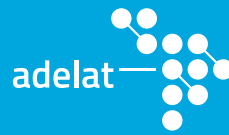


SUMMARY DSO BRIEF

THE QUALITY OF POWER DISTRIBUTION IN THE ENERGY TRANSITION

CHALLENGES AND BEST REGULATORY PRACTICES





AUTHORS AND COLLABORATORS

Viviana Vitto, Alessandra Genu Dutra Amaral, Roberto Cajamarca Gómez, Sandra Marcela Quijano López, Adrián Abella, Alessandra Maria Barbosa Cordeiro, Andrés Camilo Agredo, Dimitri Barros Pereira de Oliveira, Dimas Carranza, Talita Darwiche, Paulo Andrés Espinoza Arriagada, Carlos Figueroa, Alfredo Gallegos, Jorge Enrique Juscamayta Meza, Jorge Loayza Guerra, Julio Cesar Luján Rojas, Clarissa Machado Rocha, Ednelson de Moraes, Lucas Noura Guimarães, Percy Raúl Perez Becerra, Aldo Pessanha, Ruben Darío Reyes Trujillo, Aldo Víctor Romero, Mariana Silva Barreto, Marcelo Horacio Spitalnik, Víctor Alejandro Tavera Olivos, Sergio Zambrano.

Latin America has made significant advances in electricity service coverage. However, there are still opportunities to improve reliability and continuity, which directly impact the productivity of countries and the quality of life of the population, substantially increasing costs for energy acquisition (IDB, 2020).

Moreover, an adequate level of distribution quality is key to the energy transition, as this will involve increased participation of electricity consumption in energy demand in our region and a shift from the traditional paradigm of passive distribution networks with unidirectional energy flows. This new dynamic demands a substantial and faster improvement in service quality indices. To accelerate this process, investments in infrastructure and digitalization, as well as adequately localized incentives balanced with tariffs for end consumers, are required.

The distribution of electric power is influenced by various factors that impact investment planning and service quality. On one hand, there are stochastic factors, such as increasingly frequent climatic events, causing unscheduled interruptions, and unanticipated demand growth generating high performance requirements on equipment. On the other hand, there are failures due to a lack of investments in system expansion, forcing infrastructure to operate outside its design values.

Reliability levels are directly related to the incentives provided by regulatory frameworks, which in many Latin American countries have focused on minimizing distribution costs for a certain level of service quality, producing a negative incentive that limits investments in reliability. There is a relationship between regulations that remunerate investments, the institutional framework to validate them, and the quality of service. In this regard, a regression analysis of quality indicators for Latin America, conducted by the consulting firm BA Energy Solutions, found that service quality indicators (SAIFI, SAIDI) have a negative correlation with the distribution value added set by regulators (VAD). This can be explained by the lack of resources caused by low tariff remuneration values.

Additionally, the configuration of each distribution network and aspects of its environment, such as user density and energy losses, have a significant impact on quality indicators. These characteristics must be carefully considered by regulators when defining quality goals and remuneration. Finally, external events, especially of a climatic nature, significantly affect the quality of service. The increasing frequency of these events due to climate change makes resilience a crucial consideration for regulation and economic incentives in distribution activity. Quality goals and performance indicators should reflect the specific conditions of each region, considering their exposure to climate risks, and appropriately remunerate investments aimed at improving resilience and recovery speed in the face of adverse events.

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OVERVIEW OF SERVICE QUALITY IN LATIN AMERICA

Latin America, in general, enjoys better quality services than other regions in the developing world. However, geographical, economic, and social diversity of the region results in different levels of development and service quality due to differences in infrastructure, regulation, and energy policies. While in developed countries the System Average Interruption Duration Index (SAIDI) is measured in minutes, in urban areas of Latin America it is still measured in hours, and in rural areas it is several times higher.

