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LEARNING FROM POWER SECTOR REFORM EXPERIENCES

THE CASE OF PERU

This report has been authored by Hugh Rudnick and Constantin Velásquez. The authors are very grateful for financial support from the Energy Sector Management Assistance Program (ESMAP) and the Public Private Infrastructure Advisory Facility (PPIAF). Special thanks to Eduardo Zolezzi, who provided most of the source information, data and analysis used to develop this paper. Thanks are also due to Janina Franco who acted as peer reviewer. Any shortcomings are the sole responsibility of the authors.

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Learning from Power Sector Reform: The Case of Peru[1]

Hugh Rudnick and Constantin Velásquez[2]

Abstract

By the late 1980s, Peru was in a desperate macroeconomic situation and its power sector was in crisis due to distorted tariffs, poor performing utilities and frequent supply restrictions. The incoming government enacted a new constitution in 1991 and, within a wider reform package, profound restructuring of the power sector began 1992 with enactment of the Electricity Concessions Law. Restructuring, introduction of competition and privatization proceeded quickly until it stopped definitively in the 2000's when the political landscape changed, and privatization lost public support. After initial efficiency gains and capacity additions, progress slowed and capital inflows to generation and transmission segments stopped due to inadequate regulation. A second wave of reforms since 2006 introduced further competitive forces, successfully incentivizing new investments in generation and distribution. More recently, auctions for renewable energies and incentive regulation for distribution have been introduced. Furthermore, the government has successfully implemented out-of-market adaptations to pursue public policy objectives such as energy mix diversification. The reform package of Peru's power sector delivered sizable efficiency and productivity gains, accruing to high quality regulation, industry restructuring, competition and private management. However, challenges still remain in improving performance of state-owned distribution companies, expanding coverage and increasing quality of service in rural areas, and managing the risks of government-led out-of-market policies without a sound planning framework.

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Foreword

Rethinking Power Sector Reform, a multi-year global initiative of the World Bank's Energy and Extractives Global Practice, provides an updated assessment of experiences with power sector reform across the developing world. Its goal is to refresh our thinking on power sector reform by analyzing lessons learned over the past 25 years in countries that have undertaken various types of reforms, and by articulating a new vision based on that analysis. Critically, the initiative examines how the recent technological trends and business models that are disrupting the sector may call for new reform strategies.

Since the 1990s, a standard set of policy prescriptions for power sector reform has been widely used. Those prescriptions include vertical and horizontal unbundling of power utilities; private sector participation; creation of an independent regulator; and competition in power generation (with associated cost-recovery pricing). Although this package of reforms was adopted, at least partially, by several developing countries, momentum and uptake slowed considerably in the 2000s, and it is past time to revise our approaches in the light of experience, evidence, and technological advances.

It is our hope and intention that the revision will provide practitioners with a flexible frame of reference that can help them identify the types of reforms most likely to improve the performance of the power sector in a given country context.

With support from the World Bank's Energy Sector Management Assistance Program (ESMAP) and the Public–Private Infrastructure Advisory Facility (PPIAF), Rethinking Power Sector Reform works with partners and experts across the World Bank Group and beyond to generate evidence, analysis, and insights on key themes of interest to power sector reform practitioners and decision makers. Findings and recommendations will be published in a forthcoming report.

The research undertaken by the initiative is grounded in an in-depth exploration of the 25-year reform journey of 15 World Bank Group client countries that represent a wide variety of geographies, income levels, and approaches to reform. The countries are Colombia, Dominican Republic, Arab Republic of Egypt, India, Kenya, Morocco, Pakistan, Peru, Philippines, Senegal, Tajikistan, Tanzania, Uganda, Ukraine, and Vietnam.

An important output of the project is a series of case studies—of which this is one—that provide a narrative of the reform dynamics in each country and evaluate the impact of reforms on key dimensions of sector performance, including security of supply, operational efficiency, cost recovery and energy access. With respect to a subset of countries that pursued deeper reforms—Colombia, India, Peru and the Philippines—the project also includes a series of free-standing case studies that evaluate experience with wholesale power markets. The purpose of all the case studies is to reflect upon the experiences of individual countries, with a view to extracting lessons of broader interest to the global community. It is not the role of these papers to recommend, let alone prescribe, any particular approach in any particular country or context.

These case studies, which constitute companions to an eventual flagship report, are being published in the World Bank's Policy Research Working Paper series. As such, they represent the views of the authors alone and should not be attributed to the World Bank Group or to any other person or institution.

