Advisory

# Evaluation of technical losses in electricity distribution system

ERE Conference “Albanian Energy Sector, Challenges and Regulation”,

7 October 2010

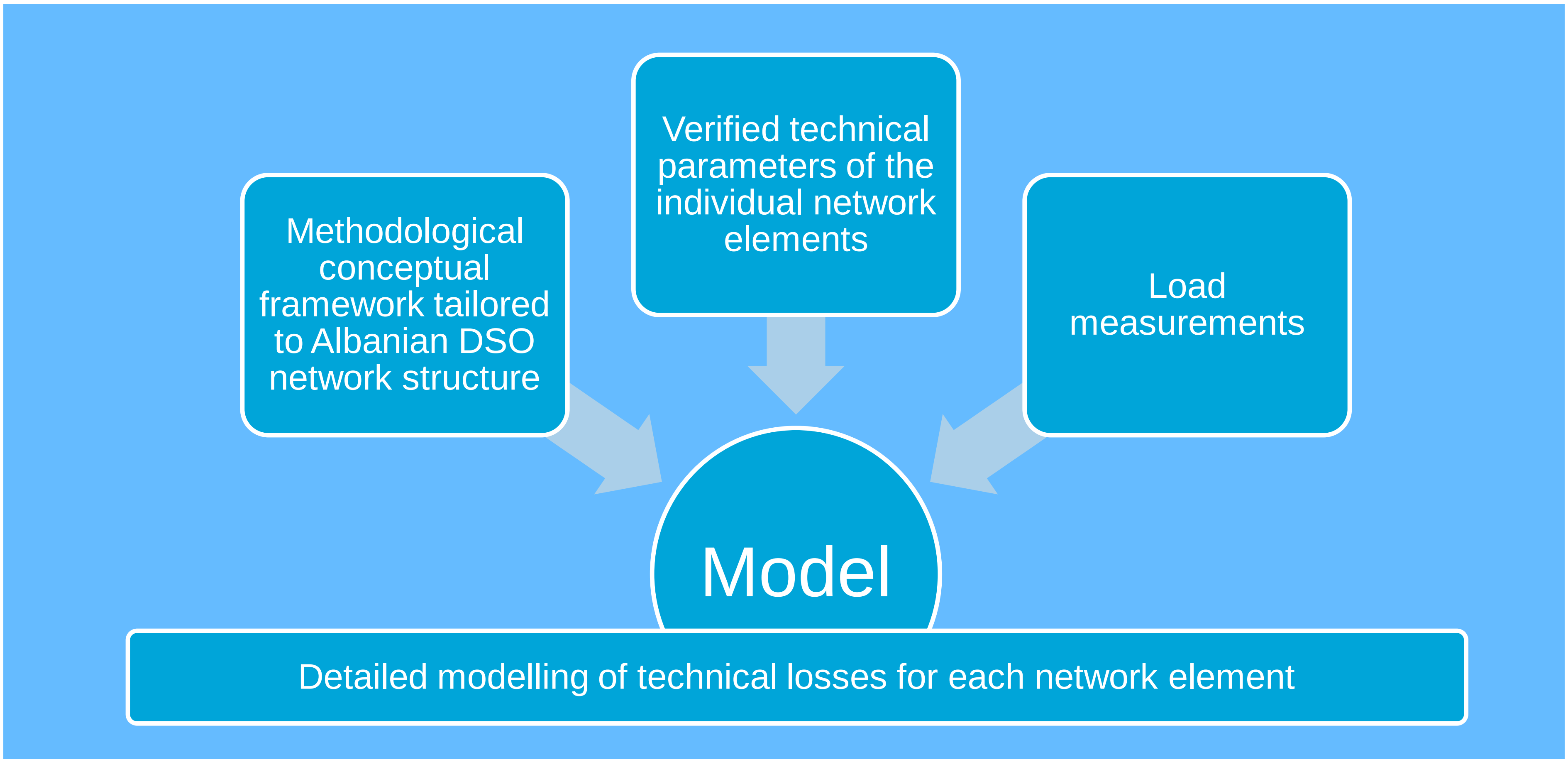
# Agenda

# PricewaterhouseCoopers has a Centre of Excellence focusing on Economic Regulation in utilities in CEE

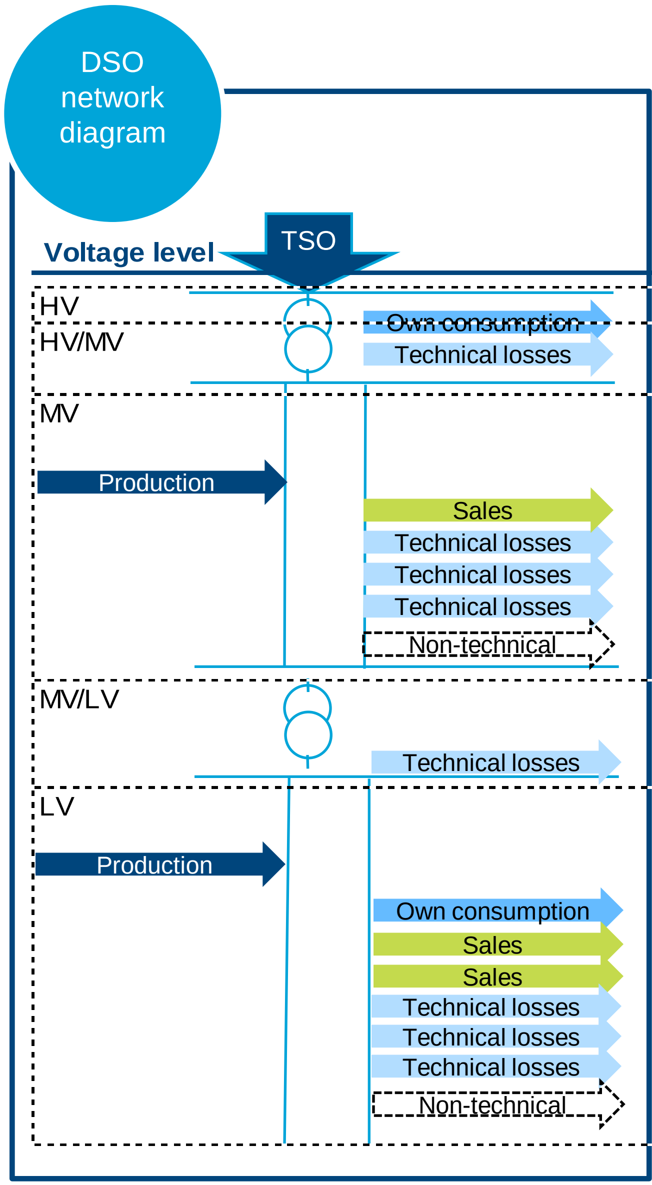
- We have established a virtual network of specialists in major countries of CEE, who focus on Economic regulation in utilities industries
- Their expertise covers following areas:
  - Regulatory strategy and case building
  - Sector policy, competition policy
  - Cost modelling, business modelling
  - Retail price regulation
  - Cost of capital
  - Comparative efficiency analysis
  - Accounting separation, unbundling
  - Regulatory accounting, compliance and assurance

# We have developed a detailed technical model to determine technical losses at DSO's network element level

- Timeline: February 2010 – June 2010



# Our model mirrored DSO network structure




**High level technical losses calculation**

**Detailed modelling at element level**

| | Inflows/ Outflows | Elements |
|---|---|---|
| P | Purchases from OST | |
| O | - Own consumption | |
| T | - Losses | Substations |
| | **Subtotal input** | |
| P | + Production | |
| S | - Sold to commercials | |
| T | - Joule losses | MV lines |
| T | - Electrometers losses | Electrometers |
| T | - Leakage and dielectric losses | MV lines |
| N | - Non-technical losses | |
| | **Subtotal input** | |
| T | - Losses | Cabins |
| | **Subtotal input** | |
| P | + Production | |
| O | - Own consumption | |
| S | - Sold to commercials | |
| S | - Sold to households | |
| T | - Joule losses | LV lines |
| T | - Electrometers losses | Electrometers |
| T | - Leakage and dielectric losses | LV lines |
| N | - Non-technical losses | |

