Reaction to CEER's 3rd Report on Power Losses

Webinar on CEER Report on Power Losses in European Electricity Grids

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Congratulations on the report!

- Data is useful for transparent, well-functioning markets, be it distribution or transmission
- The case study referring to Portugal and E.DSO member E-REDES is useful and E-REDES appreciates the example
- Agree that international benchmarking is difficult with different standards and definitions – makes European guidelines difficult – even the voltage levels are not the same, which must affect technical losses – perhaps even bigger challenge at distribution level
- Some countries do not distinguish between technical and non-technical losses
- What is included in non-technical losses is diverse
- How losses are measured is diverse (estimates or measures)
- Good to look at losses per kilometre

Interesting findings for us…

- Finding that losses in distribution are lower in countries with higher DSO revenue per km – do you get what you pay for? Perhaps all else equal – something to consider in a time of global competitiveness concerns and grid tariffs' contribution to electricity prices
- Finding that countries with lower population density have lower distribution losses even though longer distances between metering points result in higher losses in MWh – would be interesting to strip out technical and non-technical losses there – to test the theory that high-density areas have higher non-technical losses

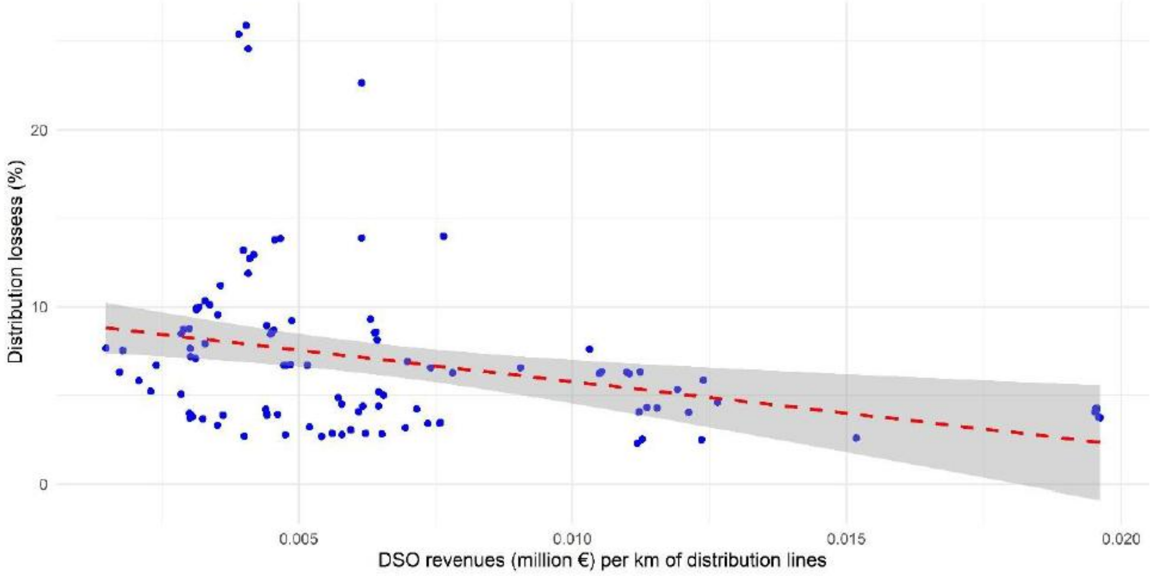

Figure 13 – Distribution losses (%) as a function of revenues per kilometre of lines in distribution (all years)