Contents

Abbreviations and Acronyms

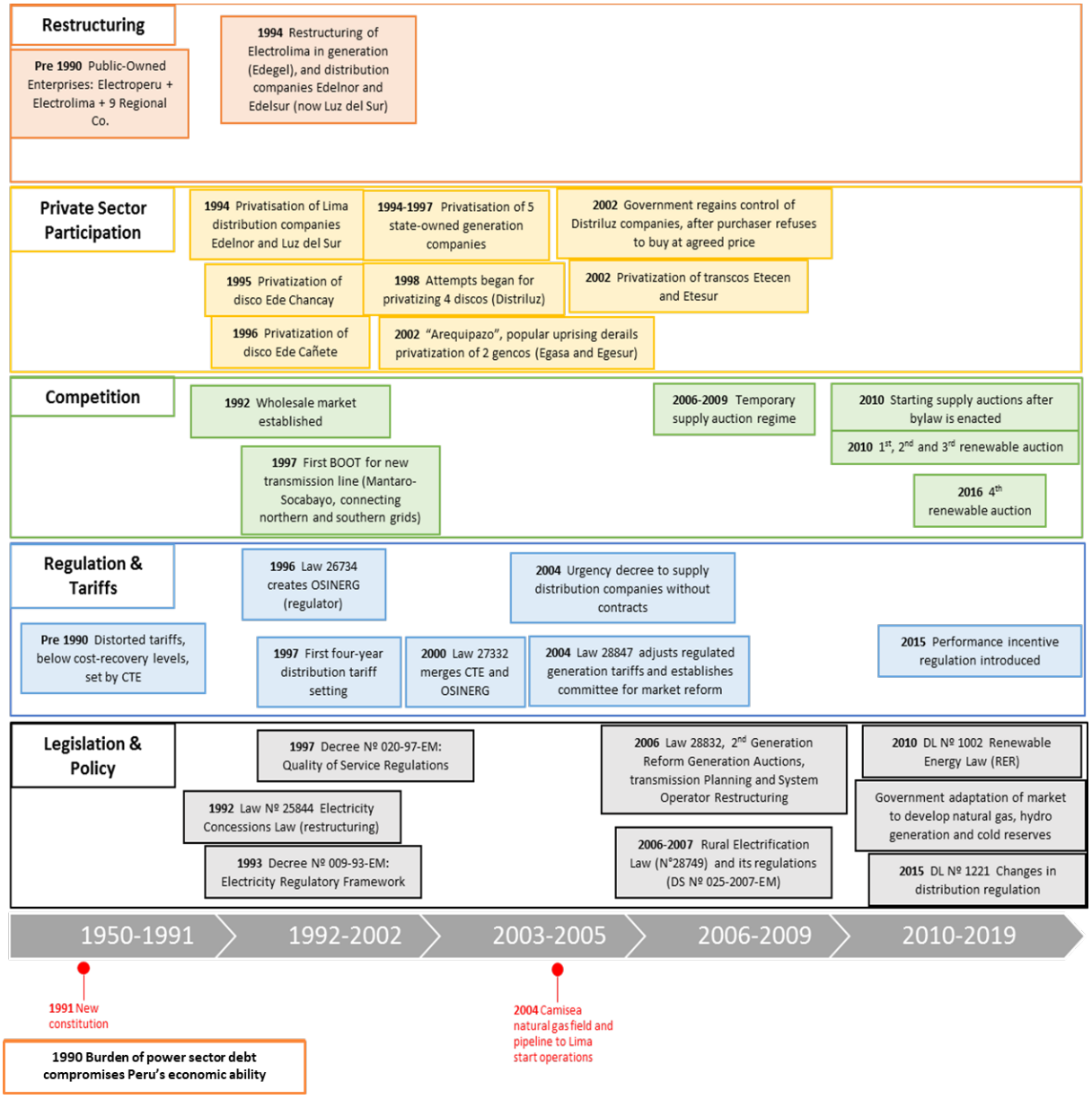
BOOT	Build-Own-Operate-Transfer
COES	Committee for Economic Operation of the System (system operator)
ECL	Electricity Concessions Law
OSINERGMIN	Organismo Supervisor de la Inversión en Energía y Minería (Energy and Mining Investment Overseeing Organism)
MINEM	Ministry of Energy and Mines
FONAFE	National Fund for Financing the State's Entrepreneurial Activity
INDECOPI	National Institute for the Defense of Competition and Protection of Intellectual Property
DGEE	General Directorate of Energy Efficiency
ProInversión	Agency for the Promotion of Private Investment
QfD	Quasi-fiscal Deficit
SAIDI	System Average Interruption Duration Index
SAIFI	System Average Interruption Frequency Index
SOE	State-Owned Enterprise

1 Introduction

Peru's power sector was heavily distressed by the late 1980's. Amidst a desperate economic situation, the power sector was also in crisis due to supply restrictions, poor performance of public utilities and political setting of tariffs. To tackle these challenges, the incoming government launched in 1992 a comprehensive reform package with enactment of the Electricity Concessions Law (ECL). ECL established the framework for vertical unbundling and private sector participation, a new regulatory framework and rate-system governed by principles such as efficiency and financial sufficiency, and introduction of wholesale competition, among other measures. Privatization efforts came to an absolute halt in the early 2000's having lost public support, whilst investment in generation and transmission was lacking. After 2006, a new period began for the Peruvian power sector, following the introduction of a new competitive mechanisms for incentivizing generation and transmission investments. Newer regulations include the promotion of renewable energy, out-of-market adaptations to pursue public policy objectives, and incentive regulation in distribution tariffs (see Figure 1-1).

This case study analyses Peru's experience with power sector reforms and is structured as follows. Section 2 reviews the literature on Peruvian power sector reforms. Section 2 provides a chronological account of reforms. Section 4 assesses performance of the Peruvian power sector, and analyzes institutional factors for such performance outcomes, under the following four areas: (1) investment and security of supply; (2) access and affordability; (3) utility efficiency and financial sustainability; and (4) tariffs and cost-recovery. Section 5 concludes this case study by summarizing performance outcomes of reforms and drawing lessons that may be relevant for other developing countries.

Figure 1-1: Peru power sector reform timeline.



Source: own.

2 Literature Review

Literature on the impact of Peru's power sector reforms generally points to efficiency and productivity gains. Perez-Reyes and Tovar (2009) found that improvements in the efficiency and productivity of electricity distribution in Peru have occurred and were largest the first years following restructuring. Incentives introduced by reforms and management of private utilities led firms to become more efficient, showing the need to introduce incentive mechanisms to state-owned utilities to allow them to act as private agents (Bonifaz & Jaramillo, 2010; Pérez-Reyes & Tovar, 2010). A WorldBank report (2012) also argues that superior performance of private utilities can be greatly attributed to the corporate dynamic inherent to private firms, not constrained by government controls imposed on SOEs. It is worth noting that rather contradicting evidence is presented by Bonifaz & Santin (2000), who found privatized firms did not outperform state-owned distribution companies.