# We have used granular data about individual network elements and load measurements to build a robust engineering model

### High level structure of significant data used in the model

| Data | Primary source | Secondary source | Simplified role in the model |
|---|---|---|---|
| Substations' power transformers | FAR | technicians | Technical losses in HV/MV and MV/MV transformation |
| Cabins' power transformers | FAR | technicians | Technical losses in MV/LV transformation |
| MV lines | FAR | technicians | Technical losses in MV lines |
| LV lines | FAR | technicians | Technical losses in LV lines |
| MV electrometers | FAR | technicians | Technical losses in MV electrometers |
| LV electrometers | FAR | technicians | Technical losses in LV electrometers |
| OST hourly load measurement | OST | OSSH | Energy inflows, max peak loads |
| Other delivery points measurements | OST | OSSH | Energy inflows, max peak loads |
| Delivery points matched to network elements | OSSH | | Matching of max peak loads and network elements |
| Electricity billings | OSSH | Billing system | Energy billings |
| Own consumption | OSSH | | DTL own consumption |
| Substations load flow 24 hour measurements | OSSH | | Max peak loads |
| 24 hours customer measurements | OSSH | | Typical diagrams for customers |
| MV lines detailed schemes | OSSH | | Max peak loads simulations in Bizon |
| Cabins detailed schemes | OSSH | | Simulation of cabins |

**1** Fixed Assets Register was the sole most important information source used in the model

**2** Hourly load diagrams determined levels of variable losses

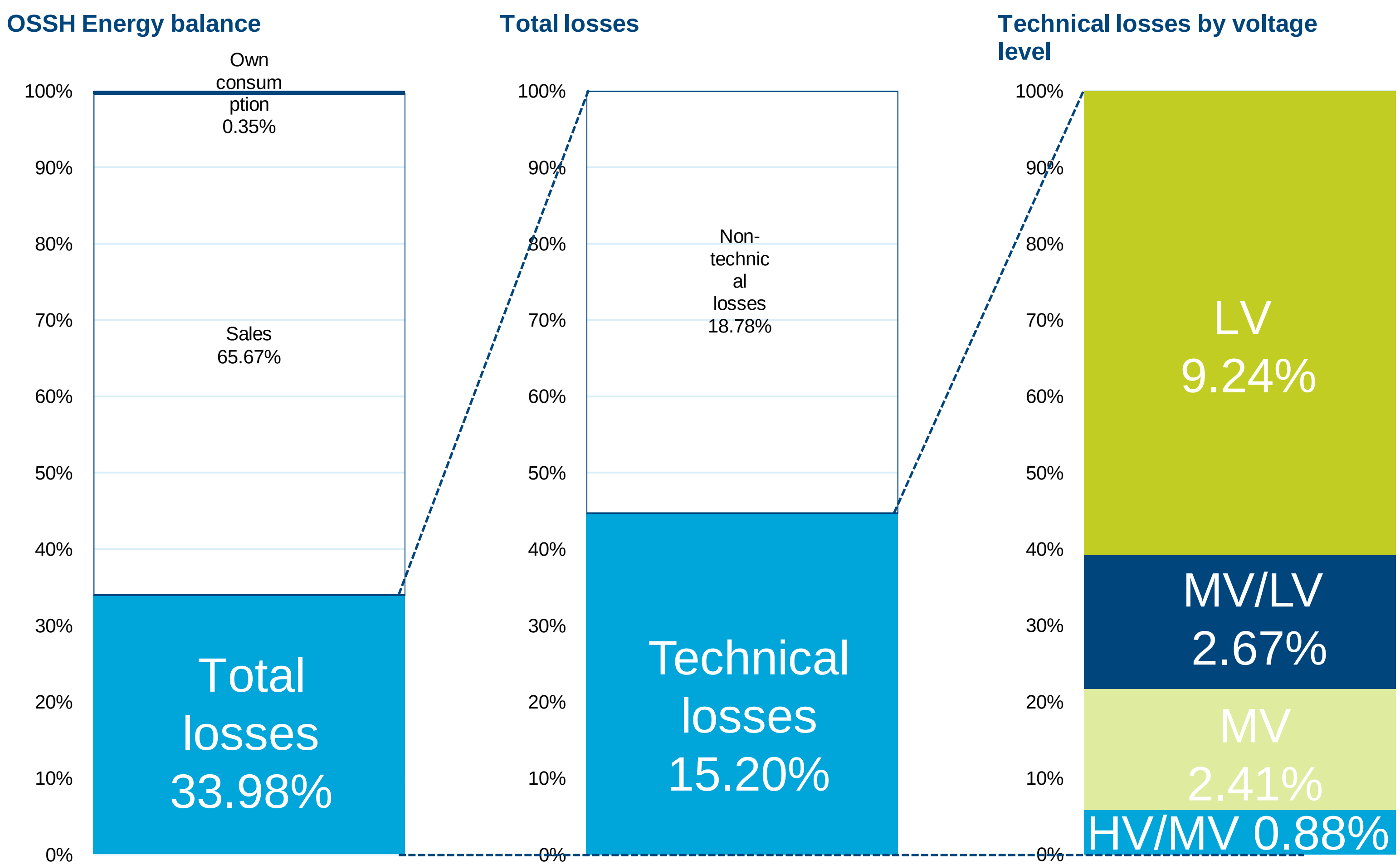
**3** Additional technical information were gathered by OSSH technical teams