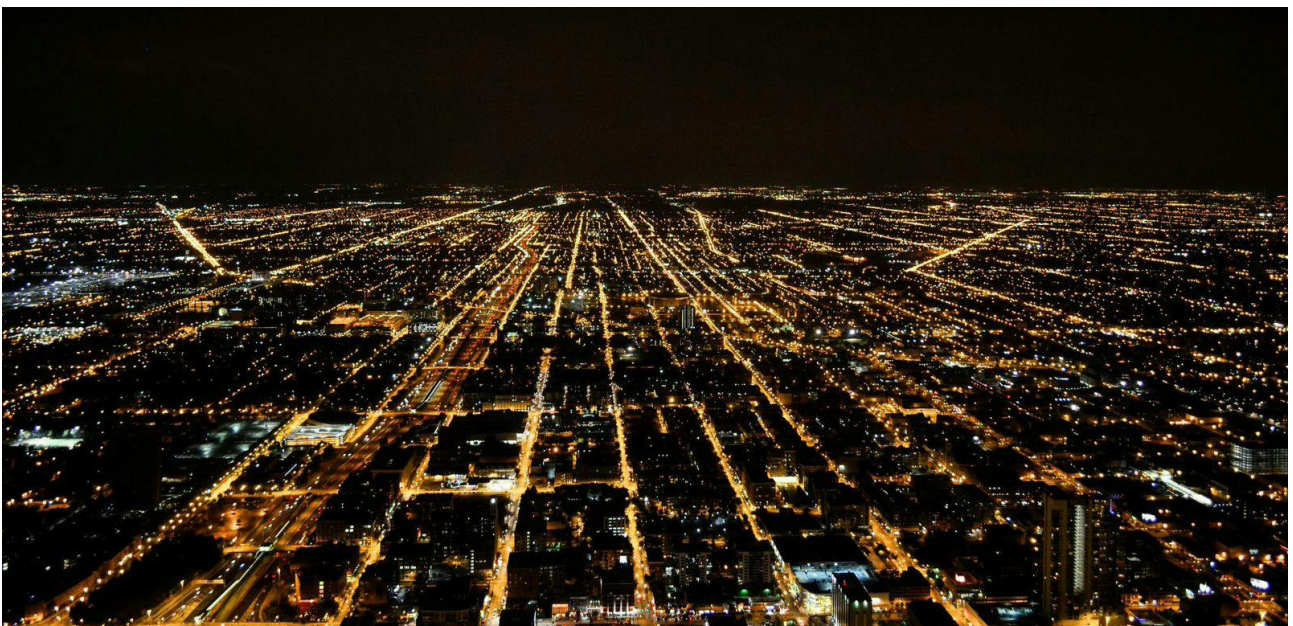
Comparing power distribution quality indicators between countries in Latin America presents challenges due to the diversity of metrics used for the frequency and duration of interruptions (SAIFI-SAIDI, FMIK-TTIK, FEC-DEC). Considering this, the following table presents a summary of the main service quality indicators, with emphasis on Argentina, Brazil, Chile, Colombia, Ecuador, Guatemala, and Peru.

Quality Indicators by Country (2023)

Country	Frequency		Duration		Source
	Index	Value	Index	Value	
Argentina	SAIFI	10,2	SAIDI	16,5	GME*
Brazil	FEC	5,2	DEC	10,4	ANEEL
Chile	SAIFI	7,3	SAIDI	13,6	SEC
Colombia	SAIFI	15,4	SAIDI	23,4	SSPD
Ecuador	FMIK	6,0	TTIK	7,5	ARCERNNR
Guatemala	FMIK	5,1	TTIK	23,4	GME*
Peru	SAIFI	2,5	SAIDI	6,7	Osinergmin***

* Weighted average of a sample of companies calculated by Grupo Mercados Energéticos.

*** Only considers medium voltage.



Latin America has seen significant improvements in recent years thanks to investments in network modernization, adoption of smart technologies, and regulatory reforms. However, challenges such as unequal coverage, frequent interruptions, and energy losses persist. For a sample of information from 15 DSOs reported to ADELAT, an average improvement of between 17% and 19% in SAIFI and SAIDI indicators was found between 2019 and 2022.

Average quality indicators for DSOs reported to ADELAT

Index	2019	2020	2021	2022	2019/2022 Variation
Average SAIFI	7,1	6,0	5,9	5,9	-17%
Average SAIDI	13,2	10,4	10,7	10,7	-19%

Several Latin American countries have developed regulatory schemes based on the cost associated with low-quality levels, which indicate the required levels, incentives and penalties, excludable events, and reporting and control mechanisms. While not all regulatory aspects are comparable, a brief review of the regulatory frameworks on service quality in the ADELAT member countries is presented below.



An adequate level of distribution quality is key to the energy transition.



Overview of the Regulation on Power Distribution Quality in ADELAT Member Countries.