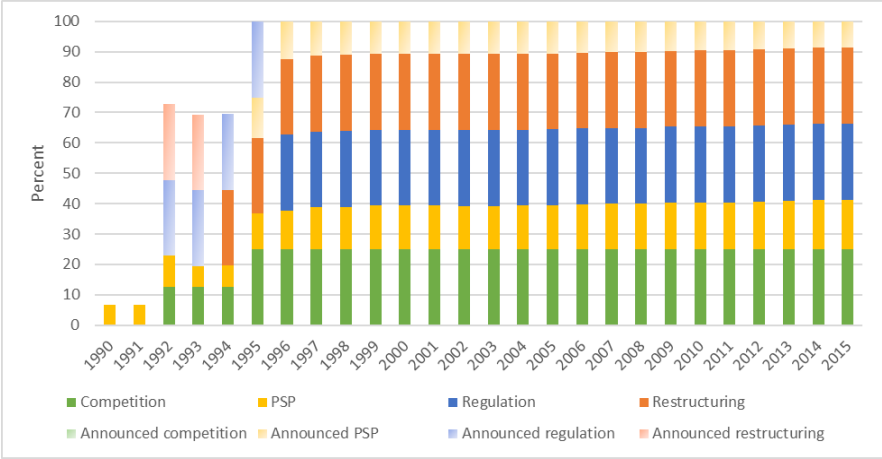
Literature on the welfare impacts of reforms points to significant benefits, albeit with limited benefits to final customers, and diversity among regions. Anaya (2010) found through a cost-benefit analysis that privatization was worthwhile as gains amounted to US$ 542 million in 2007 prices, although government and producers seem to have benefitted the most, and consumers benefitted the least due to price increases. Torero & Pascó-Font (2001) applied three different methodologies to 1991, 1994 and 1997 urban households LSMS surveys. They found no clear evidence that electricity reforms benefitted customers, possibly due to incomplete reforms and overdue price increases (given tariffs below cost-recovery levels in the pre-reform period). Using panel data from 1980 to 2009, Urrunaga & Aparicio (2012) find that electricity and telecommunications have significant differences in the repercussions on the per capita output of each region, which can be explained by differences in the quality of regional infrastructure. The authors suggest the need to continue to develop and improving electricity infrastructure, along with complementary policies to reduce regional gaps in the long term (focused on human capital, for example).

Based on rural household surveys from 2005, Alcazar, Nakasone, & Torero (2007) found that quality of service improves for customers served by private distribution companies compared to those served by publicly-owned distributors. Better quality of service also has a significant and positive effect on labor mobility to non-farm activities. However, the study does not analyze the evolution of quality of service and labor mobility in households served by different distribution companies. Lacking a comparison of pre and post privatization performance, results should be interpreted carefully, since it is not clear the degree to which privatization contributed to performance, with respect to initial conditions of the privatized utilities.

3 Evolution of Peru's Power Sector Reforms

In the late 1980's, the Peruvian electricity sector was vertically integrated in twelve state-owned companies. Adverse macroeconomic conditions, poor sector performance and political intervention in price regulation were among key drivers for reform of the power sector. The Electricity Concessions Law of 1992 laid the foundations of Peru's power sector reform. By 1996 Peru had implemented comprehensive reforms, comprising restructuring, competition and regulation measures, as well as partial privatization that fell short of announced reforms (see Figure 2-1).

Figure 2-1: Announced and actual power sector reforms in Peru.



Source: Rethinking Power Sector Reform Project, see further details in Annex A.

A chronological account of reforms is provided below. The reform and incomplete privatization process between 1990-2002 is discussed first (section 2.1). The following period (2003-2005) was characterized by the lack of investment in generation and transmission due to ineffective price regulation (section 2.2). A second wave of reforms was implemented from 2006, based on long-term competitive tenders for generation and transmission (section 2.3). Finally, out-of-market adaptations have been implemented to pursue public policy objectives, such as fuel diversification (section 2.4).

3.1 1990-2002: Power sector reforms and incomplete privatization

With severe recession, trade deficit, fiscal deficit, and lack of foreign exchange reserves, Peru was in a desperate economic situation in the late 1980s. The power sector was also in crisis; with frequent electricity supply restrictions, low quality of service and inefficient public utilities in serious financial difficulties.

With a new government administration coming into office in 1990, Peru embarked on a drastic economic stabilization and structural reform process, including a vast privatization program of state-owned enterprises. The Fujimori administration agreed this program with the international financial community, to overcome the debt crisis left by previous administration of President Garcia.

Fujimori (of Cambio 90) was elected president in a second round of the 1990 Peruvian elections, in a run-off with Mario Vargas Llosa (leading a coalition of economically liberal parties, collectively known as

the Democratic Front). Although Fujimori was elected with 62.4% of the popular vote, its Cambio 90 party had a clear minority in Congress[3]s.

Fujimori and the opposition in congress started an early confrontation which lead to a "self-coup" in April 1992. With military backing, Fujimori dissolved Congress, suspended civil liberties and established government by decree. Later, Fujimori called for elections of a new congress that was later named the Democratic Constitutional Congress (*Congreso Constituyente Democrático*). In November 1992, Fujimori received a majority of 44 seats (of 80) in this new congress, which later drafted the 1993 Constitution. The new constitution came into force on 29 December 1993, after being approved by 52% of voters. In April 1995, Fujimori was (re)elected president under the new 1993 Peruvian constitution.

It was under Fujimori's regime that the initial electricity sector reform of 1992-1993 was enacted and the sector privatization process took place. For the power sector, the government enacted in 1992 the Electricity Concessions Law (ECL) and subsequently approved the detail regulations (RECL), which established:

- unbundling of generation, transmission and distribution segments (further details in),
- creation of a competitive wholesale power market and system operator,
- methodology for tariff settings,
- granting of concessions,
- customer service guidelines,
- creation of a sector regulatory entity, and
- an umbrella legal and regulatory framework for the sector.

The ECL recognized two categories of electricity public service users: "large customers" with a demand greater than 1 MW, and "small" regulated customers. Large customers (also known as "free" or unregulated users) contract their electricity supply directly with generators or distributors through bilateral, freely negotiated contracts, in a competitive electricity market. In turn, distribution companies have the obligation to supply electricity to small users within their concession areas at a regulated price.

Institutional organization after reforms is summarized in Box 1. The Ministry of Energy and Mines (MINEM) is the main policy institution in the sector, and together with the Ministry of Economy and Finance (MEF) are members of the Board of Directors of FONAFE, the institution in charge of the management of the sector state-owned electricity companies. The sectoral regulator and oversight institution is OSINERGMIN, while the system and market operator is COES.

[3] Elected in the first round of the elections, Fujimori´s Cambio 90 party obtained only 32 (of 180) seats in the deputies chamber (16.5%) and 14 (of 62) seats in the senators chamber (21.7%); a clear minority against the opposition of the Democratic Front (of Vargas Llosa), with 62 seats in deputies and 19 seats in senators; and the APRA (of former President Garcia), with 53 and 16 seats in deputies and senators chambers, respectively.