# We have leveraged off the Fixed Asset Register Reconstruction project, which was performed in 2009

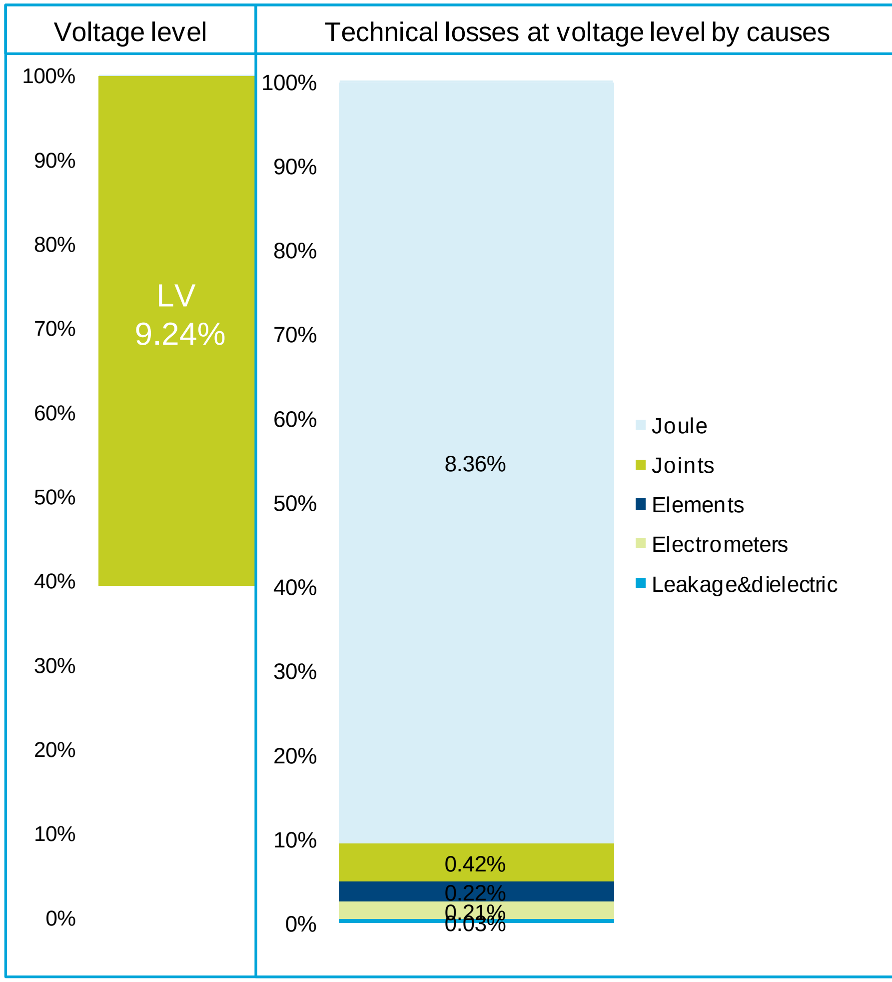
| | |
|---|---|
| **Situation** | Fixed Asset Register (FAR) of OSSH was decentralized and there was concern about the quality and completeness of the fixed asset register of OSSH |
| **Task** | Our objective was to assist with preparation of the IFRS Fixed Assets Register opening balances as at the date of acquisition |
| **Action** | Development of the overall reconstruction approach;<br>Training of the regional team leads;<br>Overall coordination of the assets physical inspection and labeling;<br>Sample testing at selected sites in all regions;<br>Building models to reconstruct selected asset classes based on available technical information;<br>Revaluation of assets;<br>Data consolidation. |
| **Result** | Fixed assets register that was approved by auditor as complete and accurate |

