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Status of Non-Technical Losses of Electricity in Brazil

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Abstract

The electricity demand in Brazil has been growing. Some studies estimate that through 2035 the energy consumption (the power consumption) should increase 78%. Two distinct actions are necessary to meet this growth: the construction of new generating plants and to reduce electrical losses in the country. As the construction of power plants have a high price, coupled with the growth of (current) environmental concern, electric utilities are investing in reducing losses, both technical and non-technical. In this context, this paper aims to present an overview of non-technical losses in Brazil and to raise a discussion on the reasons that contribute to energy fraud.

Keywords: Non-technical losses, energy consumption, energy status

1. Introduction

The main concern in the distribution sector, the electricity losses, as inferred by the name, refer to the electrical energy that although inserted in the interconnected system and network of the distribution companies, does not arrive to be sold, either for technical reasons or commercial reasons.

Technical losses can occur by a number of reasons, one of the main, however, occurs by heating of electricity conductors, due to flow of electric current (*electricity*), called the "Joule effect". In this aspect, therefore, the extension of networks and the greatness territorial of Brazil make its level of technical losses suffer impact.

Already losses known as commercial losses generally have two main modalities: energy theft and fraud. The theft is characterized by direct diversion of energy by the consumer, what makes the used energy illegal and not registered, such as, leading to losses [1], for example:

- Illegal connection;
- Bypass.

In the case of fraud, however, the consumer is recorded by the distributor, but the consumer makes tampering the electrical installations of residence, commerce or industry, so that, although consuming a quantity of energy, effectively will pay only for a small part of consumption due to fraud [2]. The examples of fraud are listed below:

- Change in the measurement connections that make the disc turn back;
- Sectioning or opening the potential of meters (open test leads);
- Locking of disc meter;
- Handling of the register;
- Change the gears of logger;
- Potential coil violated;
- Wires of the secondary of currents transformers (CTs) bare, forming a bridge for contact between drivers, reducing the current flow by the meter;
- Key blade of verification open;
- Enlargement of the poles of the key benchmarks, interrupting electrical contact;
- Insulating varnish on the poles of the switch of measurement.

Research conducted on commercial losses estimate that 10% of the generated energy in Central America is stolen, in Asia this percentage is in the range of 20%, reaching 45% in India. Even in countries like the United States, Canada, England, Australia and New Zealand electricity thefts occur. Today in Brazil, 16% of all energy produced is lost [3].

The reduction of these non-technical losses has been a priority in the energy concessionaires in Brazil, as well as regulatory agencies, both for its growth in recent years as by their current size. The thefts of electrical energy performed by active consumers in the residential, commercial and industrial are the major amount of commercial losses.

The existence of this problem is due to several factors that go beyond the scope of management of distribution, such as socioeconomic status, education level and cultural level of the population and degree of urbanization of the areas served. Therefore, the state must create institutional and socioeconomic conditions that favor the reduction of losses and defaults and the regulatory mechanisms that encourage energy concessionaires to act efficiently in the same direction.

In this context, the paper presents a discussion of the reasons that lead to consumer default, besides measured values of the national view on the problem.

2. National Panorama of Energy losses

The generation of electricity in Brazil on public utilities and auto producers has reached 552.5 TWh in 2012, 3.9% higher than the result of 2011. The net imports of 40.3 TWh, added to internal generation, allowed a domestic supply of 592.8 TWh of electricity, an amount 4.4% higher to 2011. The final consumption was 498.4 TWh, an increase of 3.8% compared to 2011. About 16% of the total offered was lost through technical losses and non-technical, i.e., about 9,472 TWh [4]. Fig. 1 presents an overview of energy consumption by sector from 2003 to 2012.

