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SAARC ENERGY CENTRE
Energy for Peace & Prosperity

Power System Losses and Contemporary Solutions

Webinar on “Power System Losses: Evaluation and Mitigation”

Webinar Agenda

- Losses in electricity supply
- Evaluation/ assessment methods for losses
- Loss mitigation strategies
- Technological revolution – Contemporary solutions
- Success story

Losses in Electricity Supply

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"Losses refer to the amount of electricity injected into the transmission and distribution systems that are not paid for by users"

Technical losses	**Non-technical losses**
Mainly consists of power dissipation in: • transmission and distribution lines • transformers • measurement systems	Mainly consists of: • electricity theft • non-payment by customers • errors in accounting and record-keeping

- High losses mean lesser revenue for the amount of electricity generated.
- This also means increased load on system. Experience on consumer behaviour shows that electricity consumption is reduced if consumers starts paying for the energy they are utilizing.

Losses in Electricity Supply

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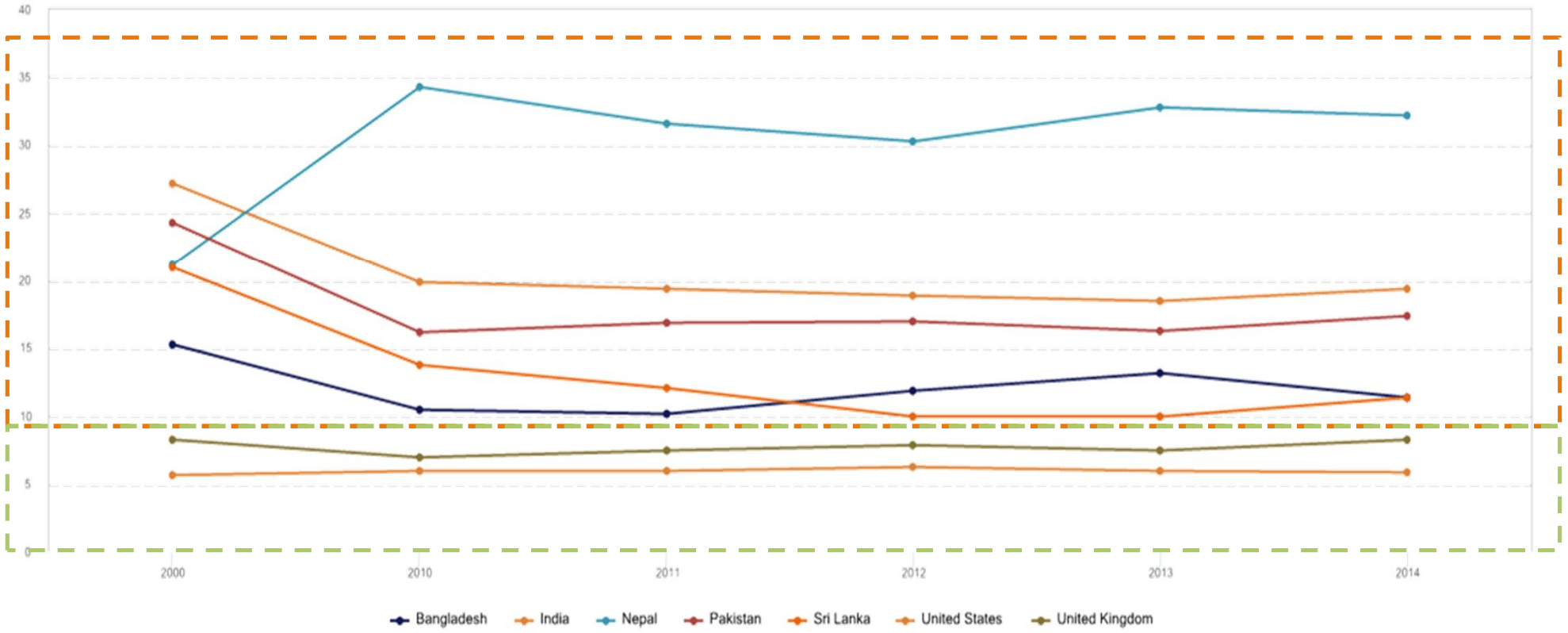
Transmission and distribution losses in the SAARC region in comparison with developed countries



SAARC region losses
11 ~ 32 %

Developed countries losses
5 ~ 10 %

Series : Electric power transmission and distribution losses (% of output)
Source: World Development Indicators
Created on: 07/10/2018

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Evaluation/ Assessment Methods for Losses *(for Transmission Networks)*

