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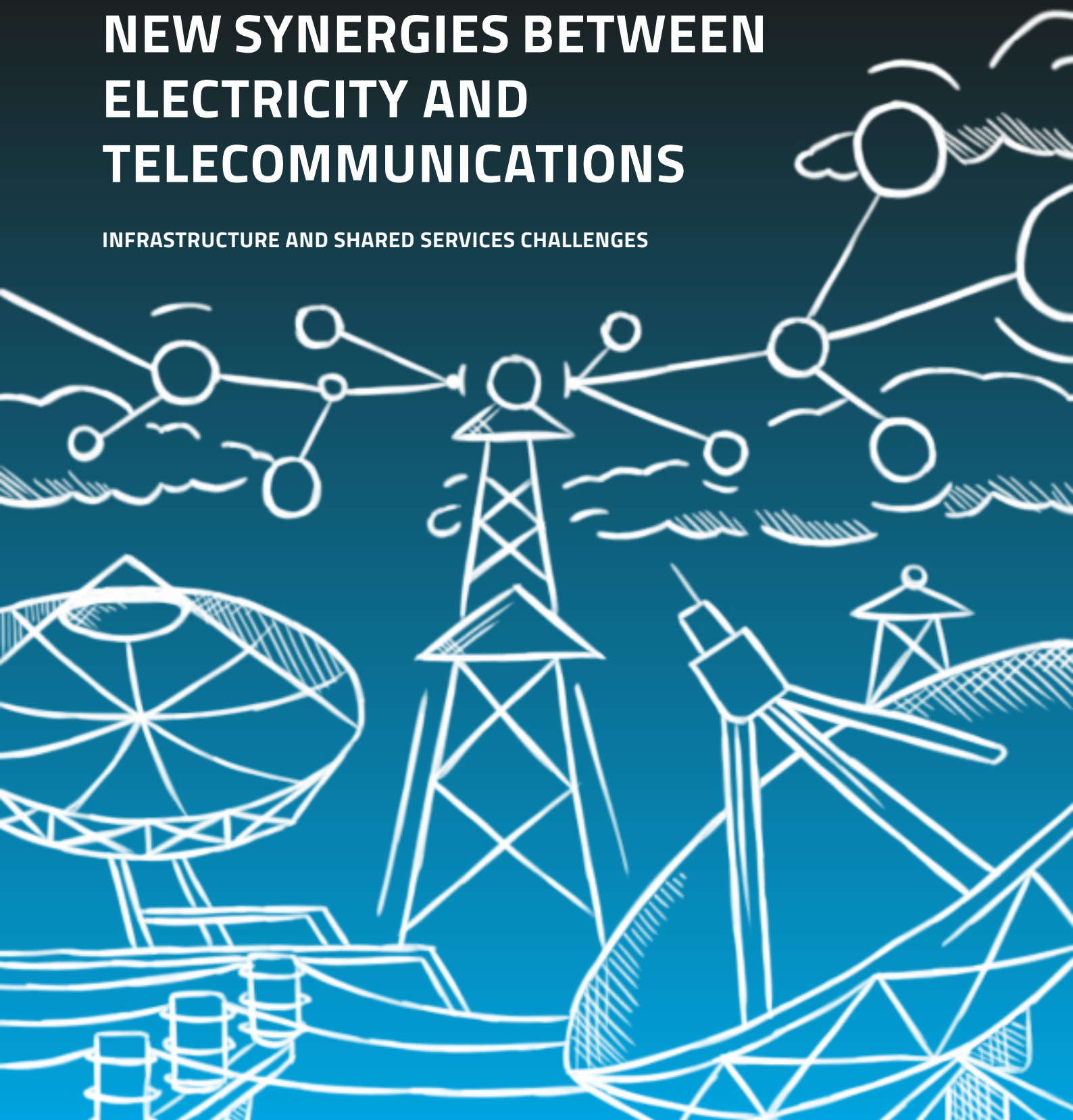
EXECUTIVE SUMMARY DSO BRIEF