Box 1. Peru's power sector institutions after reforms

Ministry of Energy and Mines (MINEM). Responsible of power sector policy-making.

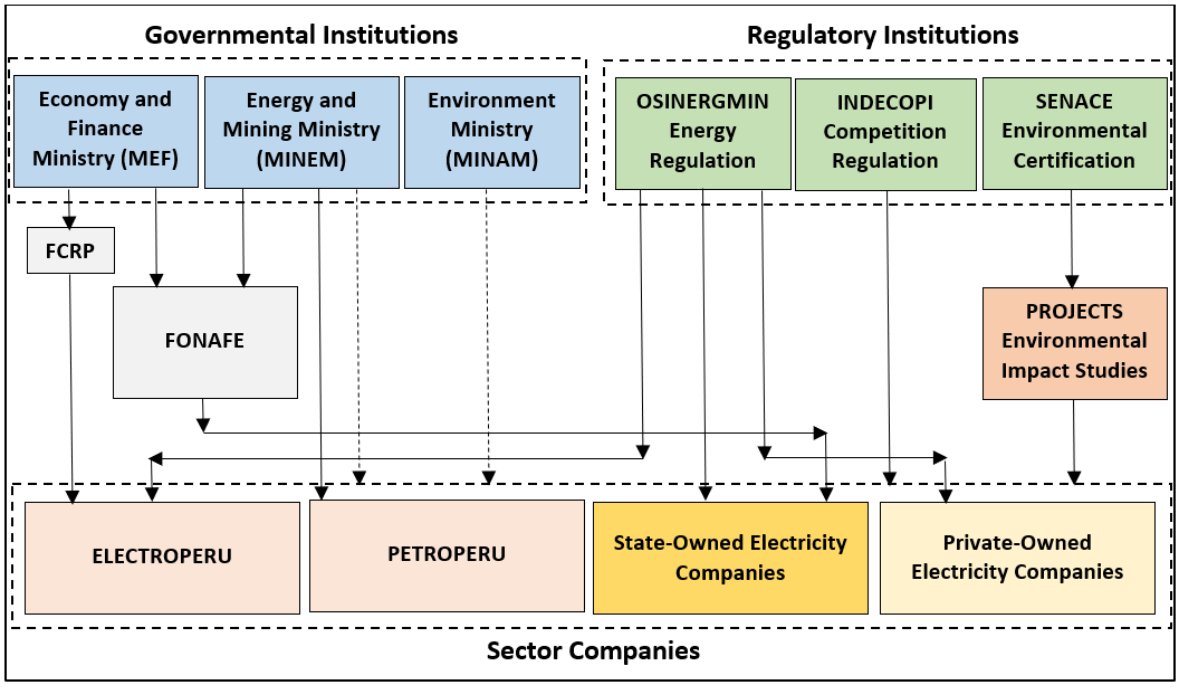
Supervisory Body for Investment in Energy and Mining (OSINERGMIN). Independent regulator of the energy sector, in charge of electricity and natural gas price/tariff setting and the supervision and monitoring of the legal and technical standards in the electricity market and in the transportation and distribution of natural gas.

National Institute for the Defense of Competition and Protection of Intellectual Property (INDECOPI). Anti-trust institution, with functions related to market / competition promotion and protection of consumer rights. Created in November 1992 by Law Nº 25868. Since 1997 it is also in charge of analysis and approval of large mergers and acquisitions.

National Fund for Financing the State's Entrepreneurial Activity (FONAFE). Institution in charge of the management of the sector state-owned electricity companies.

Agency for the Promotion of Private Investment (ProInversión). Organism attached to the Ministry of Economy and Finance, responsible for promoting private participation in utility services, infrastructure, and State Owner Enterprises, among others.

Committee for Economic Operation of the System (COES). The Peruvian system and market operator, COES, is a private, not-for-profit entity with public law status. Among functions established by 1992 ECL and Law Nº 28832 of 2006, COES is responsible for coordinating power system operations, planning expansions of the bulk transmission system, and calculating prices and settlements of the pool electricity market. Further details in Annex B.



Prior to the reforms of the electricity sector in 1992, twelve state-owned companies were responsible for providing electricity service in Peru. Between 1994 and 1997, the government privatized ten state-owned enterprises, five in electricity distribution and five in electricity generation.

Privatization started in 1994 with distribution companies that served the Peruvian capital city. Before reforms, Electrolima was a vertically integrated, state-owned power utility serving metropolitan Lima. Its distribution network served metropolitan Lima, which in 1992 had a population of 7.5 million. Electrolima was restructured into three separate companies: one generation company, Edegel, and two distribution companies, Edelnor and Edelsur (later renamed Luz del Sur). The sale of the Lima distribution companies was successfully completed in August 1994.[4]

Privatization then continued with Ede Chancay and Ede Cañete in 1995 and 1996, respectively, which served the provinces of Lima and which were acquired by the same economic groups controlling Edelnor (Ede Chancay) and Luz del Sur (Ede Cañete). Between 1994 and 1997, the government also privatized five state-owned electricity generation companies.[5]

The 1994–97 privatization in the power sector resulted in the transfer of about 70% of generation capacity, 100% of transmission capacity, and 45% of the distribution market, from public to private ownership, including their management and operation. In distribution, according to regulations, the initial tariffs set for privatization were recalculated for the first time in 1997; followed by 4-year re-settings.

In 1998, attempts began for privatizing four additional distribution companies: Electro Norte, Electro Norte Medio, Electrocentro and Electro Noroeste. Although only 30% of the assets/shares were initially transferred, the privatization process contemplated the final transfer of the total assets, in two additional phases. In a second phase, after three years of the initial operation, the acquiring company was required to buy another 30% of the assets, at the same price offered in the initial bidding. After nearly three years of operation, the four distribution companies returned to government hands because the buyer did not purchase the additional 30% of shares. The process arguably failed due to the bid being excessively high compared to the regulated tariff recognized for these companies, and also due to the relatively lower profitability of these distribution companies when compared to the Lima distribution companies privatized in 1994-1997 (see Box 2).

