sort of NTL might be purposeful or inadvertent on the part of the consumers. Unintentionally, due to the meter's age, about 20 years, it has a propensity to no longer be reliable in reading, which consumers are unaware of. As a result, average consumers simply let it go because of the advantages of decreased electric bills. However, in such a case, it should be reported immediately to the cooperative for free repair upon the owner's discovery that the meter is malfunctioning, as this would otherwise be regarded as a form of electricity theft.

Other causes include 'diversion of grounding,' 'meter tilting,' direct tapping,' and 'broken glass. These appear to be less popular than others as a type of pilferage. However, among all sorts of thieving, one of the simplest is meter tilting. It is vulnerable to electromechanical meters, or simply meters with rotating discs, as it impedes rotation, especially if the meter is old. As a result, the implementation of replacing all electromechanical meters with digital/smart meters has become a concern.

The cooperative should prioritize the implementation of random inspections and meter replacement because it is the major basis for determining how much a client must pay during a billing month. Finally, NTL losses are primarily attributed to 'Jumpering' and 'Defective Meters'; hence, a request for tight implementation in meter checking should be addressed. The reader should check on a regular basis to ensure that the meters are still in good condition.

3.2 Management Strategies and Preventive Measures

Theft cannot be differentiated from Transmission and Distribution Losses or from the overall system loss. Singh. T (2009) assessed the worldwide energy loss and theft exceeds the total electricity demand of Germany, UK and France, the third, fourth, and fifth largest economies of the world. It is estimated that utilities of developed countries alone lose 500 million every year by way of system loss.

Electricity theft is extremely common. Meter inspection is the primary method of NTL detection since utilities consider electricity theft to be the primary source of NTL and the majority of occurrences of power theft involve jumpering and malfunctioning meters. The following are the numerous steps that must be taken in order to lower NTL at the customer, utility, and government levels:

Non-technical distribution losses are accounted for a greater proportion of total system loss. Total distribution losses are the sum of technical and non-technical losses.

The following are non-technical ways for minimizing or mitigating non-technical losses. 1.) Process improvement through DMAIC methodology. As Defined, DMAIC is A Problem-Solving Approach and Process Improvement Methodology of Six Sigma That Is Used by Businesses in Improving and Optimize Current Processes, Identify, And Fix Errors to Produce Quality Output. (S.Shaikh, J.Kazi. 2015). 2) Electricity meters must be improved to attain standard accuracy in order to reduce non-technical losses through statistical analysis. 3) In order to reduce non-technical loss, utilities must employ integrated billing and prepaid energy meters.4) Technical training for operating staff is required, as is increasing employee loyalty in order to reduce pilferage in the distribution system. 5) Smart card technology can play a key role in reducing energy theft. 6.) Statistical monitoring of energy use by industry, class, and geographical location is essential, as is the statistical evaluation of meter reading.

3.3 Significant Relationship of NTL to Monthly Power Rate

The energy bought by ISELCO II varies monthly based on consumer demand, recorded losses, and other factors that contribute to energy usage. It results in a continual change in the monthly energy price paid by consumers. In fact, the most significant reason ascribed to it is the entire accumulated losses of the cooperative Technical, NTL, and Administrative or System Loss, regardless of the consideration to Generation Charge. As a result, the purpose of this paper is to determine whether there is a significant relationship between the monthly energy charge per kWhr and the reported monthly NTL.

There is no consistent charge per kWHr in the actual scenario when consumers pay their monthly bills because to various factors such as system loss (universal charge), generation charge, transmission charge, distribution charge, and metering charge.

All of these factors have a significant impact on the monthly kilowatt-hour fluctuation. Computations, on the other hand, are reserved for the utility of the offered charges.

As seen in table 2, the recorded data of NTL changes on a monthly basis due to changes in power supply and demand covered by the specific area. Losses are calculated by subtracting the purchased power from the sold power. Syed (2010) mentioned that based on his study conducted the extracting of NTL and TL from the total losses was based on the residual value from the computed technical loss.

The table shows that the month of May recorded the highest NTL at the same time of highest electrical power charge per kWhr, 1, 940, 839.94 kWhr and P0.9173 per kWhr, respectively. This implies that the month of May, NTL increases.

Table.2. Monthly Power Rate per kWhr with respect to the corresponding Non-technical Loss recorded of 2018

Month	Non-technical Loss (kWhr)	Monthly Power Rate per kwhr (peso)
January	1, 070, 776.93	0.6228
February	1, 118, 960.6	0.7202
March	936, 509.64	0.6183
April	1, 447,513.11	0.8238
May	1, 940, 839.94	0.9173
June	1, 637, 442.65	0.7019
July	1,115,582.82	0.5331
August	1,527,554.44	0.7371
September	1,307,439.95	0.6664
October	1,423,501.25	0.6114
November	547,406.38	0.3192
December	1,050,732.13	0.6398

Table 3 shows that variables are treated using Pearson Moment of correlation that yields a value of 0.59 ($p=0.045$). The value computed which is 0.59 indicates that there is a relationship between the two variables. This means that the null hypothesis at 0.05 level of significance was rejected, implying a statistically significant relationship between the cooperative's non-technical losses and the computation of the monthly energy charge per kwhr consumed by the users.