| | |
|---|---|
| ***Statistics*** | **During 6 month project over 500 OSSH's employees verified existence and technical attributes of over 200,000 network elements** |

# We have calculated 15.20% technical losses in the Albanian DSO network

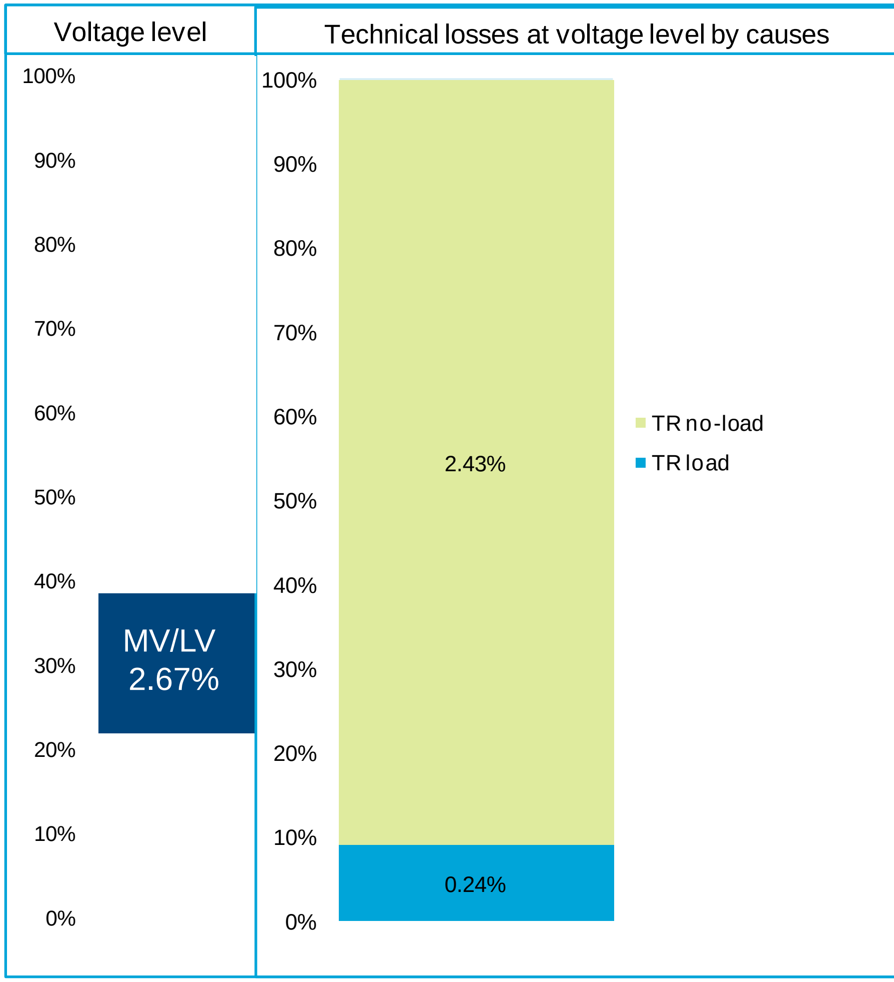


# Technical losses at LV level are mostly related to Joule losses in LV lines



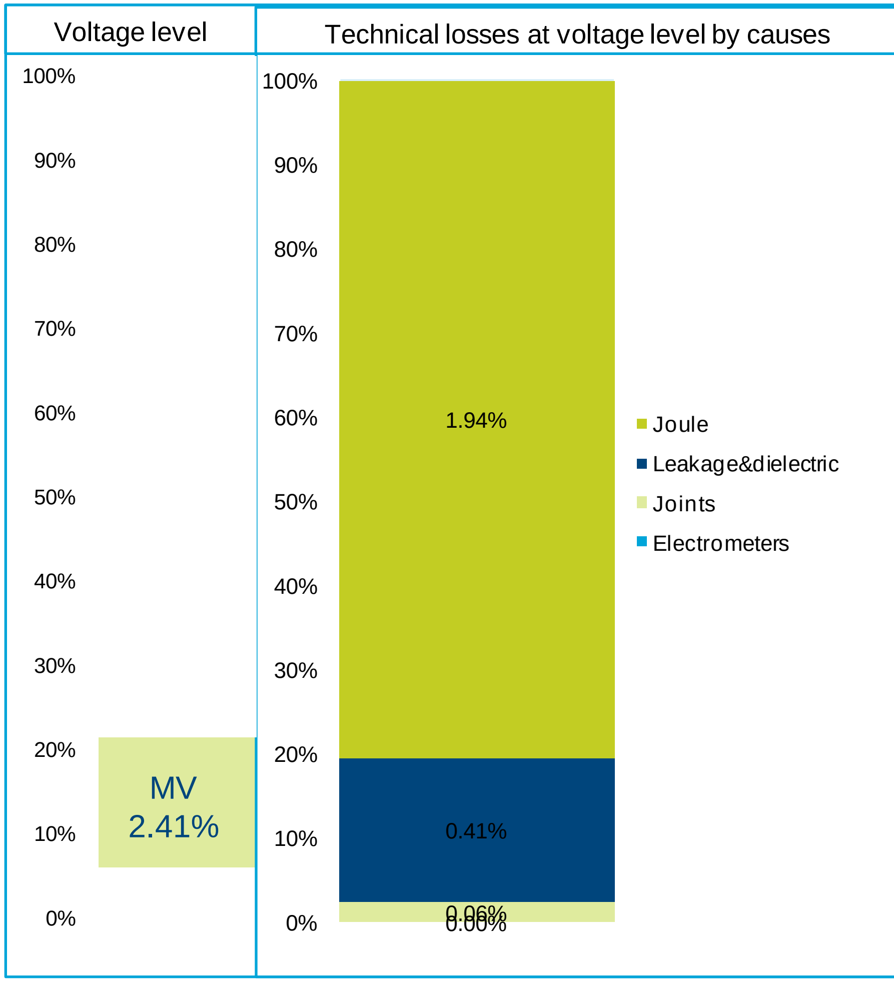

| Element | Approach | Calculation based on | Modelling level |
|---|---|---|---|
| **LV lines** | Joule | Length, power and energy losses, average peak loads, technical parameters | Calculated for groups of LV lines by type and per each zone |
| | Leakage & | Length, coefficients | Calculated for groups of LV lines by type and per each zone |
| **Electro - meters** | Consumption | Technical parameters | Calculated for groups of electrometers at zones |
| **Joints** | Benchmarks | 5% of LV losses | |
| **Breaker elements** | Benchmarks | Length, coefficients | Circuit breakers and fuses in the grid |