When Alberto Fujimori's regime abruptly ended in 2000, Peru started to change its political system. An interim government organized a new presidential and parliamentary elections. As a result, Alejandro Toledo was elected president in a run-off election in July 2001, lacking a solid majority in Parliament and faced with high popular expectations[6]. Toledo's arrival in power put an end to 10 years of Alberto Fujimori's government. Yet a mere two years after Toledo assumed the presidency, his popularity reached just over 10%, the lowest in Peruvian presidential history.

[4] A consortium led by Chilectra of Chile and Endesa of Spain acquired 60% of Edelnor for US$177 million. A consortium led by Ontario Hydro of Canada and Chilquinta of Chile acquired 60% of the shares of Edelsur for US$212 million. The strategic share transactions were followed by a global and local issue of the remaining 30% of Edelnor's and Edelsur's shares (renamed at the time as Luz del Sur) in 1996.

[5] Most generation state-owned companies were privatized except for: (i) Electroperu, owner of Mantaro, the largest hydroelectric power plant of the country, at the time; and (ii) two other smaller generating companies (EGASA and EGEMSA) located in the southern provinces.

[6] Toledo's Peru Posible party won 45 seats of the 120 unicameral legislature.

Toledo's popularity started to decline sharply at the middle of 2002 after the "Arequipazo", the privatization fiasco of two state-owned electricity generating companies in southern Peru (see Box 3). Strong regional and public opposition forced the government to cancel the privatization of two publicly owned generating companies (Egasa and Egesur) serving southern provinces. By the early 2000s the public sector kept half of the generating capacity and its distribution utilities served about half of nation-wide residential clients.

By the early 2000s, the distribution privatization process slowed down considerably, partly due to the Asian financial crisis. Furthermore, the wider privatization policy had lost political support, with public approval falling from 60% in 1992 to only 22% in 1999. Despite performance gains from privatization and reforms of the power sector, the marked decline in public approval of privatization (for electricity and other sectors as well) can be attributed to the following factors (World Bank, 2012):

(a) an overall perception of increased inequalities associated with the recovery of the economy, which included a drastic reduction of subsidies in all sectors;

(b) an appeal to nationalistic feelings as great part of the assets were bought by foreign companies; this was aggravated by the (still surviving) concept that energy was a strategic sector of national interest and, hence, had to remain in local hands; and

(c) a common political feature: the weakening of a government that remained in power too long[7].

The transmission system also experienced significant transformation in this period. Before the SEIN (National Electric Interconnected System) was formed in Peru, there were two interconnected systems:

(i) the Northern Central Interconnected System (SICN), which represented 82% of the national energy consumption; and

(ii) the Southern Interconnected System (SISUR), with 18% of national consumption (in 1996 the eastern and western areas of southern Peru joined to form the SISUR).

Two state-owned companies were in charge of transmission in SICN and SISUR: the Transmission Company of the Center (ETECEN) and the Southern Transmission Company (ETESUR), respectively.

At that time the major challenge in transmission was the interconnection of the SICN and SISUR systems, in order to establish a national interconnected electrical system (SEIN). The Government, through ETECEN, could not afford an investment of this magnitude and decided to promote the participation of the private sector. Thus, in January 1998, the government called for an international public bidding for the design, construction and operation of the Mantaro-Socabaya transmission line, which would link SICN with SISUR, under a BOOT ("build, own, operate and transfer") concession scheme. The concession was awarded to the Consortium Transmantaro S.A. (whose strategic operator was Hydro Québec of Canada) for US$ 179.2 million. The Mantaro-Socabaya transmission line began its commercial operation in October 2000.

A year later, with the successful experience of the Mantaro-Socabaya transmission line concession, the government convened a second international public bidding for the reinforcement of the southern transmission systems, also under a BOOT scheme. The project was awarded to the consortium Redesur

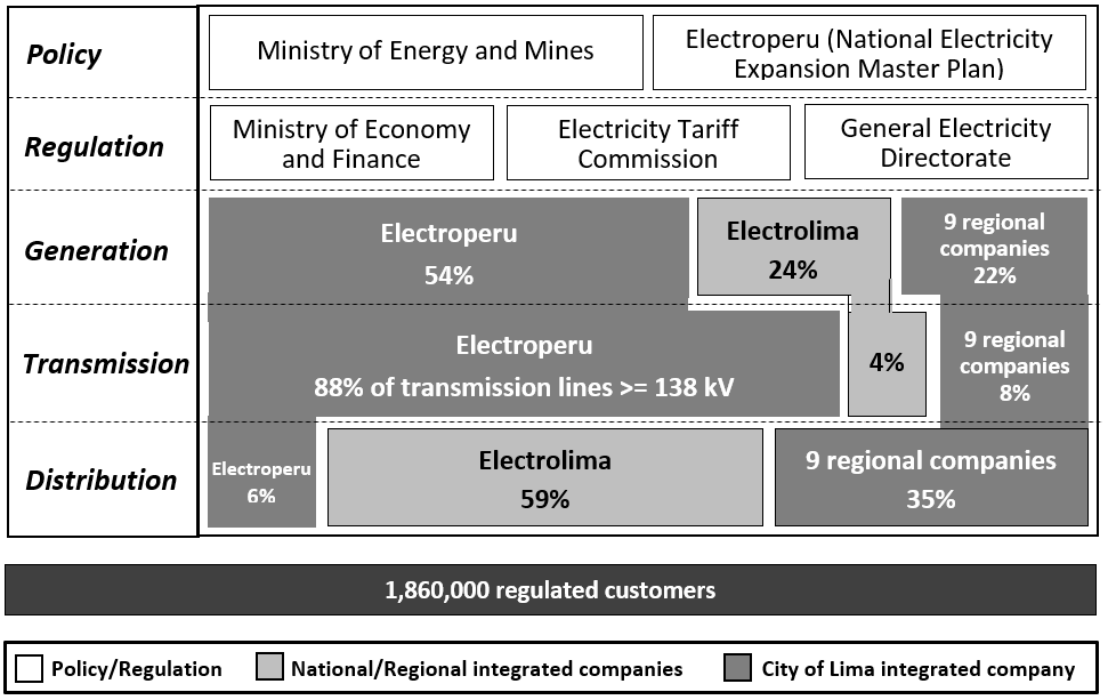
[7] Fujimori's regime lasted eleven years (1990-2001). This political continuity offered the opportunity to consolidate policies that required a sustained (longer) support, but also came with an increased questioning of the government's legitimacy and declining approval.