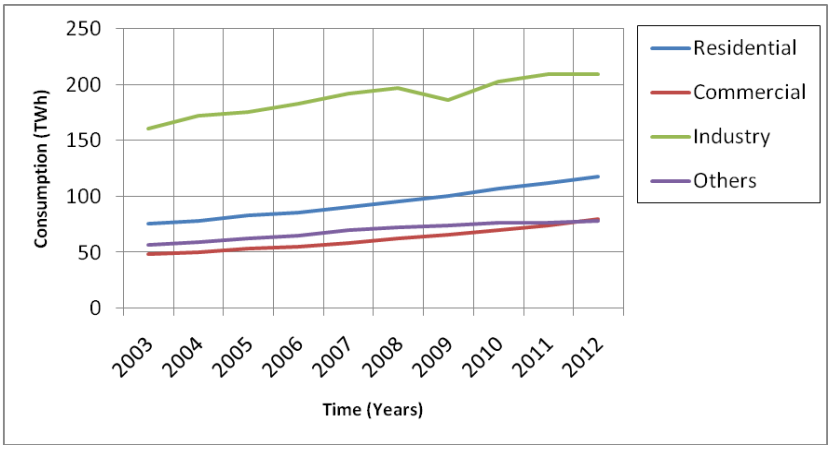

Fig. 1. Energy Consumption by Sector in the last 10 years in Brazil

It can be observed that the electricity consumption grew in all sectors over the past 10 years due to increase per capita income and the development of the country in the past years. In the Fig. 2 is shown the percentage of non-technical losses over recent years in relation to the total energy generated and imported.

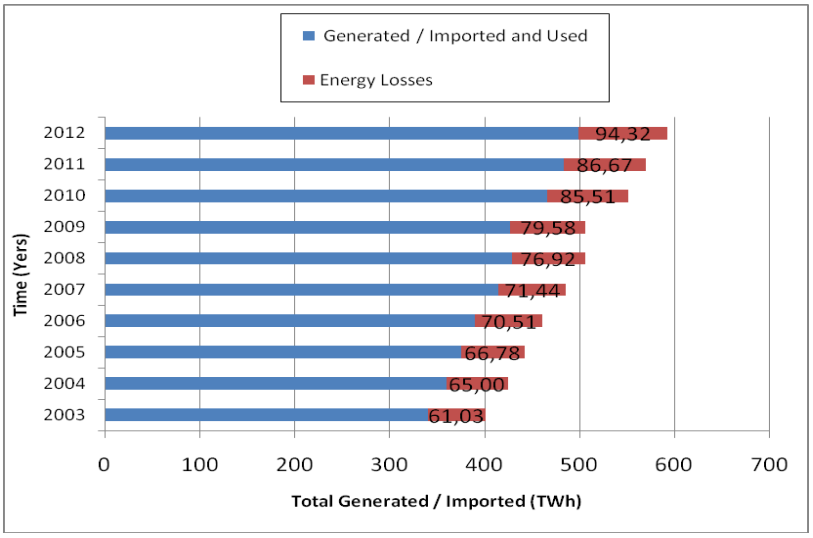

Fig. 2. Total energy lost in last 10 years on Brazil

Although energy losses present increasing numbers in the past years, as shown in the previous figure, the percentage in front of the total remained basically constant at 15%, as can be seen in Fig. 3. This means that the non-technical losses are growing along with the growth in demand. If we consider that the losses by Joule effect increases due to higher current flow in the existing system and that concessionaires are finding some defaulters, means that new customers may be stealing, or that have not been discovered are stealing even more.

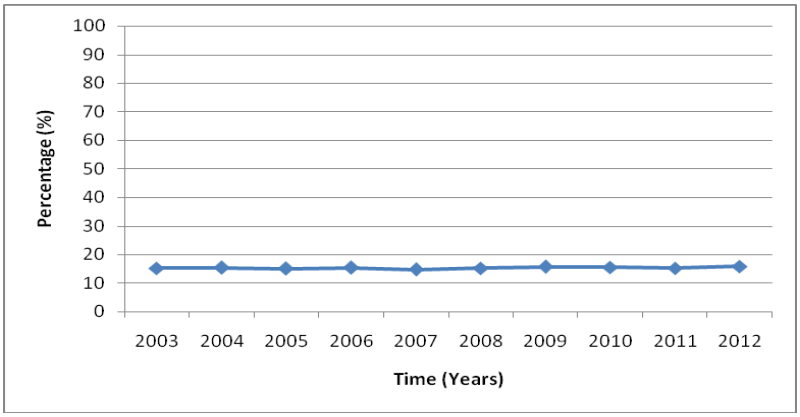

Fig. 3. Percentage of losses in relation to total production in the last 10 years in Brazil

Fig. 4 shows the percentage of each portion of the technical and non-technical losses.