# No-load losses in cabin power transformers constitute the major part of the technical losses at MV/LV level



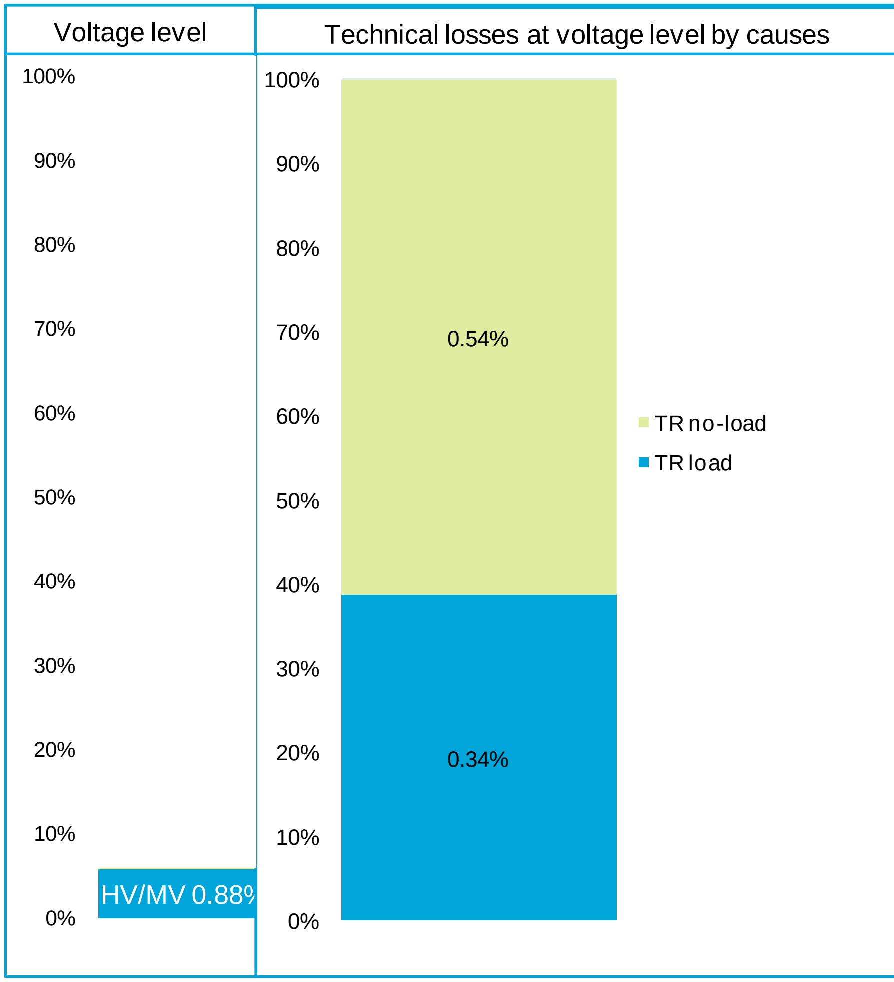

| Element | Approach | Calculation based on | Modelling level |
|---|---|---|---|
| **Transformers** | No-load | Nominal technical parameters of the equipment | Calculated for each individual power transformer (appx. 20,000 pcs) |
| | Load | Average peak loads, short circuit losses, utilisation | Calculated for each individual power transformer (appx. 20,000 pcs) |

# The largest part of technical losses at MV level are Joule losses in MV lines




| Element | Approach | Calculation based on | Modelling level |
|---|---|---|---|
| **MV lines** | Joule | Length, power and energy losses, peak loads, technical parameters | Calculated for each individual feeder (appx. 1,200 pcs) |
| | Leakage & Dielectric | Length, coefficients | Calculated for each individual feeder (appx. 1,200 pcs) |
| **Electrometers** | Consumption | Technical parameters | Calculated for groups of electrometers at zones |
| **Joints** | Benchmarks | 3% of MV losses | |