NEW SYNERGIES BETWEEN ELECTRICITY AND TELECOMMUNICATIONS

INFRASTRUCTURE AND SHARED SERVICES CHALLENGES



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Latin America is experiencing the expansion and modernization of the electricity distribution infrastructures and telecommunications networks to incorporate new technologies and solutions, which will go hand in hand with important challenges of efficiency and environmental impact, as well as the need to optimize available resources. Therefore, it is crucial to explore strategies that allow the development and integration of these systems in an effective, sustainable and organized manner, as this will allow us to advance more strongly towards the objectives of the energy transition in the region, the path of sustainable economic development and the improvement of people's quality of life.

> Electricity distribution and telecommunications currently play a fundamental role in the functioning of our society and their convergence represents a key opportunity to transform operations, improve access to essential services and promote social and economic development in Latin America

INFRASTRUCTURE SHARING

The sharing of passive infrastructure (such as poles, pipelines and rights-of-way) between electricity distribution providers and telecommunications companies facilitates the rapid expansion and evolution of both networks and especially the improvement in the provision of both services, also reducing total costs, especially in regions where the construction of duplicate infrastructure would be unfeasible or economically inefficient. This model allows electric distribution and telecommunications companies to leverage existing assets to significantly reduce the initial costs of deploying new technologies.

From a technical point of view, sharing involves the development of compatible solutions that allow both sectors to use the same infrastructure without interference. For example, poles must be adapted to support both electrical and fibre optic cables, respecting safety standards and the spaces required to avoid technical problems or risks to workers. In addition, underground pipelines must be designed with additional capacity and accesses that facilitate the maintenance of networks in both sectors.

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In regulatory terms, infrastructure sharing agreements require clear and detailed frameworks that define the rights, responsibilities, and obligations of each party involved. This includes the equitable distribution of operating costs, such as maintaining poles, ducts, and other shared assets, as well as costs associated with repairing damage or necessary renovations. In addition, it is essential to establish technical criteria that guarantee the safety and functionality of the infrastructure, such as the maximum load allowed on poles and the appropriate materials for underground ducts. Finally, regulation should include dispute resolution mechanisms that allow parties to resolve disputes quickly and efficiently, avoiding project delays and ensuring a sustainable cooperation environment.

From an economic perspective, creating standardized rates for asset usage is crucial to avoid conflicts between operators. These rates should be based on transparent cost models that include not only routine maintenance, but also long-term infrastructure amortization.

In some Latin American countries, regulatory advances have been made to harmonize interests and simplify processes for telecommunications companies to access electricity distribution poles, with facilitation of access to rights of way and underground pipelines. Despite these advances, significant challenges remain. In many cases, the lack of technical standards and the absence of regulatory harmonization generate delays in projects and conflicts between actors. Overcoming these challenges requires not only investment in technology, but also greater cooperation between regulatory authorities and companies to establish common standards that maximize the benefits of shared infrastructure.

ENERGY AS A TELECOMMUNICATIONS ENABLER

Access to electricity is an essential prerequisite for the operation of telecommunications networks. The lack of energy in rural or peripheral areas not only limits the possibility of connecting their inhabitants with the rest of the world, but also slows down their economic, social and educational development. Stand-alone solutions make it possible to increase electrification and, at the same time, enable antennas and telecommunications systems, repeaters and other critical infrastructures necessary to guarantee connectivity, offering the opportunity to close gaps in broadband access and move more quickly towards next-generation protocols and networks such as 5G networks. This not only facilitates access to the internet and telephony, but also enhances essential services such as telemedicine, online education, banking and digital government, which are key to sustainable development and the reduction of inequality.