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- No single best practice for losses calculation that can be followed by every utility.
- Increased precision in loss calculation may add additional insight to seasonal variation but also increases the cost and complexity of the analysis. Cost of more detail may not always provide more value.
- Key methodologies used in industry for loss calculation
  - **Peak Analysis:** Run a single coincident peak system load flow and develop loss factors to calculate annual energy losses. Not recommended as leading practice as the method does not factor variable dispatch levels and system configurations.
  - **Multiple Load Levels:** Run a number of power flow scenarios with seasonal load and resource data. Usually six scenarios are simulated, representing six load levels: peak, minimum, and four intermediate levels for both a summer and winter season, with various levels of generation.
  - **Hourly Load Level Scenarios:** Generally provide more accurate results
    - Historic Load and Resource Data
    - Security Constrained Economic Dispatch (SCED) Analysis
    - State Estimator

Evaluation/ Assessment Methods for Losses *(for Distribution Networks)*

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- As in the case of transmission networks, no single best practice for losses calculation.
- Software modeling of each feeder can be tedious and costly as a typical distribution network may contain tens of thousands of kilometers of distribution circuits. Sampling is a relevant approach and widely used in the industry.
- Difference between the energy “sent” through the distribution feeder and energy “metered” at the end consumer gives the total technical and non-technical loss for that particular feeder.
- Computer simulation can then be used to approximate technical losses.
- Typical data required for software simulation includes
  - **Substation/ distribution transformers:** Size, no-load iron (Fe) core losses, load, copper (coil) impedance, and voltage levels.
  - **Primary/ Secondary circuits:** Conductor sizes, impedance definitions, lengths, loading, voltage class.
  - **Equipment data:** Loss data for buses, regulators, capacitors, and street lights.
  - **Load data:** Load profile, power delivered at different times throughout the period.

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Loss Mitigation Strategies

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- Use on-load tap changers on power transformer with optimizing tap controls.
- Add shunt capacitor banks closest to load with high reactive power requirements.
- Phase balancing to reduce line and neutral conductor losses.
- Reduce lengthy LT lines or eliminating LT lines by installing low capacity distribution transformers.
- Select that size of LT conductor which limits the voltage drop to a maximum of 5% along the entire length of LT circuit.
- Use insulated cables/ aerial bundled cables for overhead secondary distribution, or use underground distribution.
- Properly install energy meters in vertical position.
- Replace defective and analog meters with digital. Analog meters degrades over time. A meter that is 15 years old reads 2% less energy consumed… 2% less revenue !
- Implement equipment removal order in time.
- Regular monitoring and checking of disconnected consumers.
- Use compression or bolted connector, eliminate wrapped wire connection on distribution lines.
- Periodic maintenance of distribution transformers for efficient performance.
- Trim trees which are touching the electric lines.

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Technological Revolution – Contemporary Solutions

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- **Advanced Metering Infrastructure (AMI)** – Substation, feeder, consumer load level data can be directly assigned to computer simulation model. In region where losses are already soaring, AMI can offer following positive benefits:
  - Identification of abnormal consumption due to tampering/ meter by-passing
  - Enhancement of the company's corporate governance and anti-corruption efforts
  - Implementation of pre-paid consumption
  - Losses eradication in non-manageable areas
  - Demand side management
  - Meter data management
- **HVDC Transmission and FACTS devices**– With more economic options becoming available, HVDC lines could be preferred over AC lines for reduced losses and precise power flow control. FACTS devices like SVC can reduce transmission line loading by regulating voltage and power factor
- **Gas Insulated Substations** – With their lower footprint in comparison with typical Air Insulation Substations, GIS can be contained in a basement of a building closer to the load, reducing the transmission current and losses.
- **Distributed Generation (DG)** – Rising levels of DG resources will have impact on distribution capacity, voltage, stability, VAR requirement as well as losses. Generating electricity close to load can result in energy loss reduction.

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Success Story – Energia+ Project

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Facts and figures

- Eletrobras generates about 40%, transmits 69% of Brazil's electric supply and owns 6 distribution companies in the North and Northeast regions.
- 22% of all the power it generates.
- Amazonas Energia incurred 39.2% commercial losses in Brazil.