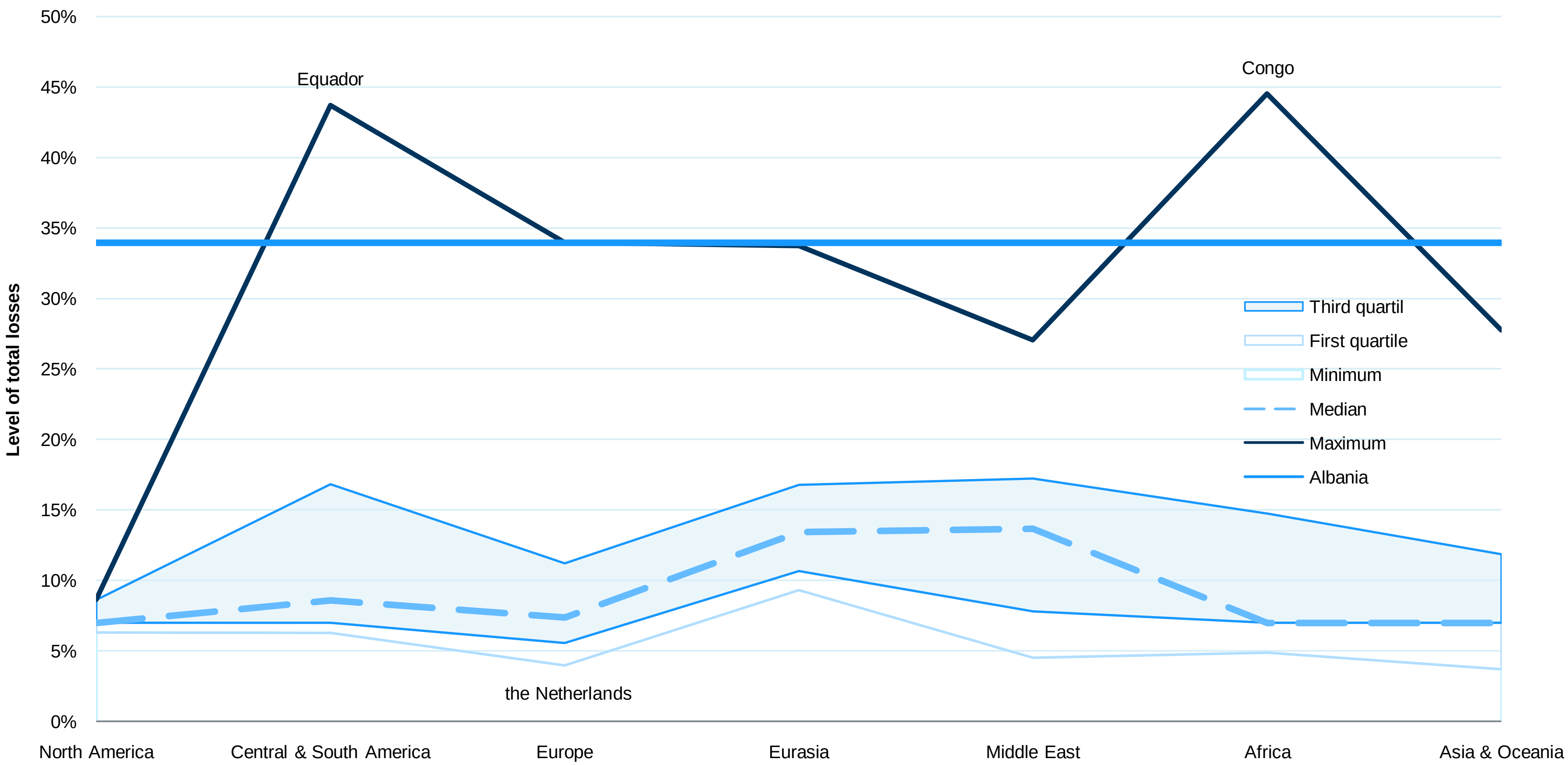
# Technical losses at HV/MV lines consist of two major parts: no-load and load losses at power transformers




| Element | Approach | Calculation based on | Modelling level |
|---|---|---|---|
| **Transformers** | No-load | Nominal technical parameters of the equipment | Calculated for each individual power transformer (appx. 130 pcs) |
| | Load | Peak loads, short circuit losses, utilisation | Calculated for each individual power transformer (appx. 130 pcs) |

# Challenges

**Level of distribution losses in the world**




Source: EIA

# Thank you for your attention