The region has made significant progress in this regard. In Brazil, programs such as "Light for All" have electrified isolated communities, allowing not only to improve living conditions, but also to deploy telecommunications networks that connect previously marginalized communities. In Peru and Colombia, innovative microgrid projects with renewable energies have managed to integrate telecommunications base stations in the Amazon region and other rural areas that are difficult to access, transforming these regions by allowing access to basic services and economic opportunities. In Costa Rica, the combination of clean energy and telecommunications technologies has been key to connecting schools, health centers, and entire communities in remote areas, consolidating a replicable model of integration that can serve as a reference for other countries.

However, a number of technical and economic challenges remain. Some of these solutions require energy storage systems, such as batteries, which still have high costs, especially in areas with low economic resources. On the other hand, electrical infrastructures in remote areas face difficulties in accessing maintenance. In addition, the lack of locally trained technical personnel increases dependence on external personnel, making the operation more expensive. Finally, installing distributed generation systems requires significant upfront investments that are not always available to small communities or local governments.

From a regulatory point of view, it is essential to design regulatory frameworks that promote investment in electrification projects to enable telecommunications, through public and private funds or tax incentives that facilitate the implementation of electrical infrastructure, technical training programs for local personnel for the maintenance and operation of these systems, and collaboration between governments, private sector and multilateral organizations to finance and develop electrification and connectivity projects.

ICTS FOR THE DIGITALISATION OF ELECTRICITY DISTRIBUTION

Information and telecommunications technologies (ICT) are essential for the digitalization and modernization of the electricity sector, allowing the implementation of smart grids that significantly improve the efficiency, sustainability and resilience of the electricity system. These networks, enabled by advanced communication systems, make it easier to collect, transmit and exchange information on consumption, generation and quality in real time, allowing for more accurate, automated and resilient operations in the face of contingencies.

One of the main benefits of smart grids is the ability to manage electricity demand efficiently. The installation of smart meters connected through fiber optic networks allows operators to collect real-time information on electricity consumption at different points in the network to proactively balance the load, avoid interruptions, better manage demand at critical times and offer detailed information to users, encouraging more efficient consumption habits. Likewise, the use of sensors and communication devices to collect energy consumption data in real time will promote energy efficiency and sustainability, allowing users to have better information to make decisions about their consumption and optimize energy use, always safeguarding the security and privacy of the data.

Real-time fault detection and location is another advance that can be driven by high-speed telecommunications systems, such as LTE (Long Term Evolution) networks, fiber optics, and satellite communications. The integration of predictive maintenance is also an advantage, as telecommunications allow the continuous transmission of data from IoT sensors installed in critical assets such as transformers, substations and distribution lines. This information, processed using artificial intelligence algorithms and big data techniques, makes it possible to identify patterns that predict failures before they occur.

Efficient integration of renewables is another key benefit. Telecom-enabled smart grids allow distributed generation to be synchronized with the main grid in real time. This facilitates a greater penetration of clean energies into the electricity system, guaranteeing the stability and reliability of the supply.

Finally, the development of 5G networks and the expansion of fiber optics represent the future of the modernization of the electrical distribution system. 5G networks offer ultra-low latency and unprecedented ability to connect millions of simultaneous devices. This enables new advanced automation applications, such as remote substation control, automatic overload detection, and instant analysis of large volumes of data. These capabilities not only optimize network management, but also increase resilience to extreme events, such as storms or natural disasters.

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CHALLENGES FOR INFRASTRUCTURE INTEGRATION

The **lack of harmonization between the regulatory frameworks** of the electricity distribution and telecommunications sectors creates uncertainty and slows down the implementation of joint projects. In addition, divergences between national, regional, and local regulations exacerbate the problem, making project planning and execution difficult. This regulatory fragmentation also generates bureaucratic delays, administrative cost overruns, and an unequal distribution of resources, which affects the viability of initiatives that could benefit both sectors and the communities that depend on these services.