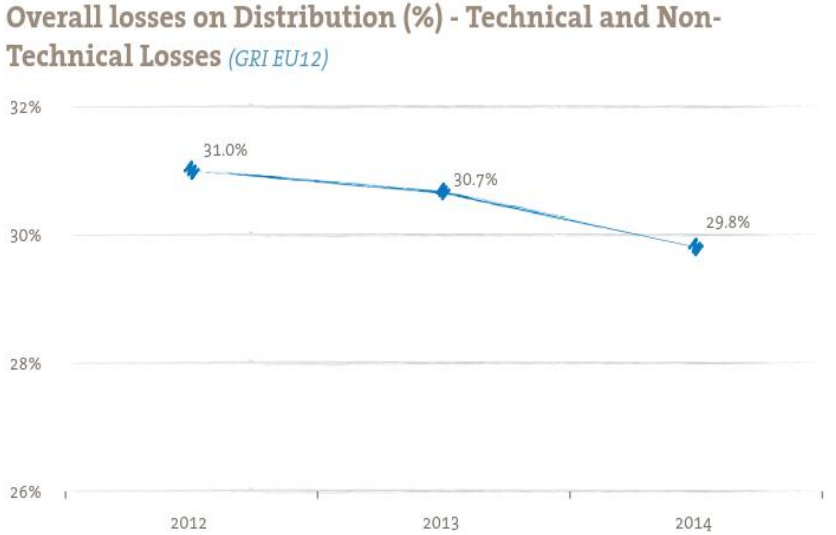
Siemens project scope

- Smart meters
- Meter data management (MDM)
- Advanced metering infrastructure (AMI)
- Installation services covering around 120,000 consumer units

Result

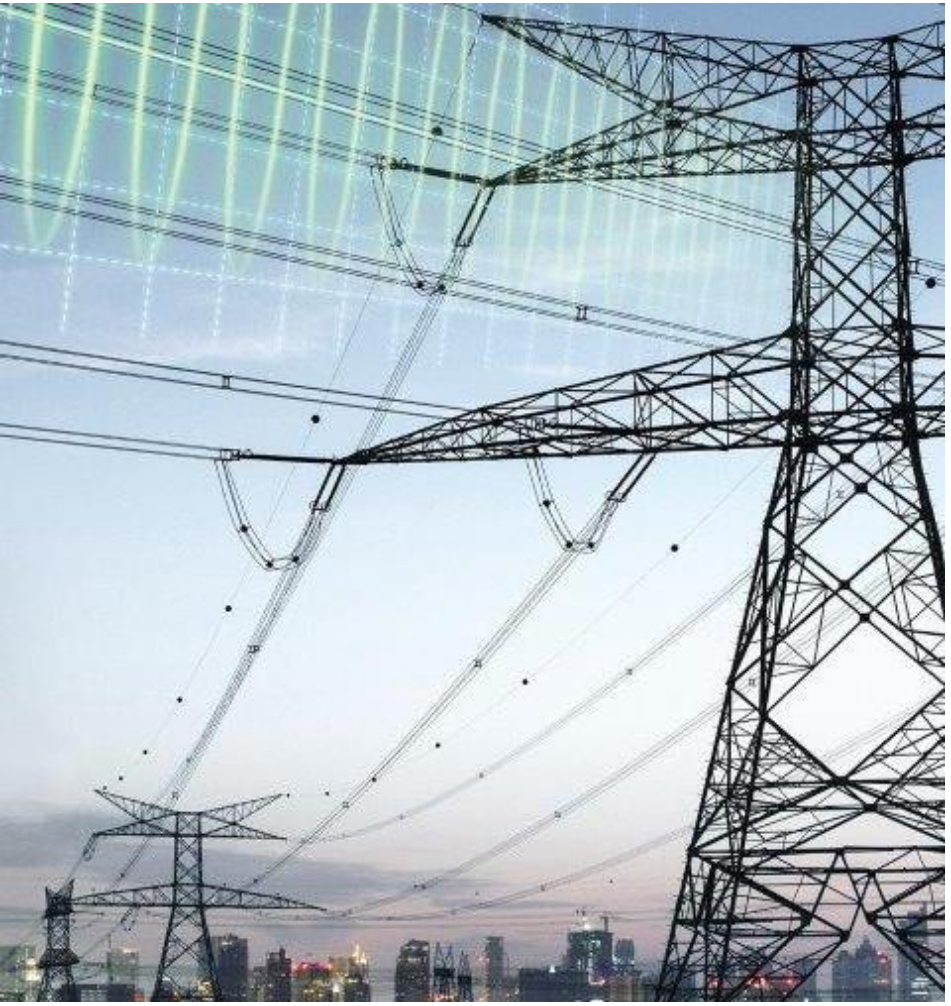
- Reduction in overall losses from 31.0% to 29.8%
- Recovery in revenue of approximately R$ 28.8 million

Eletrobras



Source: Eletrobras Annual and Sustainability Report 2014

Thanks for your attention!



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