



First ELECON Workshop Towards Efficient European and Brazilian Electricity Markets

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Non-technical losses in Brazil: subsidies for implementation of smart-grid (*)

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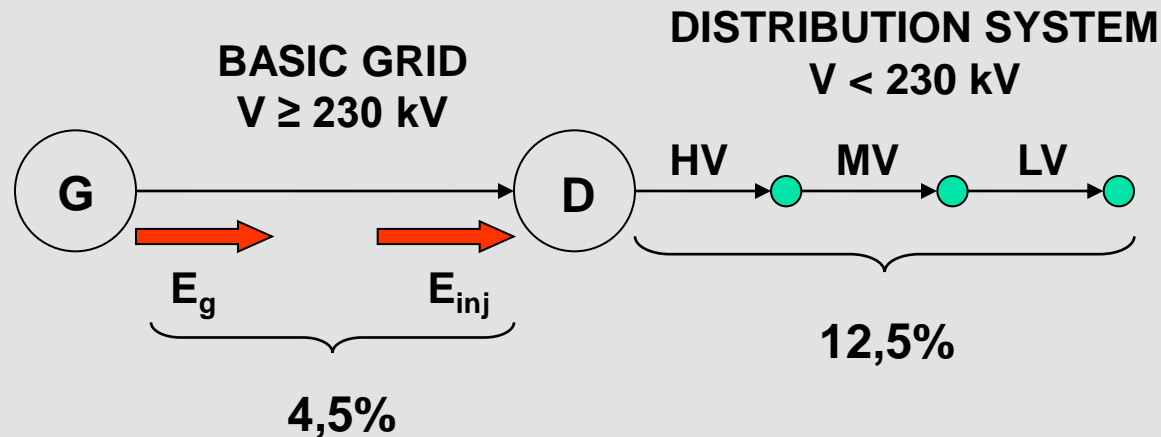
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- **Current situation related to non-technical losses in Brazil**
- **Cost of Non-Technical Losses**
- **Nature of Non-Technical Losses**
- **Approaches to Combat Non-Technical Losses**
- **Smart-Grid Contribution**
- **Conclusions**



$$E_{inj} = 86,7\% E_g$$

$$\text{Distribution Losses} = 14,4\% E_{inj} \left\{ \begin{array}{l} \text{TL} \rightarrow 8\% \\ \text{NTL} \rightarrow 6,4\% \end{array} \right.$$