To overcome these barriers, it is essential to develop integrative policies that establish unified, coherent and flexible regulatory frameworks that facilitate shared use agreements, reducing costs and execution times. These may include inter-agency coordination mechanisms, economic incentives to reduce integration costs, and the adoption of international best practices for infrastructure sharing. In addition to these strategies, additional measures can be implemented to foster transparency and reduce administrative costs associated with regulation. For example, the use of digital platforms can facilitate the issuance of permits, dispute resolution, and the management of joint projects. These tools can be integrated with real-time monitoring systems to ensure regulations are complied with efficiently.

Technology **compatibility and the lack of common standards** are also major barriers to infrastructure integration. For example, poles and ducts used for power grids do not always meet the weight, space, or insulation requirements needed to support telecommunications equipment. In addition, differences in communication protocols between IoT devices in both industries can limit interoperability and increase deployment costs.

To mitigate these challenges, it is essential to adopt international standards such as those defined by bodies such as the Institute of Electrical and Electronics Engineers (IEEE) and the International Telecommunication Union (ITU), but also to complement them with specific guidelines adapted to local needs. For example, in countries with high humidity or extreme temperatures, the materials of poles and ducts must be resistant to adverse weather conditions. Likewise, the implementation of innovative solutions such as multifunctional smart poles can optimize shared infrastructure. These posts integrate sensors for environmental monitoring, efficient lighting systems, charging points for electric vehicles and communication antennas. The lack of standardization in IoT protocols can be addressed through common data management platforms that allow devices from different manufacturers and sectors to be integrated.

Capacity building in technical teams is also crucial, as it ensures that professionals are prepared to manage the technical complexities of cross-sectoral projects. Finally, it is essential to strengthen the links between the electricity distribution and telecommunications sectors through the creation of technological consortia that promote the transfer of knowledge and the development of joint technologies.

Another challenge in integration is the **lack of an adequate remuneration scheme** for owners of infrastructure, such as poles and ducts, which does not fully recognize the opportu-

nity costs associated with shared use. This creates disincentives for homeowners to invest in infrastructure maintenance and modernization. For example, in countries where access fees are regulated without considering factors such as amortization, operational risk, and depreciation of assets, owners face difficulties in justifying new investments. This is especially critical in rural areas, where infrastructure wear and tear is greater due to adverse weather conditions and lower user density.

To address this problem, it is essential to develop regulatory frameworks that contemplate remuneration models based not only on direct costs, such as maintenance and operation, but also on the cost of capital invested and the risks associated with shared use. They should also include economic incentives, such as guaranteed rates of return. It is equally important to establish dispute resolution mechanisms that allow the actors involved to resolve disagreements over rates and terms of use efficiently.

The emergence **of new small operators of telecommunications**, while positive for fostering competition, presents significant risks when they do not fully comply with technical and safety regulations. To mitigate these risks, regulatory frameworks must require minimum operating standards, such as compliance with international regulations on electrical safety and telecommunications. Oversight mechanisms should be strengthened through the incorporation of regular inspections and the use of remote monitoring technologies that allow for early identification of non-compliance. It is also necessary to establish certification requirements for new operators, ensuring that they have the necessary technical and operational capacity to integrate into the existing ecosystem without generating disruptions. Specific training programs aimed at these actors can ensure adequate knowledge of regulations and best practices.