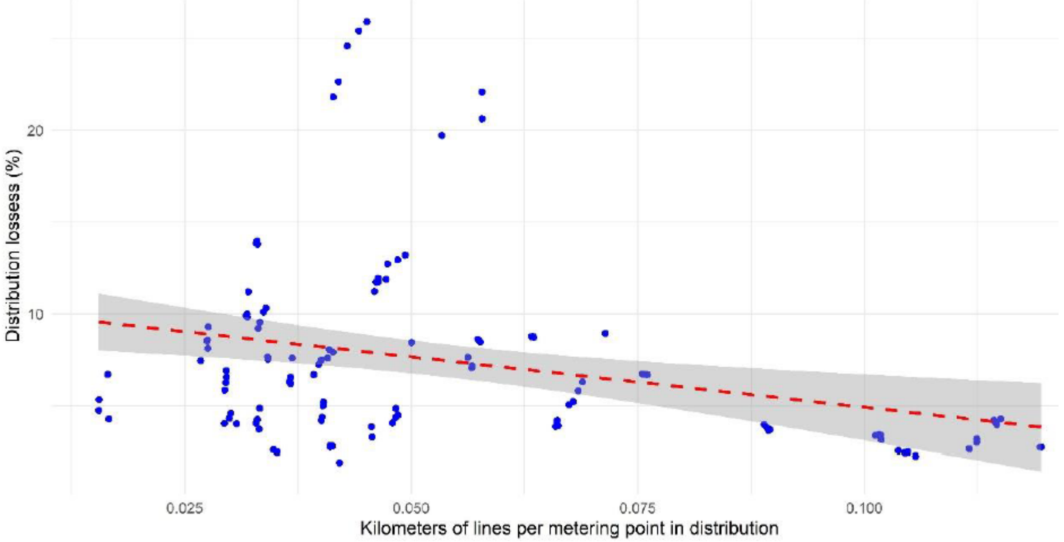

Figure 15 – Distribution losses (%) as a function of kilometre per metering point in distribution (all years)

What are DSOs doing about losses?

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- Not here to comment on individual countries – in a few countries, a single E.DSO member is responsible for the entire distribution grid but in most not
- Nevertheless, the general trend of reduction of losses, particularly non-technical losses is a good one – E.DSO members endeavour to reduce non-technical losses… E.DSO SUCCESS CASES
- https://www.edsoforsmartgrids.eu/success-cases/ - there more relevant cases on the E.DSO website, such as "Distribution Network Webcams" and "reCONNECT"
- Today, two have been selected:
- **i-TRAFO** (i-DE, Spain): on an architecture centred on the secondary substation, where different LV supervision and/or automation solutions are located, all managed through a central element, called low voltage remote terminal unit (LV RTU) and based on market standards that allow for flexible, scalable and common operations. **Reduction of power losses:** on-load tap changer (OLTC) transformers can help minimise power losses by adjusting the voltage to be as close to nominal as possible. This is particularly relevant in systems with high DER penetration, where distributed generation can vary significantly.
- **GridWise** (E-REDES, Portugal): As distributed energy resources (DERs) are integrated into the grid, the complexity of managing the LV network escalates. GridWise is intelligent platform integrates Information Technology (IT) and Operational Technology (OT) to effectively monitor transformer substations. It can do **Technical Loss Analysis**: calculating technical losses within the network provides actionable insights for planning and investment decisions; and **Fraud Mitigation**: enhanced capabilities for identifying non-technical losses such as theft or fraud bolster the overall network integrity.

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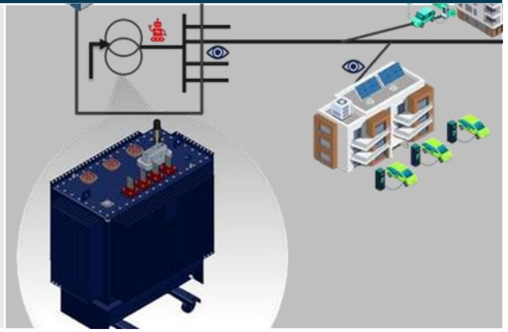
i-TRAFO

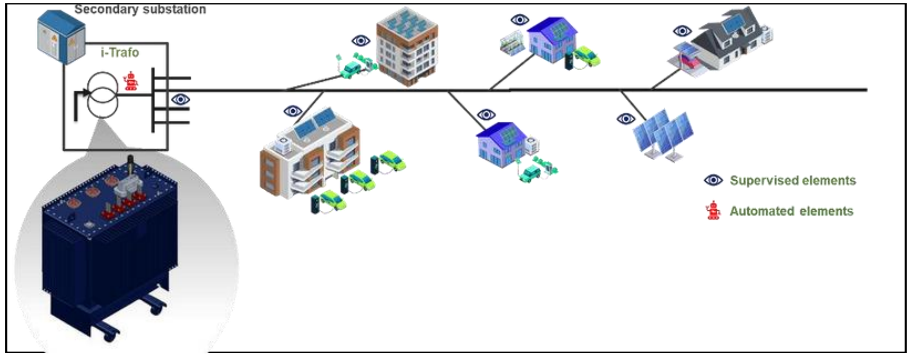
INTEGRATIONOF OLTC TRANSFORMERS INTO THE LOW VOLTAGE GRID



THE CHALLENGE

Current problems in the field of quality of electricity supply are closely related to compliance with standards, such as the IEC 61000-4-30, which establishes **voltage thresholds** that must be respected both by consumers and generators connected to the low voltage (LV) network. According to the EN50160 standard, DSOs in Spain have the responsibility of maintaining the voltage within a range of ±7% of its nominal value. This requirement guarantees the **reliability and quality of electricity supply** for end users.