(subsidiary of Red Eléctrica de España S.A.) for US$ 74.5 million. The transmission reinforcement was completed in February 2001.

Finally, in September 2002, ETECEN and ETESUR were privatized through a 30-year concession to Red Eléctrica del Perú (REP), whose main shareholder is Interconexión Electrica S.A. (ISA, of Colombia), for US $ 261 million.

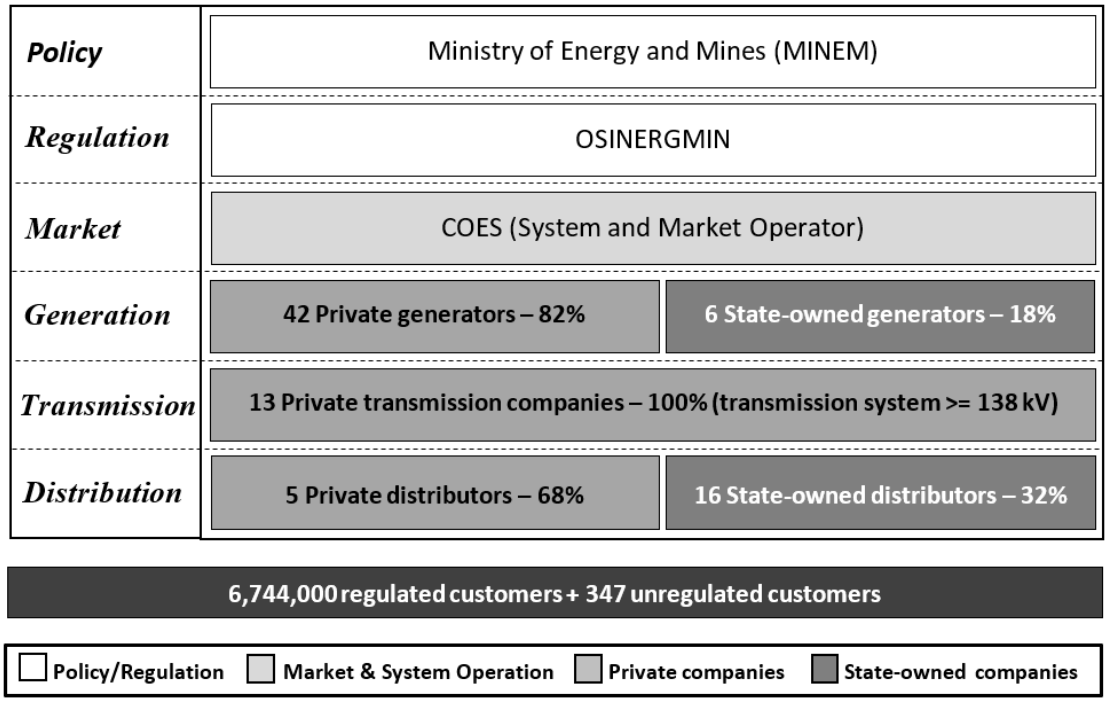
Summarizing, reforms had a material impact on the taxonomy of the Peruvian power sector. The generation, transmission and distribution activities were unbundled; full private sector participation was introduced in transmission; and only partial private sector participation was introduced to generation and distribution, largely due to loss of wider political support for the process. Regarding institutions, a sectoral regulator (OSINERGMIN) and a market operator (COES) were also established (see Figure 3 and Figure 4).

Figure 2-2: Taxonomy of Peruvian power sector before reform (1991)



Source: Rethinking Power Sector Reform Project.

Figure 2-3: Taxonomy of Peru power sector after reform (2015)



Source: Rethinking Power Sector Reform Project.

Box 2. The failed privatization of the Distriluz Group

A Special Privatization Committee for the regional electricity companies was created in 1996 initially to manage the privatization of the eight state-owned regional distribution companies: Electro Sur Medio, Electro Norte Medio, Electro Centro, Electro Norte, Electro Noroeste, Electro Sur, Electro Sur Oeste, and Electro Sur Este. In the case of the group of regional companies in the north and center (Electro Norte Medio, Electro Centro, Electro Norte and Electro Noroeste) the privatization process contemplated the initial transfer of 30% of the shares of each company. The concession contract contemplated the explicit indication that the acquiring party would have management control, even though it would initially own only 30% of the voting rights.

In November 1998, the Peruvian firm J. Rodríguez Banda S.A- JORBSA (better known as Gloria group), offered the highest amount for each one of the four companies, a total of US$ 145.6 million for 30% of the shares (about 80% more than the base bidding price of US$ 87 million; representing an equivalent of US$ 578 per customer). The privatization process contemplated the final transfer of the total companies' shares, in two additional phases. After three years of the initial operation, the acquiring company was required to buy another 30% of the assets, at the same price offered in the initial bidding. From the remaining 40%, 10% were reserved for company workers and the other 30% would be put in the stock market to be acquired by the general public (this last feature was the standard practice in all the other power sector privatizations).

In November 2001, a new distribution tariff was approved by the regulator. During the tariff resetting process, the company insisted that its assets were evaluated to what it paid in the privatization. This was

not accepted by the regulator because it did not follow the established tariff setting regulations, based on the costs of a theoretically efficient distribution company.

At the end of 2001, when the obligation to buy the second 30% of shares kicked in, the company refused to comply with its obligation and took the Government to the courts claiming a breach of contract. Finally, Gloria group abandoned the concession after failing to find a partner, in the aftermath of the Asian Financial Crisis, willing to finance the acquisition of the additional 30% at the agreed price. In March 2002 the Government regained control of the companies.