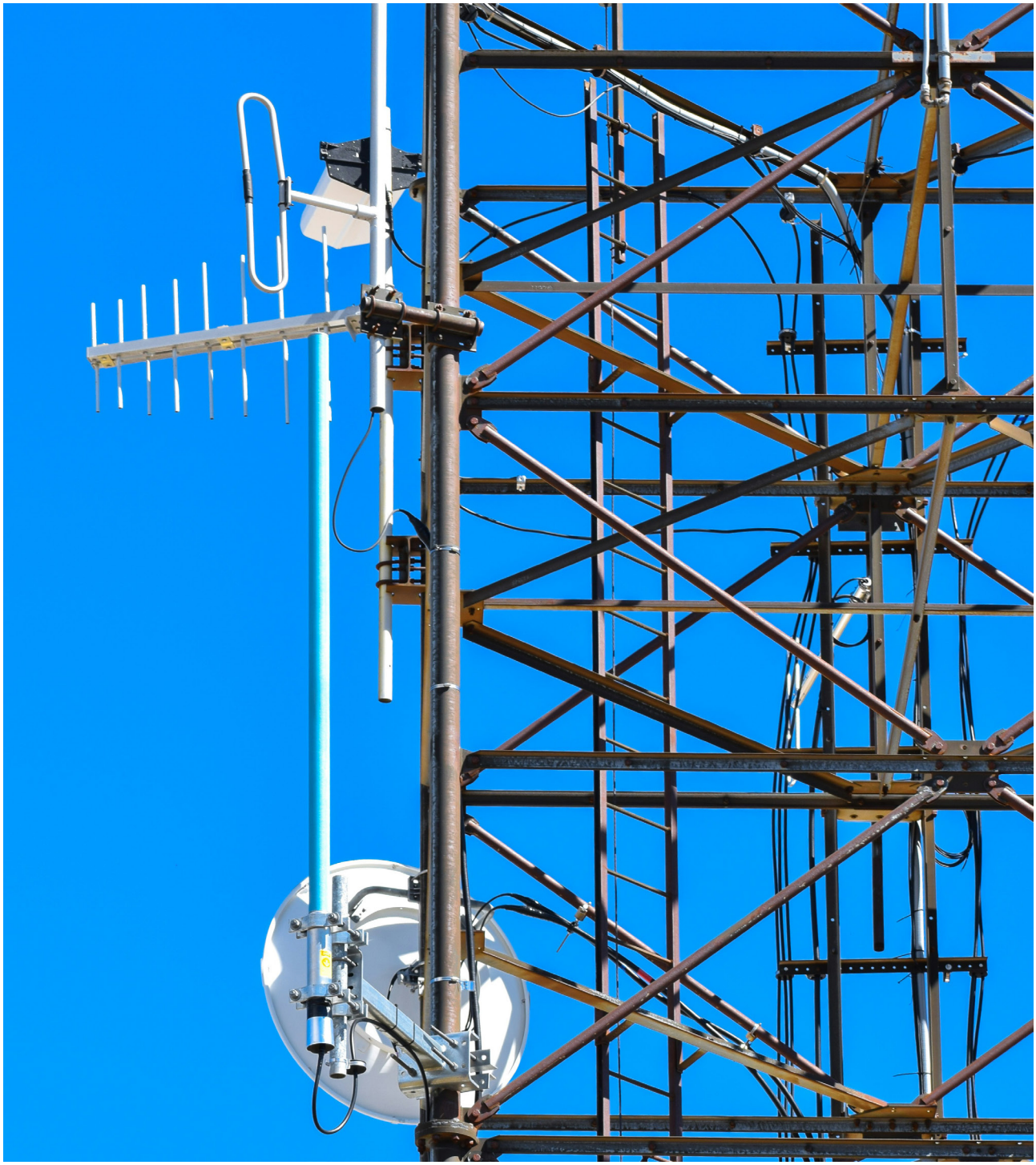
The integration of electricity and telecommunications networks exponentially increases the **risks associated with cybersecurity.** Interconnected systems can be vulnerable to attacks that compromise sensitive data, disrupt power supply, or affect consumer privacy. In addition, the growing reliance on IoT devices in both industries presents additional risks, as many of these lack robust protections against cyberattacks.

To mitigate these risks, it is imperative to develop security protocols that include multi-factor authentication mechanisms, advanced encryption, and continuous network monitoring. Companies must take a proactive approach, investing in AI and machine learning solutions that identify and neutralize threats before they materialize. In addition, incident response plans must be implemented to allow for quick action in the event of a security breach.