Table.3. Correlation between the Monthly Power Rate per kWhr and the Non-Technical Loss

	Non-Technical Loss	Monthly Power Rate /kwhr
Non-Technical Loss	-	
Monthly Power Rate /kwhr	.59	-

* Note: Correlation is significant at the 0.05 level (2-tailed)

As more consumers engage in electricity fraud, the monthly bill charges rise, burdening every consumer to cover the losses collected during the billing period. Losses, whether intentional or unintentional, are still charged to consumers at a set percentage, and others will be included in the utilities budget. This is necessary and is applied to the monthly charges based on the system loss cap computation of established by the ERC and RA 7832. The imposition of losses on consumers is permissible and authorized by the law, as long as it complies with the rules governing power theft.

Transmission and distribution (T&D) losses represent energy generated and supplied to the electricity grid but not paid for by consumers. Such losses are features of all electricity systems and result in increased electricity tariffs for customers, increased carbon emissions and in general have a negative impact on the electricity system as a whole (Carr, D.; Thomson, M. 2022). The World Bank has reported that when total losses are high, in excess of 25%, large consumers usually account for a large fraction of the losses. They refer to this as the Pareto effect, whereby a small percentage of customers account for a disproportionately high fraction of the total revenue (Antmann, P.2009).

Customers being billed for accurately measured consumption and regularly paying their bills are subsidizing those users who do not pay for electricity consumption. There is a wide range of situations creating non-technical losses. A classic case is a theft of electricity through an illegal connection to the grid or tampering of a consumption meter. But examples also include unmetered consumption by utility customers who are not accurately metered for a variety of reasons (Antmann, 2009).

3.4 Significant Difference of NTL and Technical Loss

The two biggest losses of ISELCO's power system are technical and NTL. Both have very different sources yet have the same effects on customers. Technical losses can only be computed if a load profile is provided, but NTL can only be estimated based on technical losses.

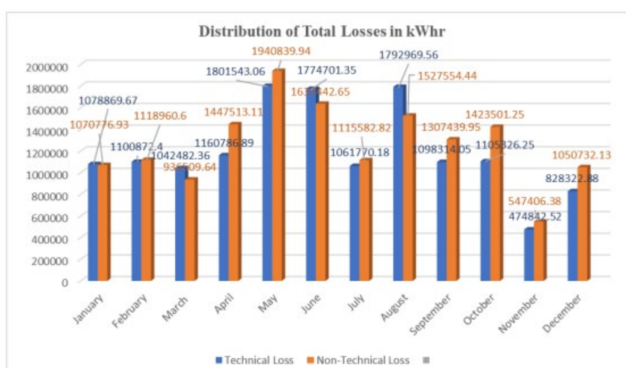

Figure 2. *Distribution of Total Losses*

Figure 2 represents the monthly distributions of losses, the data shows that losses were occurring monthly, and the bulk of the losses experienced by the ISELCO II were non-technical loss (NTL) with eight months compared to four months of higher technical loss (TL). The highest recorded month for NTL was May, which was assessed to have a difference of TL and NTL, 139,296.88 kWhr. The findings directly validate the assumption that the month of May was the most vulnerable to electricity theft due to the external factor influence of ambient temperature. Furthermore, it demonstrated that NTL was not the primary source of ISELCO II system loss, but rather the equipment employed by the utility, such as distribution transformers, PT, CT, switchgears, and the like. Equipment should be adequately maintained, and some were used for longer than the estimated life value of the equipment, resulting in additional losses. Equipment has a life value, and as it ages, its performance efficiency declines, as evidenced by corroded distribution transformers and putrefied distribution lines. Heat developed as a result of those punch lists, which was the primary source of losses.

Table.7. Significant Difference of TL and NTL

Variable	Mean	*p*-value	σ	t-tabular	t-stat
TL	1193400.0975	0.6747	0.05	2.0738	0.04253
NTL	1260354.9866				

Based from the table above, non-technical loss (NTL) has a mean of 1260354.9866, whereas technical loss (TL) has a mean of 1193400.0975. The computed T-value is 0.0425, which is less than the tabular value of 2.073. At 0.05 level of confidence, with a p-value of 0.6747, the t-value computed falls under the acceptance region. As a result, the null hypothesis is accepted, meaning that no significant difference exists between non-technical and technical ISELCO II losses.