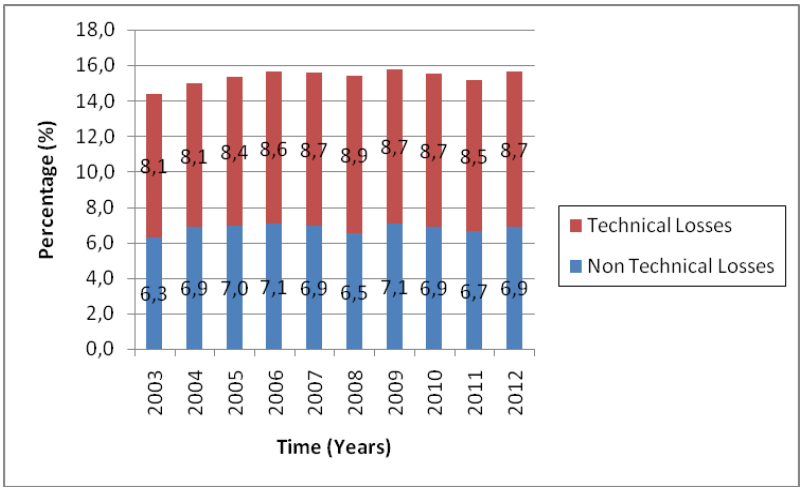

Fig. 4. Percentage of technical losses and non-technical in the last 10 years in Brazil

It can be observed by previous figure that non-technical losses or commercial losses remained constant in the past years, with around 7%, which represents approximately 45% of the energy lost in the country.

3. Relationship of Non-Technical Losses with Income Per Capita

In Brazil, commercial losses are high by several factors of socioeconomic and cultural nature such as: unemployment, low income, poor housing, inadequate infrastructure, high energy prices and connection accessories and also impunity relative to corruption and fraud.

In his context, we have the bad distribution of income and information, leading the people who live off the South-Southeast to feel a certain way discriminated. Given this, the Fig. 5 and Fig. 6 respectively, show the distribution of income by region of the country and the percentage of non-technical losses by energy company.