Fostering active collaboration between the two sectors is essential to address these threats. In addition, governments can work on regulatory frameworks that include regular audits, cybersecurity certifications, and the adoption of international best practices for converged infrastructures. Strengthening cybersecurity also requires education and awareness at all levels of the organizations involved. This includes everything from advanced technical training to awareness campaigns for employees and local communities on the importance of security in digital environments.

The integration of electricity distribution and telecommunications infrastructure poses significant risks related to the **urban and landscape impact** of facilities and new projects. Aerial infrastructures, such as poles and cables, generate visual pollution and saturate urban space, especially in densely populated areas or areas of high historical and landscape value.

The lack of clear regulations on the disposal, maintenance and removal of disused assets increases these problems, affecting the quality of the urban environment. Burying networks emerges as a potential solution, but it also involves financial risks due to its high cost. A lack of coordination between local authorities and infrastructure owners can lead to fragmented projects, with excessive costs and limited benefits. In addition, the absence of agreements on the management of assets retired before their depreciation can lead to losses and discourage future investments in integration.



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REGULATION OF SHARED INFRASTRUCTURES IN LATIN AMERICA

The Latin American regulatory frameworks on the sharing of electricity distribution and telecommunications infrastructures are generally characterized by the lack of adequate regulations and procedures for access, monitoring, control and remuneration of infrastructure sharing, in addition to the non-existent supervision and lack of fines.

In Brazil, regulators defined a single reference price for all companies in 2014, which remains unupdated to this day and has been the subject of lawsuits. In addition, there is a need to improve the mechanisms for controlling the shared use of infrastructure. In Argentina, there is no regulatory framework for shared infrastructure; The few existing standards are now more than 30 years old, and infrastructure sharing has been based solely on the leasing of overhead power line poles for cable laying. However, an initiative was recently launched that considers electricity distributors as eventual Independent Passive Infrastructure Operators (OIIP), which must register with the communications regulator (Enacom).

In Peru, the formula for calculating the infrastructure sharing remuneration issued in 2022 does not cover the real costs of electricity distribution companies, and the telecommunications regulator can issue “sharing mandates” to force the application of the formula. In Colombia, the revision of regulations in recent years has generated under-remuneration because it does not recognize the efficient and opportunity costs of distributors. In addition, there are still countless cases of inefficient, inappropriate and disorderly use of electricity networks by the telecommunications sector.

Finally, in the Chilean context, under the efficient company model, distributors operate in a scheme that prioritizes minimum cost, limiting flexibility to incorporate new investments or adapt infrastructures to the demands of other sectors, which makes shared access to poles and networks difficult. However, initiatives such as alliances for the deployment of multifunctional poles or the use of digital platforms to manage sharing agreements are paving the way for a more integrated model.

> “The Latin American regulatory frameworks on the sharing of electricity distribution and telecommunications infrastructures are generally characterized by the lack of adequate regulations and procedures for access

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GOOD REGULATORY PRACTICES

To advance in the integration of the networks of both sectors, it is essential that regulators in the electricity and telecommunications sectors collaborate and establish regulatory frameworks that promote this integration in an orderly and efficient manner. In this sense, an ideal regulatory framework to establish the conditions of access, use and remuneration for the use of the infrastructure of the electric power sector must at least consider:

The conditions of access to eligible infrastructure for the deployment of telecommunications networks and services.

The applicable general principles and obligations, such as the principle of efficient use of infrastructure and scarce resources.

Free and fair competition, in addition to non-discriminatory treatment.

An efficient cost-oriented remuneration, which recognizes the opportunity cost and the characteristics of each concession area.

The principles of publicity and transparency.

The emergence of new actors, responsible for the management of telecommunication poles and cables (“single operator”).

The proper use of the infrastructure and the non-degradation of the service of the owner of the infrastructure eligible to be shared.

