NON-TECHNICAL LOSSES IN UTILITY BUSINESS – WHAT IT IS AND WHY IT MATTERS TO ALL OF US

Losses are a constant in the utility business. They are inevitable. Or in other words... the cost to eliminate losses is greater than the losses itself.

Thus the goal should be to reduce losses to a sufficiently low level where the solution is worth the cost. Simple, right?

Well, not so simple...

Why it DOES matter – the economic impact

World Bank estimates that electricity distribution utilities lose $96 billion in annual revenue attributed to non-technical losses (also known as commercial losses). A few years ago, it was $85 billion, so it just keeps increasing. To put it in another way: electricity was generated, transmitted, distributed, and commercialised; consumption was measured, read, processed and billed. All the technical and commercial operations have been performed but the correct monetary values were not charged to all the customers and cashed in. All investments and costs have been realised but the amount charged does not reflect actual distributed energy.

Tariffs to be paid by customers are designed to charge them an adequate value correspondent to their consumption and according to regulatory rules that remunerate utilities for their investments and operational costs. When the metered consumption is adulterated, all the economics of the process are impacted.

As a consequence, regulatory rules normally include an additional factor that is independent of production, transmission and distribution investments and costs to compensate for the NTL (non-technical losses).

NTL numbers are impressive and have the greatest impact on the emerging countries especially in South Asia, Latin America and Africa where some countries show NTL percentages around 20%, and above. Countries like India alone lose $23 billion annually.

Looking into the problem from the perspective of *per capita* costs, the value lost per utility in several countries exceeds $100 per customer per year and in some cases may reach up to $500 per customer annually. This perspective shows a more equitable distribution among developed countries and emerging or undeveloped countries. The reason for that is the proportionally higher cost of energy and higher *per capita* consumption in some developed countries with small populations and their relatively low loss percentages versus the higher percentages of losses with a lower cost of energy and lower *per capita* consumption in more populated, underdeveloped or emerging countries.

The consequences of NTL are dramatic, for utilities and for society – mostly for the honest customers who pay the cost of tariff increases. Utilities lose revenue as well as expending additional resources to fight losses, which impacts their finances and reduces their capacity to invest in grid improvements and provide the quality of their service. Society pays the price of energy through increased costs (higher tariffs increase the cost of services and goods as well as reduces their competitiveness) and environmental impact. Customers who do not pay (or pay artificially reduced amounts) tend to consume inefficiently – often more than they truly need. According to the World Bank, when customers are charged by their real consumption, they reduce their consumption by 50%.

Security is also threatened due to insecure manipulation by customers or non-authorised personnel on electrical installations or directly on the grid, which may be the cause of damaged appliances and even accidents (short circuits, disconnections, electrocution and/or fire).

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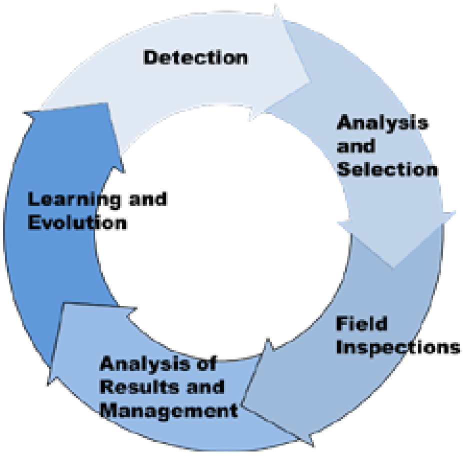
Reinforced infrastructure (generation, transmission and distribution) has to be built to support the additional load from unmetered consumption.
Unmetered load means that some grid devices will not be designed for the actual current and will deteriorate faster and may result in supply interruptions, degrading the quality of service.

It is difficult to evaluate the total cost for society of all these factors, but it certainly has a huge impact.

What are the non-technical losses?

Losses are classified as technical and non-technical (or commercial) losses. Technical losses are inherent to physical (electrical) factors. These are inevitable and can be alleviated but not physically eliminated.



Usually, it will require costly work on the grid, such as expansions, enhancements, modernisation, etc. Grid investment will typically generate an ROI in several years – on average 10-25 years.

Non-technical losses are caused by non-physical factors and are basically due to not charging the correct value according to the consumption. It can be mostly attributed to customer behaviour, fraud (meter tampering) or theft (direct connections to the grid bypassing the meter), which are facilitated by the vulnerability of the grids and meters to non-authorised manipulation.

This, of course, is not the only reason as many other issues contribute to commercial losses. We may mention a few:

- Processes issues such as bad designed/faulty processes, untreated issues or lack of adequate control procedures
- Systems issues including bad system design, faulty systems, systems errors/bugs, untreated exceptions or security issues
- Metering issues such as inaccurate and/or uncalibrated consumption meters or damaged meters
- Human issues, for example, inaccurate meter readings, wrong process actions/mistakes, registration errors, faulty inspections, irregularities, bad management or inefficient control
- Internal fraud including intentional errors, wrong doing or bribery.
- Billing errors that may be caused by process, human or system issues.

How regulations treat losses in different countries or – who pays the bill?

Dishonest customers perform tricks to reduce their metered consumption and society pays the bill. Regulatory rules treat commercial losses in two ways: normally the lost revenue (in part or total) is included in tariff calculations and sometimes (mostly for state-owned utilities) is covered by government subsidies. We can conclude that one way or the other; society will pay for the losses, either as a higher cost of energy or as higher taxes, with serious effects on individuals and all the production chain.

Adding to that, fraudulent customers' behaviour is an economic (and security) issue mostly drawn by social and cultural views that in some cases are 'minimised' by regulation i.e: benevolent regulation that does not discourage wrong-doing by fraudulent customers and thieves, or inadequate time-consuming and costly judicial procedures.