The findings support the hypothesis that the two major causes of loss are not different from one another, regardless of the fact that the nature of these losses differs. NTL can bring additional issues, such as reduced network reliability and its quality, voltage drop, damage to network infrastructure, the possibility of power outages, a risk to public safety, and loss of revenue, which in most cases leads utilities to charge benign consumers through tariffs (Yip SC, Wong KS, Hew WP, Gan MT, Phan RCW, Tan SW, 2017) (Depuru SSSR, Wang L, Devabhaktuni V. 2011) (Kadurek P, Blom J, Cobben JFG, Kling WL., 2010). The NTL's new issues in our system mostly contribute to an increase in technical losses. One justification is the reconstruction of damaged infrastructures, which may result in additional technical loss in our system; similarly, as more unauthorized connections are made in our system, there will be an excess dropping of voltage, which will primarily affect our transmission of electricity, resulting in additional technical loss. The TL will surely suffer as more consumers engage in electrical theft, resulting in an increase in NTL.

The monthly charge of the two losses is one explanation for the system loss having no statistically significant difference to each other. The monthly prices for the TL and NTL are comparable, as shown in the graph below. Using February as an example, the TL charge is 0.7072 and the NTL charge is 0.7202, indicating that the study's hypothesis is accepted.

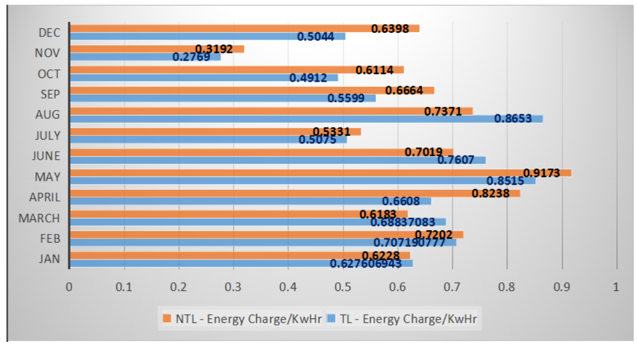

Figure 3. *Monthly Energy Charge per kwhr of the System Losses*

Finally, the findings imply that NTL and TL are not completely distinct from one another, but that they differ due to their distinct natures. NTL events outpaced ISELCO II TL occurrences in 2018, suggesting that NTL is a big concern that must be addressed.

3.5 Impacts of NTL

Isabela Electric Cooperative II (ISELCO II) aims to provide a dependable, accurate, and smooth flow of electricity to its customers. This goal is accomplished by taking into account the various elements that may disrupt the delivery of energy to the end user, such as system losses particularly non-technical.

NTL encountered by electricity utilities such as ISELCO II have ramifications in a variety of sectors, including financial and economic outcomes. Elizalde (2012) identified that financial impacts are the most critical for which involve a reduction of profits, shortage of funds for investment in improving the power system and its capacity, and the necessity for implementing means to cope with the losses.

ISELCO II is in continues combat of the system losses, however the mitigation is subject to its consumer and people as well.

NTL covers wide impact to the following:

3.5.1 Consumer

- Increase of Energy Bill. The changes of monthly electrical bills have a direct effect on the unrecovered non-technical losses.
- Damage of property. Illegal tapping may lead to electrical faulty wiring and may cause fire.
- Fluctuation of voltage due to theft may cause equipment burnt.
- Dependent of illegal actions.

3.5.2 Power System of ISELCO II

- Inefficient flow of power to the consumer which lead to poor service.
- Decrease the profit and revenue of the utility which may lead to bankruptcy.
- Power shortage which brings regular blackouts to areas concern.
- Increase in maintenance cost

IV. CONCLUSION

The study concludes the following:

- The nature and forms of practices engaged by most of the consumers of ISELCO II was 'Jumpering' as it is the easiest to execute.
- Majority of the incidents reported was situated at the City of Ilagan where the biggest number of consumers are situated.
- Theft, as an activity in some systems, is closely intertwined with governance and with the social, economic, and political environment. Corruption and electricity theft thrives off each other. In an overall culture of corruption as a way of life, electricity theft can be reduced to moderate levels by technical/engineering methods. Electric power systems can be restructured to make power sector organizations operate in competitive environments where efficiency and effectiveness in service delivery are both virtues and necessities.
- Monthly electrical charges per kWHr kept changing every month due to different reasons as such charges were added, sales in the Wholesale Electricity Spot Market (WESM), and the like. The relationship of NTL to Pesos per kWHr deemed to be significant. Hence, there is direct effect on bill the consumers monthly paid off.
- NTL and TL were of totally different items but of major contribution to system loss. Losses speak of the efficiency and good service of ISELCO II. For the year 2018, data showed that majority of losses were NTL comparing TL. The dominance of NTL only showed of ISELCO II was in-lined of the combat of electricity theft.

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