CRITERION	ARGENTINA	BRAZIL	CHILE	COLOMBIA	ECUADOR	GUATEMALA	PERU
Obligation Source	Concession contracts, national and provincial regulation	Concession contracts, national regulation	National regulation (technical standard)	National regulation	National regulation	National regulation (technical standard)	Concession contracts and national regulation (technical standard)
Average Quality Indicators	SAIFI, SAIDI	FEC, DEC	SAIFI, SAIDI	SAIFI, SAIDI	FMIK, TTIK	FMIK, TTIK	SAIFI, SAIDI
System Level Targets	Yes. Globally, at installation or transformation center level.	Yes. Differentiated according to similar distribution sets.	Yes. Differentiated by customer density.	Yes. At subtransmission and distribution levels. Consider the history of each DSO and the attributed investment levels.	Yes. Differentiated by distribution feeder density.	Yes. Differentiated between urban and rural areas.	Yes
User Level Targets	Yes	Yes	Yes. Differentiated by customer density level.	Yes. Differentiated by rurality level and failure risk index.	Yes. Differentiated by voltage level.	Yes	Yes. Differentiated for rural areas
Compliance Incentives	No	Yes	No	Yes. Increase in asset remuneration in the following year.	No	No	Yes. Through tariff adjustment factor according to proposed targets by the company.
Individual Compensations	Yes	Yes	Yes	Yes	n.a.	Yes. Reported semi-annually	Yes. By Concession Law, technical standards, and operating procedure
Excludable Events	Scheduled outages for improvements, force majeure, extreme climatic events, interruptions originating from the customer or upstream.	Scheduled outages for improvements, force majeure, emergency, or security risk, interruptions attributable to the customer, load relief schemes.	Scheduled outages for improvements, force majeure and unforeseeable circumstances, extreme climatic events, interruptions attributable to the customer.	Scheduled outages for improvements, force majeure, extreme climatic events, interruptions originating from the customer or upstream, required by official authorities, or life-threatening.	Force majeure, general service suspensions, interruptions originating from the customer, LV interruptions.	Scheduled outages for improvements, force majeure, originating from the customer.	Scheduled outages for improvements, force majeure, extreme climatic events, originated by third parties.
Reporting and Supervision	Monthly reporting to regulator, documentation of excludable events	Monthly, quarterly, and annual reporting to regulator. Annual quality indicator ranking is published.	24/7 reporting to the supervisor's platform and company websites. Annual quality ranking is published, and action plans are required in case of non-compliance.	Reports to the National Dispatch Center, market operator, and supervisor (Superintendence).	Monthly reporting to regulator's platform, which notifies the average indicators each January.	Monthly reporting of indicators and semi-annual calculation of compensations, audited by the regulator.	Reporting and supervision by regulator. Includes field inspections and record reviews. Company statistics are published, and improvement plans are required in case of non-compliance.

02

INCENTIVE REGULATION FOR SERVICE QUALITY

Regulatory frameworks play a crucial role in defining, assessing, and improving distribution quality by incentivizing or disincentivizing infrastructure and new technology investments. Incentive and compensation schemes aim to align distribution company interests with service quality objectives. Regulatory frameworks may incorporate various economic mechanisms to incentivize distribution companies to make investments improving service quality. Some incentive regulation instruments include:

Performance-Based Tariffs: Tariffs companies linked to their service quality performance.

Non-compliance Penalties: Companies failing to meet established goals may face fines or reductions in regulated tariffs.

Consumer Participation Mechanisms: Consumers may receive compensation for prolonged or recurring service interruptions.

Long-Term Incentives: Programs offering incentives based on continuous improvement over several years, promoting sustainable infrastructure investments.

Reporting: Regulations may require companies to publish periodic reports to regulatory authorities on service quality and interruptions, promoting transparency and accountability.

Audits and Supervision: Crucial for verifying the accuracy of distribution company reports, these audits ensure data transparency and reliability.

In any case, the evaluation of quality indicators must be accompanied by a clear definition of excluded events from their calculation. This should include all circumstances beyond the DSO's control (natural events, force majeure, actions by third parties, failures in other stages of the system, etc.), as well as scheduled interruptions necessary for network improvement and modernization. It is important that this does not impose excessive burdens on companies for

documenting, reviewing, and approving by the regulatory authority.

Additionally, regulation should promote sustainability and electrical system resilience through demand management programs encouraging efficient energy use and reducing demand during peak hours and investing in resilience infrastructure, that is, infrastructure development that is resistant to extreme weather phenomena, ensuring continuity of supply.

Effective implementation of these elements requires a combination of clear regulations and advanced technology. As energy transition progresses, these frameworks must continually adapt to face new challenges and seize emerging opportunities, promoting high-quality service.