E_g : Generated Energy

E_{inj} : Injected Energy

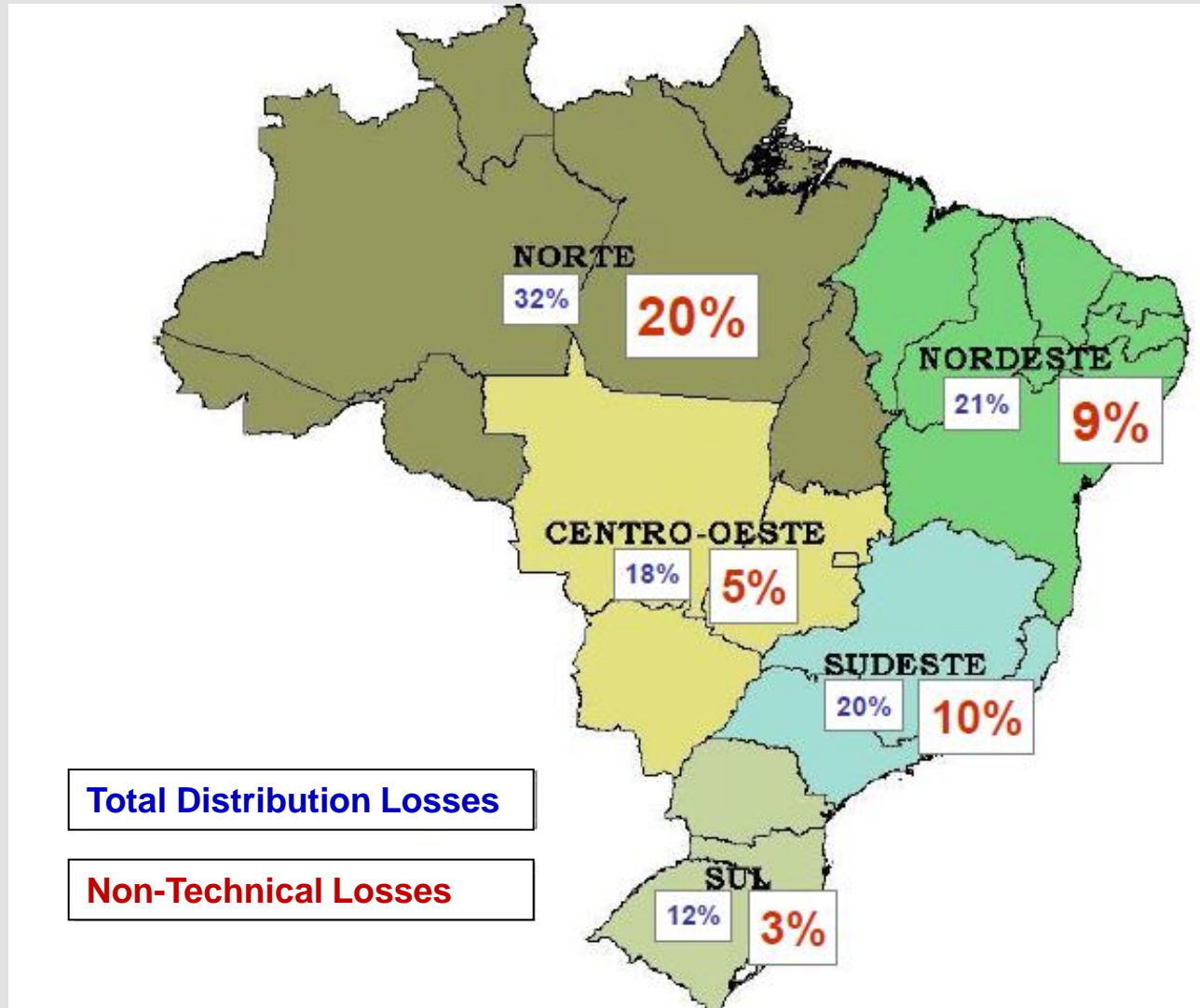
TL : Technical Losses

NTL: Non-Technical Losses

	% losses
WORLD	8.3
OCDE	6.3
North America	6.6
European Union	5.8
Eurozone	5.1
China	6.1
Brazil	17.0
India	22.0
Russia	10.1
South Africa	9.5
Colombia	16.1
Argentina	13.4
Peru	10.1
Venezuela	19.4

Brazil energy losses percentage is twice the world's average, and nearly three times the European average.

Energy Losses by Region



Non-Technical Losses

Company	State	Region	NTL/ E_{inj}	TL/ E_{inj}	NTL/LVM
BANDEIRANTE	São Paulo	Southeast	6.47	7.30	14.63
ELETROPAULO	São Paulo	Southeast	7.39	6.10	13.34
ELEKTRO	São Paulo	Southeast	0.47	8.01	0.92
CPFL Paulista	São Paulo	Southeast	2.62	8.08	4.75
CPFL Piratininga	São Paulo	Southeast	2.01	6.50	4.20
CEMIG	Mato Grosso	Southeast	3.92	10.28	8.16
CELESC	Santa Catarina	South	1.33	8.04	3.53
COPEL	Paraná	South	1.51	7.07	3.14
AES Sul	Rio Grande do Sul	South	2.35	7.04	4.91
RGE	Rio Grande do Sul	South	2.07	8.80	4.41
COELCE	Ceará	Northeast	2.02	9.57	3.62
COELBA	Bahia	Northeast	3.31	10.06	6.26
CELPE	Pernambuco	Northeast	6.79	15.49	14.00
COSERN	Rio Grande do Norte	Northeast	2.57	9.92	4.49
CELTINS	Tocantins	North	0.64	13.62	1.04
ENERSUL	Mato Grosso do Sul	Central West	3.97	13.33	7.14
CEMAT	Mato Grosso	Central West	4.16	11.39	7.24
CEB	Distrito Federal	Central West	2.92	7.95	5.05
CELG	Goiás	Central West	2.13	9.02	3.88
TOTAL			3.59	8.68	7.06

LVM: Low Voltage Market

- A percentage of the non-technical losses cost should be passed onto the tariffs (all consumers are penalized).
- The percentage to be passed onto the tariffs is annually reduced.
- The utilities are obliged to reduce the losses under the risk of financial loss.