Increased maintenance costs, as well as efforts to fight the NTL results in additional investments and operational costs for the utility. If only a part of the unmetered consumption returns to the utility, there is a loss and the consequence is that the necessary return on investment will be lower than expected, or worse, the balance sheet will show a loss and the utility will not be able to invest in better services. Then society will again pay the bill, by having a bad and/or unreliable supply of quality energy.

There is only one conclusion: the tolerance on NTL represented by disregard or lack of emphasis on fighting it damages not only the utility but the country economy and society.

What can and should be done?

We will concentrate our analysis on the theft and fraud issues and associated solutions.

Theft is described as connecting directly to energy sources bypassing the metering process. It can be done by tapping directly to the grid low-voltage conductors or by bypassing the meter. It can be permanent or temporary when the meter is bypassed during some specific periods (normally when there is less possibility that the tap is detected). An alternative method is when only part of the load goes through the bypass.

Fraud can be defined as altering the measurement registered by the meter, i.e. tampering the meter. This can be done in various forms. It is easier with the conventional meters but it is now also performed with electronic or smart meters.

Many efforts have been undertaken and are still in progress, in academia, industry, and utilities to contain NTL. Looking specifically at the theft and fraud problem, we could segment these solutions as follows:

Field audits are the only way to make due evidence of a fraud or theft, and it requires a personal visit to and inspection of customer premises. The cost is significant –

> *One common problem in developing countries is re-incidence.*

around $100 per inspection depending on local costs. The logistics are complicated, and it should not be overlooked how unpleasant it could be to an honest customer. To make this activity more effective, the field inspections should be oriented to the installations that are more likely to represent some irregularity and for this purpose, it requires analytics.

Protected cables are effective to avoid direct tapping to the grid. It has, however, limited effectiveness and no effect on meter fraud, unless the meter is also installed on top of the pole. The average cost is $100-$200 per customer.

Prepaid meters are usually effective to avoid non-payment but not as much to avoid theft or fraud. Such meters coud be better considered as a solution to collection problems as nothing prevents the user from paying for energy upfront when he has the cash; but takes some effort bypassing the meter to keep the energy supply when he/she is out of cash. Cost ranges from $90 to $120 per customer.

AMI metering is a modern, effective metering system and devices that provide near-real time measurements of consumption and other electrical data, as well as alarms. AMI metering provides an enormous quantity of data ('big data') and normally includes some limited level of analytics. The cost is high – from $190 to $240 per residential customer. AMI metering is one of the most effective means to avoid meter tampering – although presently fraud is being verified even on smart meters. Additional protection is seen in meters installed on top of poles.

Analytics should be applied simultaneously with any of the above solutions and can provide very effective results with short time paybacks and investments not exceeding $4 per year per customer. Very successful projects (as for example in Brazil with Light, an electric utility with some 4.5 million customers and in Colombia with EPM – a multi-country, multi-utility covering 7.5 million customers in electricity, water, and gas distribution) have demonstrated the efficacy of this technology.

Analytics on top of AMI data is the most effective technology to date. The additional knowledge and insights generated by sophisticated predictive analytics technology, supported by artificial intelligence and machine learning techniques plus specially designed algorithms, can build on big data provided by smart meters and give targeted orientation to the customers that perpetrate fraud; and most interestingly, where the 'big fish' are i.e. the customers that steal the most energy and normally perform technically sophisticated fraud which is not easily discovered.

One common problem in developing countries is re-incidence. In these countries, finding fraud is only the first part of a complex social problem. Community engagement and social actions have been applied with successfully educating people about the consequences of this criminal practice.

Fighting theft and fraud cannot be seen as purely a question of 'finding who is doing it'. This is only the first step in a complex process. The importance of designing and implementing the associated processes should be considered when designing a project for revenue protection. Also important is building the team that will handle the processes and will use the systems and providing them with adequate technical training. Only this way will the loop be closed, empowering a much more effective non-technical loss strategy that combines human skills and experience with innovative technologies.

Present state

Brilliant composers, John Lennon and Paul McCartney once sang in *Strawberry Field Forever*

"Living is easy with eyes closed,
Misunderstanding all you see."

However beautifully poetic, these words cannot guide us in business. The cost of energy diversion and fraud affects customers and taxpayers and helps to damage the environment. This represents a very high cost, not only to the utility but also to their customers and society as a whole. Utilities have a responsibility to fight non-technical losses with the best tools and methodology possible.

When one looks at the *per capita* cost, an immediate conclusion is that fighting NTL is a must-do. By selecting the right strategy and solutions, implementing a programme with processes backed by technological solutions to reduce losses to a manageable level, as described above, makes total business sense. There will always be a strategy that will fit any specific business case, from basic analytical solutions with existing meters/infrastructure up to a full AMI implementation project enhanced by analytics. Analytics is a major, fundamental and economical tool which will always play a key role and optimise the results of any NTL reduction programme.

Implementing a state-of-the-art solution to reduce non-technical losses requires investment but also maturity from the utility to promote a forward-thinking mentality to engage in new fields of technology and to recognise the potential of analytics. It is time for utilities to enter a new era, valuing data and knowledge as one of its' most valuable assets. MI

> *"Big data is not about the data. The value of big data is in the analytics."*
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> **Harvard Professor Gary King.**

ABOUT THE AUTHOR

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Choice Technologies is a technology company specialising in revenue protection analytic systems and methodologies.

Note: Sources of all mentioned numbers:

- *World Bank*
- *Electricity Theft and Non-Technical Losses: Global Market, Solutions, and Vendors – report published by Northeast Group in March 2017.*