03

INTERNATIONAL SUCCESS CASES IN DISTRIBUTION QUALITY IMPROVEMENT

Several countries have implemented innovative and effective strategies to significantly improve power distribution service quality, achieving notable progress. The United Kingdom launched an incentive-based regulation model known as “RIIO” (Revenue = Incentives + Innovation + Outputs). This model aims to promote efficiency, innovation, and sustainability in distribution, focusing on financial incentives for efficiency and cost reduction, promoting innovation in new technologies and best practices, and emphasizing quality and sustainability goals. Since RIIO implementation, there has been a significant reduction in service interruption frequency and duration, and companies have increased investments in advanced technologies such as smart grids and energy storage.

In the United States, distribution quality regulation varies by state. However, modernizing the electrical grid is a priority. The Department of Energy (DOE) has launched multiple initiatives to promote smart grid adoption and improve infrastructure resilience against natural disasters and cyberattacks. Additionally, many states have implemented incentive programs similar to RIIO, leading to significant improvements in service quality.

California has been a leader in adopting advanced technologies and implementing incentive programs. The California Public Utilities Commission (CPUC) has promoted smart grid adoption, enabling better service management and monitoring, and programs incentivizing consumers to reduce consumption during demand peaks, improving service reliability.



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CONCLUSIONS

It is necessary to make adjustments and improvements to ensure that regulatory frameworks be clear, coherent, and flexible, promote innovation and competition in the sector, as well as technically and economically efficient tariff schemes, and adequately remunerate investments in new technologies. Considering the above, the following are some lines of improvement for regulatory frameworks, quality assessment mechanisms, and goal and incentive schemes.

Regulatory and normative stability. It is essential that regulations be clear, stable, and have long-term goals, with their modifications being rigorously analyzed and structured. This reduces uncertainty, generates confidence for investments in quality improvements, facilitates long-term planning, and promotes user well-being.

Clear and uniform standards. It is essential to advance in clear and uniform standards to ensure that all DSOs follow the same guidelines, which facilitates comparison and performance evaluation, and provide a clear framework that encourages investment in infrastructure and advanced technologies.

Eliminate regulatory limitations and recognition schemes for investments aimed at improving service quality, and ensure remuneration based on real costs, rather than schemes based on theoretical costs of a model company. This, accompanied by appropriate reporting and monitoring mechanisms, and observing a balance in consumer tariffs.

Achievable goals adaptable to the context. This includes considering the context and differential costs under which each company operates. For example, providing the same levels of quality to rural communities is more expensive than to urban areas.

Economic incentives for companies that exceed quality goals, accompanied by additional goals that promote innovation and technology implementation that are currently unfeasible with current remuneration, and establishing compensation for consumers affected by prolonged or recurrent service interruptions.

Clarity in defining excluded events from quality indicators, ensuring it encompasses all circumstances beyond the distributor's control, and avoids imposing excessive burdens of proof for their documentation, review, and approval.

Facilitation of permits and licenses by environmental entities for the construction and operation of electrical infrastructure projects, especially those related to the expansion and improvement of distribution system coverage. This can reduce project costs and timelines, making investments more attractive.

Regulation to accelerate the deployment of advanced metering and the implementation of differentiated tariffs by hourly segments, so as to maximize the benefits through incentives for consumption during off-peak hours.

Promotion of Public-Private Partnerships (PPP) to develop joint projects in electrical distribution infrastructure. PPPs have proven to be an effective tool for combining the experience and resources of the private sector with the goals and commitments of the public sector.

Fiscal incentives or mechanisms for financing, with adequate terms and flexible conditions, for making investments in quality improvement, especially for small distributors, such as electric cooperatives.

Resilience criteria in remuneration and incentive schemes, to include investments aimed at improving the reliability of supply during extreme events, which are currently only treated as exclusions. This should cover initiatives such as burying power lines, using more resilient materials, creating meshed and redundant networks, implementing smart grids, microgrids, and energy storage systems.

Facilitating the integration of distributed resources and investments in infrastructure for electric mobility, such as charging stations and adapted distribution networks.

Regulation anticipating the adoption of innovative technologies. This can be done through pilot projects that implement advanced technologies such as smart grids and energy storage, and promoting energy efficiency and investments aimed at protecting critical electrical distribution infrastructures against cyber threats.

Greater transparency and participation. Transparency in regulatory processes and effective participation of relevant actors are essential to improve service and regulatory perception. This can be achieved through the publication of periodic reports on service quality and actions taken to improve it.

The implementation of these improvements can lead to more efficient, reliable, and sustainable electrical distribution, benefiting both consumers and the economy as a whole. Collaboration among governments, regulators, distribution companies, and consumers will be essential to achieve these objectives and ensure a more promising energy future for Latin America.