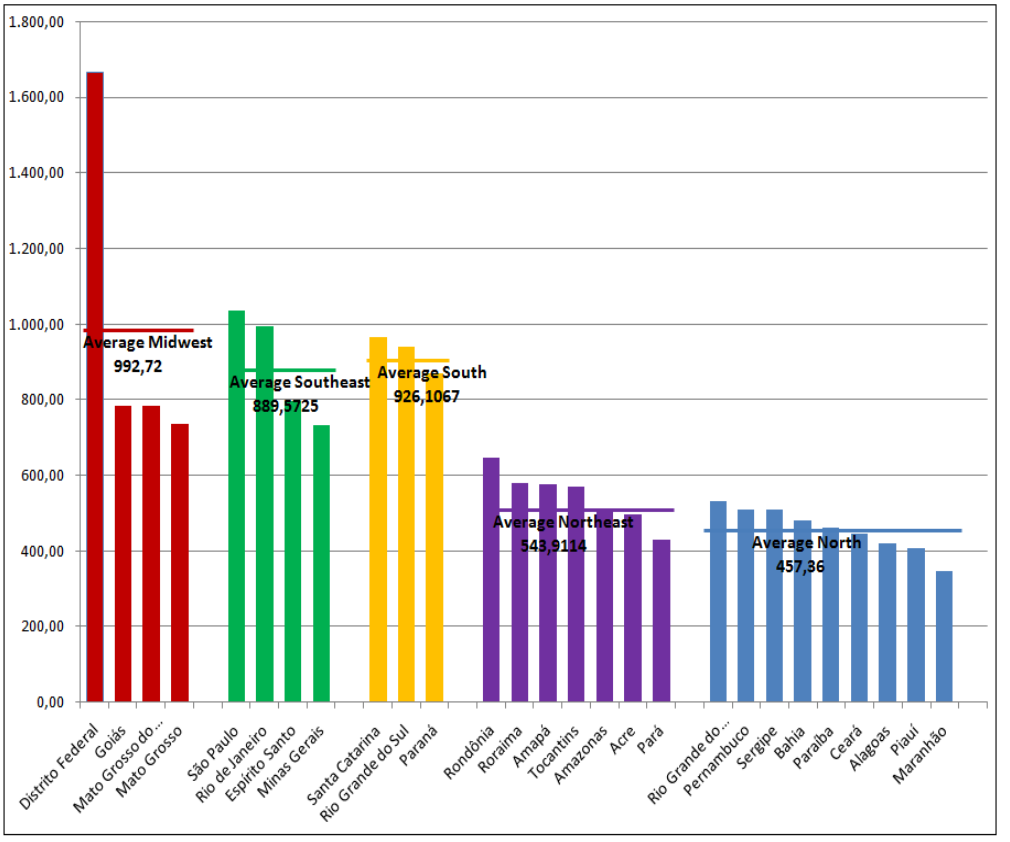

Fig. 5. Per Capita Income in R$ by Region in Brazil

In Fig. 5 it is observed that the Midwest has the highest per capita income in the country, followed by the South, Southeast, North and Northeast. This was due to the high value of income of the Federal District and also due to population density. The large center *Rio-São Paulo* despite possessing great richness also has a very high population density, coupled with slightly lower rates of other states (*Minas Gerais and Espírito Santo*) makes the region stay behind the South who have three states with good levels of income distribution and also education. The northern region is ahead of the Northeast region mainly due to population density, and the Northeast also has the hinterland (*Sertão*) regions, where the living conditions are precarious.

Stands out in Fig. 6 that the three concessionaries with higher commercial losses are located in the North and Northeast, where structural investment is lower, which makes it difficult to supervision and inspection by the companies. On the other hand, the three concessionaries with the lowest rates are located in the South and Southeast, where industrial development is greater, and public education is slightly higher.

However it should be emphasized that this relationship is not directly proportional, given the fact that the company that provides power to the Federal District (which is what has better per capita index) CEB is in twelfth place, in the total of thirty one concessionaries analyzed, with approximately 11.4% of losses; Light, serving the *Rio de Janeiro*, mainly in the Southeast is the twenty-seventh place, with a loss ratio of 23.9%. Another highlight is the company *Energisa SE* serving the states of the Northeast and Southeast who is in seventh with an index of 9.8% of commercial losses.

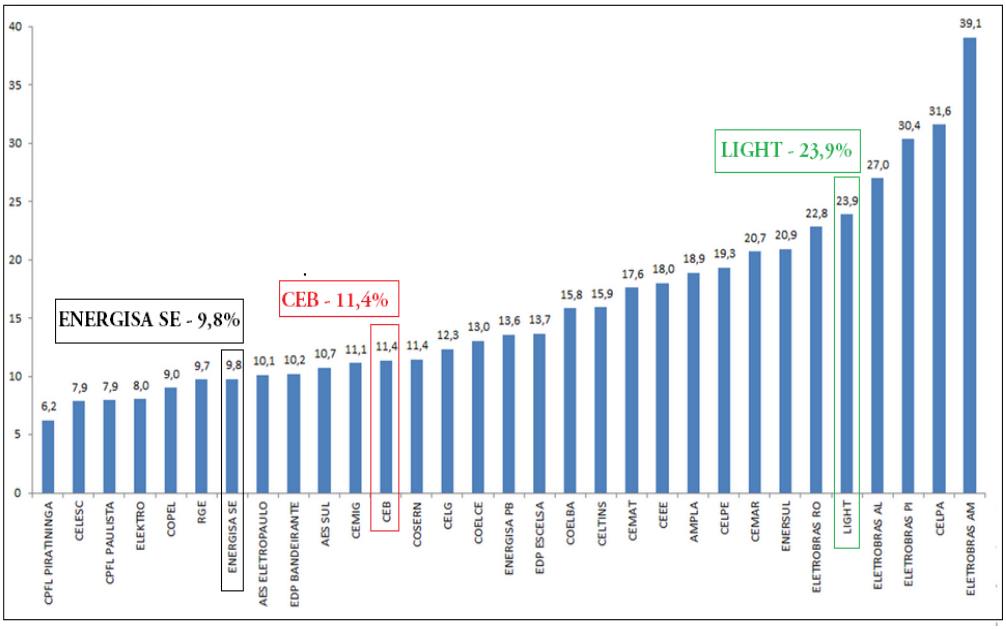

Fig. 6. Percentage of Losses by Commercial Carrier

4. Impacts of Commercial Losses in Billing Rate

A high level of commercial losses means higher tariffs for consumers, who pay for the generation and transmission of electricity stolen. In Brazil this problem corresponds to about 5% of Total Energy Required by distributors, representing an annual bonus of R$ 5 billion and tariff impact of 4% to 17%, according to each concessionaire. Fig. 7 shows the variation of the energy tariff of four power utilities in the country.

