

Overcoming Inefficiencies in Pakistan's Electricity Sector



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The electrical power distribution network in Pakistan consists of multiple entities and regulatory frameworks spanning energy generation to consumption. The structure includes several Distribution Companies (DISCOs), the National Transmission and Dispatch Company (NTDC), and oversight by the National Electric Power Regulatory Authority (NEPRA).

The NTDC serves as the primary entity responsible for transmitting electricity across Pakistan, excluding Karachi, which is served by K-Electric (KE). High-voltage transmission lines (500 kV, 220 kV, and 132 kV) connect power generation stations to load centers. Additionally, the NTDC manages the national grid to balance supply and demand across regions.

Karachi and some areas in Balochistan are served by KE, a vertically integrated utility. KE operates its own transmission system with interconnections to the NTDC for importing power when necessary. KE's operational framework allows it to handle both generation and distribution functions within its service area.The DISCOs in Pakistan include:

- Peshawar Electric Supply Company (PESCO)
- Islamabad Electric Supply Company (IESCO)
- Lahore Electric Supply Company (LESCO)
- Gujranwala Electric Power Company (GEPCO)
- Faisalabad Electric Supply Company (FESCO)
- Multan Electric Power Company (MEPCO)
- Hyderabad Electric Supply Company (HESCO)
- Sukkur Electric Power Company (SEPCO)
- Quetta Electric Supply Company (QESCO)
- Tribal Areas Electric Supply Company (TESCO)

Tariff rates, operational standards, and performance benchmarks for the electricity sector are regulated by NEPRA. Electricity prices are influenced by factors such as supply costs, operational efficiency, and consumer mix, as determined by the regulatory authority.

In 2002, Pakistan's electricity sector underwent restructuring, leading to the unbundling of the Water and Power Development Authority (WAPDA) into separate generation, transmission, and distribution companies. This restructuring resulted in a shared electricity industry framework involving private power producers and regulatory oversight.

Enhancing efficiency in power distribution systems requires a holistic approach that integrates technology, infrastructure upgrades, a conducive work environment, and effective policies. By addressing both technical and non-technical losses, utilities can improve overall performance, reduce costs, and provide better facilities to consumers.



Pakistan's power sector has long struggled with insufficient investment, inefficient power generation, and a dysfunctional distribution network. Over the past three decades, these challenges have been exacerbated by poorly conceived policies, widespread corruption, rising electricity prices, with a growing gap between demand and supply. This gap has resulted in prolonged load shedding, with urban areas experiencing daily outages of

8 to 10 hours and rural areas enduring even longer outages, often exceeding 14 hours. Government efforts to address the crisis, such as boosting power generation and introducing subsidy-based solar initiatives, have largely failed. While these measures have provided limited relief and some support to the economy, they have also contributed to issues like circular debt and sector inefficiencies.



Pakistan's power distribution network continues to face major inefficiencies, including high losses, outdated infrastructure, and mismanagement. These systemic problems remain key contributors to the ongoing energy crisis. At present, distribution companies are facing some challenging problems, most of them operational, while a few are structural. Commonly found problems in power distribution systems include improper earthing systems, stability and control issues, power quality problems, sudden voltage surges, overhead line sag, transformer failure and overloading, underground cable treeing, and circuit breaker failure.

Transmission and Distribution (T&D) losses in Pakistan have been alarmingly high, reaching 18.31% in 2024, above the regulatory target of 11.77%. This amounts to huge financial losses, with NEPRA estimating that inefficiencies caused an annual revenue loss of Rs. 596 billion. Over 60% of Pakistan's T&D network is aging and has already surpassed its designed lifespan. Many power generation plants are also outdated, particularly thermal plants that consume excessive amounts of fuel, producing less electricity and leading to lower efficiency and higher costs for consumers.

The inefficiencies within the system are also exacerbated by electricity theft. In the country, an estimated 16% of electricity is lost through theft, negatively affecting the revenue collection of the nation's DISCOs. Additionally, poor governance and mismanagement due to political issues have led to the circular debt crisis in the sector. Despite increasing generation capacity, there is a lack of proper investment in T&D infrastructure, which affects efficient power delivery. Many households find electricity bills unaffordable, with reports suggesting that electricity bills in some cases have become more expensive than rent. The circular debt problem alone has become so severe that it hampers the financial viability of DISCOs and discourages further investment in the sector.

To address these inefficiencies, several measures have been suggested. Reducing losses and increasing reliability are essential to upgrading T&D networks. According to the Asian Development Bank, investing in T&D infrastructure could boost capacity by 10% without the need to build new power plants. Smart grids and anti-theft technologies can be implemented to control peak loads and reduce electricity theft. Privatizing DISCOs and establishing competitive markets could incentivize cost reduction and efficiency improvement. Additionally, audits of existing contracts with Independent Power Producers (IPPs) could identify areas where costs can be reduced and efficiency gained.

It is critical for stabilizing the sector that the government strengthens its oversight to counter electricity theft and improve revenue collection processes. Over the past decade, utilities have gained access to data and tools that enable improved analyses and offer the potential to increase the efficiency of power distribution systems (e.g., reducing losses, optimizing voltage profiles, etc.) due to the rapid development and widespread adoption of information systems, distribution analysis tools, computational models, and, more recently, the emergence of smart grid technologies. For example, power flow data and feeder computational models are now widely available, allowing for more precise computation of system losses.

Recent developments in technology and market trends, such as the adoption of the smart grid concept, provide utilities with new resources and exciting opportunities for reducing system losses. Examples of such measures include more frequent system reconfiguration, strategic distributed generation (DG) siting and dispatch to maintain reactive power and voltage, and closed-loop operation of distribution feeders.

About the Author: *The author holds a Master's degree in Electrical Power Engineering from Mehran University of Engineering and Technology (MUET) and NED University of Engineering and Technology, Pakistan. He has 7 years of industry experience with K-Electric and over 12 years of teaching experience. Currently, he is an Assistant Professor and Ph.D. scholar at MUET. His research focuses on energy systems, artificial intelligence, and smart grids, with several publications in reputed journals and conferences.*