Voltage restrictions can be aggravated by the integration of electric vehicles (EV) and distributed energy resources (DER) as these can cause unpredictable voltage fluctuations that complicate the control of the voltage level to the end customers and, therefore, maintain the limits established by local regulations. The **on-load tap changer (OLTC) transformer** can play a relevant role in achieving **dynamic adaptation of the voltage to fluctuations in load, generation and power flows**.



Smart Transformer(i-Trafo) in a secondarysubstation.

For more information about the project, please contact:
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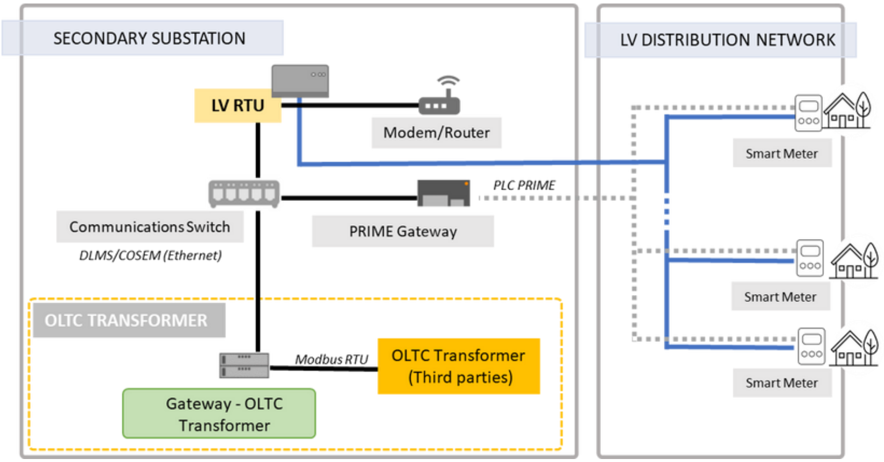
THE SOLUTION

The solution proposed by i-DE is based on an architecture centred on the secondary substation, where different LV supervision and/or automation solutions are located, all managed through a central element, called **low voltage remote terminal unit (LV RTU)** and based on market standards that allow for flexible, scalable and common operations.

This group of electronic and electromechanical devices are integrated using an Ethernet bus and controlled using the DLMS/COSEM protocol over TCP/IP (industry standards). The data obtained in real-time (e.g., electrical parameters, alarms and automation status) are sent to the DSO's SCADA/ADMS (Supervisory Control and Data Acquisition/Advanced Distribution Management

System) using the IEC 60870-5-104 real-time protocol, although other protocols such as DNP3 or IEC 61850 could be used. The LV RTU acts as a communication master for all devices and communicates with the central management system of the DSO and/or the SCADA/ADMS using different communication technologies, such as API-REST.



General proposal for the type of architecture described above.

MAIN ADVANTAGES

The integration of EVs and DERs in LV systems poses challenges and opportunities in the management of the electricity grid. In this context, the use of LV OLTC transformers can have several important implications and advantages:

- **Flexibility and adaptability**: OLTC transformers offer the flexibility to adapt the voltage in the LV grid according to changing conditions, such as variable load due to EV charging and intermittent generation from DERs (e.g., photovoltaic (PV) generation). This allows maintaining optimal voltage in the network and guaranteeing the quality of supply.
- **Reduction of power losses**: OLTC transformers can help minimise power losses by adjusting the voltage to be as close to nominal as possible. This is particularly relevant in systems with high DER penetration, where distributed generation can vary significantly.
- **Grid voltage stability**: the integration of EVs and DERs can cause voltage fluctuations in the LV grid. OLTC transformers can mitigate these fluctuations and maintain voltage stability, which is essential to ensure the safe operation of electrical equipment and EV charging.
- **Improved EV Charging Management**: OLTC transformers can be used to manage EV charging efficiently. During peak charging hours, voltage adjustments can optimise charging capacity and reduce grid congestion.
- **Improved power quality**: OLTC transformers can help maintain better power quality by controlling voltage and reducing the presence of harmonics in the network. This is especially relevant when it comes to systems with high DER penetration, which often generate energy in an intermittent and variable way.
- **Efficient infrastructure investment**: Integrating EVs and DERs into LV systems may require infrastructure investments, including OLTC transformers and advanced control systems. These investments, necessary to guarantee efficient and reliable operation of the network, represent a much more cost-efficient solution compared to other traditional solutions.