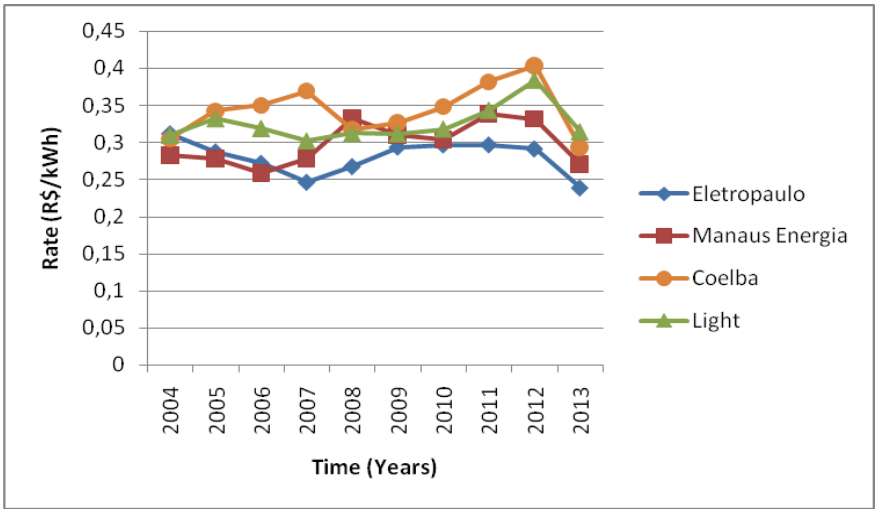

Fig. 7. Change in Residential Billing Rate by Concessionaire

Despite the variation in the residential billing of the four concessionaries analyzed are very similar, with a decrease in the last period, it is important to highlight that both *Coelba (Bahia)*, as *Light (Rio de Janeiro)* and *Energy Manaus (Amazonas)* have longer periods of elevation that decrease their tariffs, which brings us to the figure above that these companies have a high level of commercial losses.

5. Proposals of Some Initiatives to Contain Losses

Find consumers fraudsters is not a simple task since, although companies in Brazil invest millions to develop new methodologies, default continues to grow in recent years. In this context, there should be greater involvement of the state in punishing the identified consumers more rigorously, as well, new fraudsters will not commit this crime. Presented below is a sequence of proposed actions to reduce the losses, both by concessionaires, as by the state:

a) Distribution Companies
- Regular inspections searching for robbery;
- Cutting off the supply of energy customers fraudsters;
- Externalization of meters and remote metering of energy;
- Shielding of networks to prevent theft;
- Notice of court and court of defaulting customers;
- Recoveries and extrajudicial documents;
- Installment payment of defaulted consumer debt, and
- Education and awareness of the communities served.

b) State
- Regulatory incentives to encourage distributors to reduce losses and debt;

- Additional resources to deepen the actions of the distributors when the benefits don´t outweigh the incurred costs on fight;
- Social action programs and awareness campaigns;
- Improving the quality of social least favored areas of each concession.

6. Conclusion

In this work we presented a view of the non-technical losses situations in Brazil, presenting possible reasons that encourage the practice of this situation that should be considered a crime. It was verified the possible contribution of the income distribution, as well as the infrastructure of each of the five regions of the country, was presented some numbers of concessionaries, confronting the expectation that only the poorest states conduct frauds, and was listed some actions that can be taken to reduce bad debt.

Many studies are being done to decrease the rate of technical losses and non-technical studies that create new methodologies, new computational tools for classification and pattern recognition of consumers defaulted, but only these measures are not sufficient. There must be a greater awareness of population through social action programs in all areas of service concession power distribution.

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