Cost of Non-Technical Losses

Company	State	Region	TE-B1 (R\$/MWh)	NTLC (R\$/MWh)	NTLC/TE-B1 (%)
ELETROPAULO	São Paulo	Southeast	323.70	12.91	3.99
ELEKTRO	São Paulo	Southeast	386.60	1.86	0.48
ESCELSA	Espírito Santo	Southeast	354.76	9.11	2.57
BANDEIRANTE	São Paulo	Southeast	349.42	10.43	2.98
CPFL-Piratininga	São Paulo	Southeast	330.80	3.24	0.98
CEMIG	Minas Gerais	Southeast	404.87	6.36	1.57
LIGHT	Rio de Janeiro	Southeast	342.62	27.15	7.92
CELESC	Santa Catarina	South	331.91	2.91	0.88
AES-Sul	Rio Grande do Sul	South	330.82	4.06	1.23
COELBA	Bahia	Northeast	381.95	10.42	2.73

TE-B1 : Tariffs for normal residential consumers

NTLC : Cost of non-technical losses

The cost of non-technical losses for a typical residence located in the city of Rio de Janeiro is USD 27.15/MWh. In the city of São Paulo, the cost results in USD 12.91/MWh. Non-technical losses may raise the Brazilian electric tariff for the low voltage sector from 1% to 10%.

Non-technical losses in Brazil are originated by two different major consumer groups:

- **Consumers legally connected to the distribution network**

**Conventional
Losses**

defective or absent meters
reading errors
errors in the billing procedure
registration inconsistencies

Irregularities

meter tampering (fraud)
meter bypassing (theft)
irregular self-reconnection (theft)

- **Consumers illegally connected to the distribution network**
 - irregular growth of poor areas, especially in large urban centers.
 - absence of public authorities in various basic services

Southeast Utility

Irregularities: 64%
(total: fraud & theft)

Defective meters and other errors: 29,5%

Illegal hookups: 6,0%

Others: 0,5%

Northeast Utility

Irregularities: 46,7%
(fraud & theft = 38,2%, self-reconnection = 8,5%)

Defective meters and other errors: 38,4%

Illegal hookups: 13,9%

Others: 1,0%

THEFT



FRAUD



ILLEGAL HOOKUPS



- **MORAL approach**

Advertising campaigns

Encourage the population to complain

Characterize the fraud and the theft as crimes

- **SOCIAL approach**

Energy efficiency

Donation of efficient appliances (lamps, fridge)

Offer 50 kWh/month free

In exchange for the connection legalization

- **TECHNOLOGICAL approach**

Improvement the metering process

Meters outside the Consumer Unit

Use shielded lines

Centralized monitoring

Smart-Grid tools for increasing the efficiency of billing process.

- **Data Mining to identify suspicious installations:**
 - locations with higher incidences of fraud and theft
 - indicate priority units for on-site inspection
 - quantify the yield of losses
- **Real-Time Load profile:**
 - inspect the regularity of measured data
 - identification of typical loads
 - demand side management (load shifting)

Aggregation of meter sets:

- **Small interval successive measurements in MV/LV transformers or meter concentration points**
- **Possibility of discrepancies identification between the totalizer meter and the set of meters under assessment**

Total Energy (Transformer) = Sum of individual meters

Additionally, the establishment of a Smart-Grid involves the modernization of the metering system

Technical Losses: 29.5 GWh

Non-technical Losses: 23.1 GWh

Costs of Non-Technical Losses in Brazil

(considering the average tariff: R\$260.80/MWh - apr/2010)

- **Energy** **R\$ 2.2 Billion**
- **T & D Asset** **R\$ 3.8 Billion**
- **Total without tax** **R\$ 6.0 Billion**
- **Total with tax** **R\$ 8.1 Billion**

- From the total energy supplied into the distribution utilities market, about 8.0% are technical losses and 6.4% correspond to non-technical losses:
 - ✓ conventional losses → 20% to 50%
 - ✓ losses due to irregularities → 30% to 70%
 - ✓ social → 5% to 50%
- Part of the energy losses cost is passed onto the entire consumer group causing a tariff rates increase of 1% to 10%
- Smart-Grid tools may reduce 60% of non-technical losses (nearly 4% of the total energy injected into the Brazilian distribution grid)



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