In trying to explain why this process failed, two main sources of problems surface. One is directly related to the amount offered for the companies in the bidding. At the time, distribution tariffs for all Distriluz companies were known, including the asset base of the tariff (the "investment part" known as VNR). The VNR for the companies was about US$240 million, half the equivalent amount offered in the bidding for the companies. Although the companies' assets included some sub-transmission and other facilities, the price offered, at least for the distribution business, was clearly well above what could be expected to be remunerated through tariffs (the remaining part of the tariffs corresponded to operation, maintenance, administration and other operating costs).

Second, despite having a large customer base, Distriluz's market structure and the relative low level of customer consumption worked against profitability. Indeed, net profit of these four distribution companies was about 29 Soles per client, while net profit was 114 Soles per client and 248 Soles per client for Edelnor and Luz del Sur, respectively.

The Gloria group (JORBSA), a large dairy products industry with no previous experience in the power sector, saw the sector privatization process as an opportunity to expand to other lines of business, and presumably lost interest in this complicated process after two years of operation (World Bank, 2012).

Box 3. The "Arequipazo" of 2002

In the 1990s, important local industries in search of bigger markets and profits gradually began to move their production facilities to the capital city, Lima, and the shift contributed to Arequipa's high unemployment rate. Companies that moved to the capital included Aceros Arequipa S.A. (steel manufacturer), Cervesur (brewer), and Leche Gloria (milk-processing plant). These companies were regional icons of a local identity, so their exodus to Lima was an indication of, as well as a contributor to, the weakening of the provincial economy.

During the presidential campaign of 2001, Toledo told residents of Arequipa that the city's electric companies would not be sold to outsiders. Toledo subsequently signed a document indicating just that. This promise proved to be short-lived when Toledo, once elected president, decided to privatize these companies, offering no explanation for the course change.

Resistance to the sale began to build as early as April 2002, and local authorities initiated a judicial process seeking to prevent the privatization from taking place. In June 2002, protests began the day the government sold the utility companies to Belgium's Tractebel for $167 million. The residents and local government of the city of Arequipa, fiercely opposed the sale of two state-owned electric generation

companies, Egasa and Egesur. The popular protest turned violent, and the central government responded by imposing a state of emergency and a curfew.

The popular uprising successfully derailed the privatization program, triggering a cabinet shake-up and thus weakening the newly installed regime of Alejandro Toledo. Arequipa's local officials and residents dreaded higher electricity prices and worker layoffs as result of the privatization. The provincial mayor at the time of the Arequipazo, Juan Manuel Guillén, later remarked, *"Like the great majority of Peruvians, we were only witnesses to this process"*. Other economic and political forces also contributed to the eventual mobilization.

3.2 2003-2005: Investment stalls and generators refuse to sign contracts with regulated prices

During the first years after the reform of the electricity sector, investments in generation, transmission and distribution increased year after year reaching a peak in 1999, followed by a sharp decline until 2003. At that time, the authorities of the sector and the government were concerned about the reduction of investments and consequently a system with low generation reserve margin, vulnerable to blackouts and rationing. Annual demand growth close to 5% and limited generation investment were steadily reducing the system's reserve margins to critical levels.

After privatization stopped in 2002, the private sector increased its criticisms to the way the regulator established electricity tariffs, in particular for remunerating generators which supply regulated customers, which are subject to mandatory price regulation. The energy market initially established in Peru was based on (further details in Annex B):

(i) a cost-based, security-constrained economic dispatch performed by the market operator COES, and

(ii) financial contracts independent of power plant dispatch.

Final customers do not directly participate in the market, but rather through financial supply contracts with generators. While free customers (mostly large industrial customers) can freely negotiate the terms and prices of contracts with generators, contracts between generators and distribution companies supplying regulated customers (mostly households) are subject to price regulation by OSINERGMIN.

OSINERGMIN determined regulated energy prices by averaging forecasted marginal costs in the system, thus providing "stable" and "cost-reflective" tariffs for regulated customers. Moreover, a capacity payment was provided, based on the regulator's calculation of the efficient costs of peaking power plants (Maurer & Barroso, 2011). As time passed, real marginal costs in the pool increased and decoupled from relatively low regulated energy prices calculated by OSINERGMIN. Indeed, starting at mid-2003 and in the following three years, the short-term generation marginal price was more than double the annual average regulated generation price[8]. Thus, the combined regulated energy and capacity payment appeared to be insufficient to attract efficient baseload generating capacity.

[8] In 2003 the highest monthly average marginal generation price was US$ 65.89/MWh in November; in 2004, it was US$ 112.39/MWh in September; in 2005 it was US$ 98.81/MWh in November; and in 2006, it was US$ 149.81/MWh in September.

While there were mounting concerns over inadequate levels of investment and differences over regulated tariffs, two events triggered the government intervention to overcome a potential crisis in the electricity sector in 2004. First, a drought period started in 2003 and continued all 2004, affecting considerably hydropower generation (hydropower generation represented about 80% of all electricity generation by the time).

Second, a "contractual crisis" ensued when generators started to refuse supply contracts with distribution companies[9] (particularly with publicly-owned companies), at the regulated generation tariff calculated by the regulator. In fact, during 2004, energy from the electricity system was withdrawn without existing supply contracts of up to approximately 700 MW, from a total system demand of 3,131 MW. Generators complained that the regulated price was being kept artificially low by the regulator, not reflecting market conditions at the time; thus, discouraging new generation investments.

The first reaction of the government, the Ministry of Energy and Mines (MINEM) and the regulator was to intervene the market with two emergency measures in 2004 to resolve the situation. First, MINEM convinced private generation companies to assume, at the tariff rate set by the regulator, OSINERGMIN, the withdrawals of power and energy made by distribution companies without active supply contracts, during the period between January and June of the year 2004. Second, the executive enacted an urgency decree (DU) 007-2004 (of July 2004) which established that system operator (COES) shall attribute to all state-owned generation companies, at the tariff rate set by OSINERGMIN, the withdrawals of power and energy destined to attend the electricity public service that were provided without supply contracts by the distribution companies, during the period between July and December of 2004.