KEY SUCCESS FACTORS

OLTC transformers play a crucial role in LV grid management in a context of increasing integration of EVs and DERs. Their ability to adjust the voltage in real time and maintain grid stability is essential to ensure efficient and reliable operation of the electrical system in these changing circumstances. However, their effective implementation requires **careful planning**, optimising both resources and costs, and **collaboration between stakeholders** in the transition to a more sustainable and modern electricity system.

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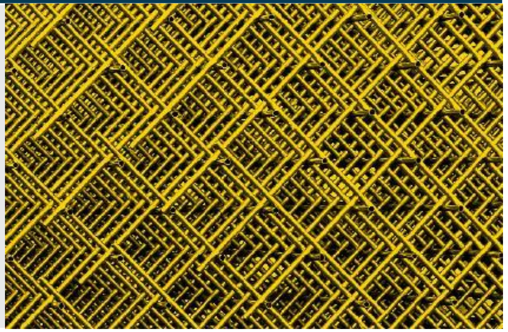
GRIDWISE

THE CASE OF THE INTELLIGENT PLATFORM THAT MONITORS AND CONTROLS THE LOW VOLTAGE NETWORK



THE CHALLENGE

The energy transition is increasingly evident in today's world, characterised by a decentralised approach that is reshaping how electricity is produced and consumed. New technologies for production, consumption, storage, metering, and efficient demand management are proliferating. This shift has resulted in a significant increase in bidirectional electricity and data traffic, making the low voltage (LV) network busier than ever before.

As distributed energy resources (DERs) are integrated into the grid, the complexity of managing the LV network escalates. Currently, in Portugal, this extensive network spans approximately 150,000 kilometres and serves over six million customers. The critical nature of this infrastructure necessitates enhanced visibility and control mechanisms akin to those already established in medium and high-voltage networks. Historically, LV grids have operated with limited digitalisation. However, this is rapidly changing to address key areas for improvement:

- **Impact of DERs**: As more DERs connect to the grid, their influence on voltage stability and power quality must be carefully managed.
- **Operational Efficiency**: Streamlining logistics and operations is essential for reducing costs and improving service delivery. **Automation and Analytics**: Increasing automation and analytical
- capabilities will enable proactive management of the network.

THE SOLUTION

In light of these challenges, E-REDES has embarked on a transformative journey towards digitalisation in LV management through the innovative GridWise project. Launched in 2023, GridWise stands out as a pioneering solution among European DSOs. This intelligent platform integrates Information Technology (IT) and Operational Technology (OT) to effectively monitor

E-REDES transformer substations. GridWise employs advanced technologies such as artificial intelligence (AI), Internet of Things (IoT), Big Data analytics, and Edge Computing to create a centralised real-time monitoring system. The primary objectives of GridWise include:

- **Fault Detection**. The continuous monitoring of LV circuits allows for the timely identification of faults or conditions that may jeopardise the power supply.
- **Power Quality Assurance.** Monitoring power quality parameters enables the generation of compliance reports aligned with international standards.
- **Network Topology Mapping**. The automatic mapping and creation of network topology facilitate the identification of phases and outputs for each smart meter connected to transformer stations.
- **Technical Loss Analysis**. Calculating technical losses within the network provides actionable insights for planning and investment decisions.
- **Fraud Mitigation**. Enhanced capabilities for identifying non-technical losses such as theft or fraud bolster the overall network integrity.
- **Neutral Conductor Monitoring**. Tracking the physical loss of neutral conductors ensures comprehensive oversight of network performance.