Adequate regulation should promote that distribution companies have the incentives to share their infrastructure and, in turn, share with the electricity consumer the economic efficiencies represented by the additional income from the rental of assets, translated into possible reliefs in the distribution component of the electricity tariff. The remuneration, in addition to being efficient and recognizing the opportunity cost, must consider that the replacement values of the electrical assets for both the conduits and poles reflect the costs of the assets that are currently being used. Likewise, it must consider the useful life, the cost of operation and maintenance, the discount rate of the electricity sector and other costs incurred by the distributors, such as: analysis of the technical feasibility of the requested infrastructure, expenses of inspection of deficiencies of the telecommunications networks,

incremental expenses for additional time when changing poles, adaptation of infrastructure to be shared, administrative expenses for the management of sharing contracts, management of the unauthorized supports installed, among others.

Regarding technical aspects, the regulations must encourage telecommunications operators to comply with the technical and safety standards observed by the distributor, in such a way as to guarantee an orderly installation of the networks with minimum safety distances. The marking on posts and pipes that are shared, the removal of unmarked or unused elements when the provider of telecommunications networks or services is identified or not, as well as the operation and security protocols on the assets of the other party, must also be regulated. Finally, there must be a scheme of sanctions and fines for those telecommunications companies that carry out network installation without authorization and/or without signing a contract with the electricity network operator or that, having signed a contract, occupy poles not included in the contract.

In this regard, it is important that regulation addresses the following challenges:

Encourage installations exclusively through authorized ducts or poles.

Prevent the multiplication of unused networks and prevent overbooking.

Promote the correct identification of wiring (in use and disuse).

Expedite the standardization of deficiencies and the transfer of networks.

Establish a framework procedure that simplifies and accelerates the authorization of infrastructure sharing between agents.

For their part, distributors must carry out inspections of pre-approved projects, maintain a limit on the occupancy of points in each infrastructure and encourage unification by economic groups. In addition, it is important that they have the necessary information to develop geographic information systems, which allow the identification of shared infrastructure, which would allow better planning of growth and identification of future projects, as well as the supervision and control of the infrastructure.

Finally, it is necessary for telecommunications companies to strengthen the training of the personnel of the contractor companies that access the infrastructure for installation purposes, demanding the appropriate industrial safety tools for the great risks to which they are exposed in their operation, such as electrical and height risk in order to protect both the operational personnel themselves and the citizens who travel near the infrastructure.

The integration of distribution and telecommunications infrastructure represents an excellent opportunity to address and mitigate the impact on urban and landscape furniture, for which coordination between local governments, national authorities and the sectors involved is essential. This collaboration must be aligned with urban development plans and the specific regulations of each sector, so that the development of large infrastructure works in cities is used as an opportunity to bury the networks, since otherwise it will result in costs between 5 and 7 times higher than those of aerial networks.

In addition, regulatory frameworks should establish clear procedures for the dismantling and disposal of retired assets prior to depreciation, ensuring adequate compensation for owners; and to promote the use of multifunctional poles that combine public lighting, telecommunications and charging points for electric vehicles, minimizing the proliferation of structures.

In summary, it is essential to advance in the development of a comprehensive business model for infrastructure sharing, promoting sustainable agreements with the telecommunications sector on issues such as the optimization of the use of poles and ducts, standard agreements to maximize available capacity, allow co-investment in critical infrastructure, and establish rates based on real costs and transparency, ensuring an equitable benefit for the parties involved.

The integration of the electricity distribution and telecommunications sectors represents a unique opportunity to transform Latin America's infrastructure, generating economic, social and environmental benefits. Electricity distribution companies, telecommunications companies and regulatory authorities have a crucial role to play in leading this process, ensuring that policies, investments and actions are oriented towards inclusive and sustainable development, and incorporate a long-term vision that seeks efficiency, resilience and the well-being of the society.

> The analysis carried out throughout this document highlights the importance of integration between the electricity distribution and telecommunications sectors as a key driver for sustainable development and infrastructure modernization in Latin America


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