THE RESULTS

The implementation of GridWise yielded remarkable improvements in both efficiency and service quality for E-REDES:

- **Cost Savings.** Regulatory power quality monitoring costs have been reduced by approximately €1.5k per year for each transformer substation installed. With 168 transformers planned for installation in 2024, this translates to an estimated total savings of €250k annually.
- **Faster Fault Resolution.** The average time required to detect, allocate resources, and resolve faults has decreased by around 20 minutes compared to traditional methods reliant on call centre communications.
- **Fraud Detection Potential**. The enhanced monitoring capabilities of GridWise improve the potential for detecting and mitigating fraud and theft within the network.
- **Improved Quality Indicators:** The positive impact on Technical Service Quality indicators to reflects a commitment reducing fault identification times and improving operational responsiveness.

OTHER BENEFITS

- **Social Benefits.** Minimising the negative impact of network disturbances on the daily activities of individuals and businesses is crucial. By ensuring a stable power supply, GridWise enhances the reliability of services that people rely on for their everyday activities. **Environmental Benefits.** The
- GridWise project not only enhances operational efficiency but also contributes to sustainability goals. By optimising energy consumption and reducing losses, GridWise plays a vital role in decreasing carbon emissions associated with electricity distribution.

AWARDS

The innovative approach embodied by GridWise has attracted significant recognition within the industry: •**Portugal Digital Awards 2023**. GridWise was awarded in categories such as ***Best Future of Intelligence Project*** and ***Best Energy & Utilities Project***.

•**KAIZEN Awards Portugal 2024**. GridWise was recognised in the ***Innovation*** category for its transformative impact on energy management.

NEXT STEPS

The GridWise project is advancing on two crucial fronts. In the short term, all analytical layers will be integrated into corporate systems while, in the medium term, these will be connected with Advanced Distribution Management Systems (ADMS). The number of monitored transformer substations is set to expand significantly, from 200 at the end of 2023 to approximately 12'000 by the end of the decade.

Regulatory considerations

- Incentives must be established in such a way as to provide the right investment/operation signals, so they constitute a clear indication of how to reduce losses.
- Incentives must be a lever to reward companies with the best performance. A level playing field for all DSOs is essential.
- Processes should not be overly complicated. For example, in the March 2025 ACER report on network tariffs highlighted the case of Norway, with a tariffication scheme based on marginal grid losses, differentiated in each network node. This is difficult to achieve, at least at distribution level, as it would be extremely complex to implement. This might make sense in a more (older) centralised system, but the energy transition is proposing decentralised networks where the integration of renewables is vital. They are closer to demand, and more importantly, their marginal cost is close to zero, therefore energy losses are less relevant.
- In this regard, Eurelectric's "Grids for Speed" report says "…most renewables are produced and consumed within the same distribution grid. This is more efficient as losses are lower with less distance between production and consumption." One can refer to the Viesgo case study in the 1st CEER Power Losses report: "It can be observed that increased renewable generation in scenarios with low penetration levels of DG has a barely-significant impact on the level of network losses. On the other hand, an increase of the renewable generation in scenarios with high levels of penetration of DG, has a quite significant and relevant impact in the level of network losses."
- The 1st CEER report goes on to say, "When NRAs consider incentives to reduce network losses in distribution, how the grid losses percentage is calculated should be taken into account in order to avoid the effect of energy injected into the grid by distributed generation. The purpose here is to prevent a situation wherein the transmission of energy to networks of higher voltage excessively penalizes distributors in areas with lower demand."

Regulatory considerations

- Losses costs should not be borne by DSOs. Some regulatory perspectives allege that retailers assume additional risk by managing the costs of losses until they are recovered (usually after a regulatory validation). Transferring this risk to DSOs could be a bad idea, since it is increasing the costs and burden for a regulated activity, without a fundamental reason for this. Any initiative that de-risks grid activities in energy markets is very welcome, given the enormous investment needs in Europe’s grids sector (+€60 bn/year in distribution alone)
- Avoiding energy losses is not trading risk management for DSOs: incentive schemes should be volume based, and not penalize the DSO for price volatility.
- Zero-sum gain benchmarking of DSOs where incentives (premium/penalty) are only relative to other DSOs may not bring any real efficiency improvements. E.g. a situation wherein the penalties amount is collected are redistributed among “best performers”. This kind of scheme pushes for competition among DSOs but not for collective improvement of the sector.