Although the aforementioned actions solved the contingency presented in the Peruvian electricity market during 2004, these actions did not lead to the signing of long-term supply contracts between generation companies and distribution companies. Furthermore, it was foreseeable that the 2004 crisis would be repeated in 2005, even more so, due to growing electricity demand from regulated customers and the coming to term of other supply contracts during 2005 and 2006.

These problems were addressed at a high level by Law 28447 in December 2004. First, the law adjusted the procedure for fixing the regulated generation tariff to be followed by the regulator OSINERGMIN. Second, distribution companies were temporarily allowed (until December 2017) to breach the regulatory requirement of minimum contracting levels[10]. Third, an ad-hoc committee was formed by MINEM and OSINERGMIN high-level personnel, with the objective of developing and presenting a new complementary electricity bill designed to ensure the efficient expansion of electricity generation, through a structured, integral, definitive and sustainable scheme that support and encourages the signing of long-term power and energy supply contracts between generation and distribution companies, and attracts new investment in generation.

The major stakeholders and agents which actively participated in the meetings and discussion in drafting the new legal and regulatory framework for the electricity sector were:

[9] Under the Electricity Concessions Law, distribution companies should maintain their regulated demand fully contracted with suppliers, for at least two years in the future; if not, distribution companies would lose their concessions.

[10] Peruvian regulations comprise a provision for declaring expiration of the distribution concession for distribution companies that do not maintain supply contracts sufficient to cover their total power and energy requirements for the next twenty-four (24) months. These provisions were temporarily suspended.

(i) leading the ad-hoc commission, the Energy Vice/Deputy Minister of MINEM;

(ii) MINEM's high ranking advisors;

(iii) OSINERGMIN's generation and transmission regulation managers;

(iv) high ranking authorities of the Society of Mining, Petroleum and Energy (SNMPE in Spanish; representing the private-sector electricity companies as a guild);

(v) major private-sector generation and distribution companies; and

(vi) representatives of large consumers, through the National Industry Society (SNI in Spanish).

From the political point of view, the congressional Special Pro-Investment Commission, presided by the opposition party, was the congressional focal point on this matter as well as the permanent energy and mining congressional commission, also presided by a member of the opposition.

3.3 2006-2009: Second wave of reforms aim at attracting adequate generation and transmission investment

The ad-hoc Technical Commission created by Law 28447 identified a number of factors limiting competition and efficient investment in generation, including the following:

- Generating plant with marginal costs excessively sensitive to hydrological variations and to high demand growth, which occasionally lead to large differences between regulated generation prices and short-term / "spot" energy electricity prices;
- Lack of an effective measured or calculated parameter to recognize or establish, in a timely manner, the required level of reserve or security of supply of the system;
- The need to curb the discretion of both the regulator in the determination of generation prices and the Ministry in the determination of variables that affect those prices;
- The existing asymmetry, in the Electricity Concessions Law of 1992, which obliges distributors to have contracts to cover their concession demand for at least the next two years in the future, without an equivalent obligation of the generators;
- Lack of direct access of demand (distributors and large consumers) to the market, in order to be able to respond to supply scarcity or abundance signals conveyed by electricity prices, a weakness that requires the adoption of measures that include the access of distributors and free customers to the spot market; and
- Lack, in the Electricity Concessions Law of 1992, of provisions to protect the system against the insufficiency of generation to supply the demand with an adequate reserve margin. Specifically, the absence of mechanisms that allow timely action, reducing the likelihood of rationing through new investments.

After 18 months of work, the Technical Commission submitted to Congress a complementary electricity draft law, discussed and agreed with the main agents and stakeholders of the sector (generation, transmission and distribution companies and large consumers). The main premises of the proposed draft law were the following:

(i) maintain the basic economic principles of the Electricity Concessions Law of 1992, for the determination of generation prices and promote competition in the wholesale market;

(ii) correct the deficiencies that were identified as barriers to the development of competition in generation, and incorporate the necessary measures to promote such competition;

(iii) reduce the discretionary power of the regulator in the determination of generation prices, opting for market solutions when possible;

(iv) ensure the sufficiency of generating capacity to reduce risk of exposure of the power system to excessive electricity prices or prolonged rationing due to insufficient generation, with a minimum of intervention;

(v) promote market solutions for the efficient development of required transmission infrastructure, eliminating sources of revenue uncertainty to pay for the necessary investments; and

(vi) modify the governance of COES to make it a more independent and representative entity of the all the different agents involved in the electricity market.

In July 2006, Congress passed Law 28832 "to ensure the efficient development of electricity generation". This new law introduced three important changes in the ECL, to ensure investment recovery in generation and transmission, and to improve corporate governance of the system operator.

First, Law 28832 established a system of energy auctions to ensure short to long term generation supply to distribution companies, to meet the demand of the regulated market. Supply contracts between generation and distribution companies are awarded under competitive bidding procedures. Generation prices resulting from the auctions are incorporated in the methodology for setting regulated generation tariffs. This addressed the weaknesses of the administrative procedure for setting tariffs, which was previously based entirely on theoretical simulations by the regulator, and were perceived by generation companies to be too decoupled from actual market conditions. Auctions were thus expected to provide adequate incentives for investment in new power plants that guarantee timely and efficient electricity supply for the regulated market. Under this new mechanism introduced by Law 28832 and its regulations, 14 long-term distribution supply auctions were successfully conducted between 2009 and 2015[11].

Second, Law 28832 addressed the problem of almost no transmission investment by private initiative under the former ECL regulations[12], which did not guarantee investment recovery. The new regulatory framework formalized a centralized transmission planning process undertaken by COES and approved by MINEM. Transmission projects included in the plan are developed by transmission companies which are awarded BOOT (Build, Own, Operate and Transfer) concession contracts through a competitive bidding procedure. This framework provides a much more stable signal to investors and eliminated the uncertainty of the concept of "economic adapted line" of the Electricity Concessions Law of 1992. A line

[11] In the interim period 2006-2009, a temporary auction regime was implemented in order to have a smooth transition to the new comprehensive power supply auctions regulations.

[12] The former transmission tariff system was based on a theoretical "New Replacement Value" that yielded different results every year and was not linked to actual transmission investment costs.

was said to be economic adapted if it was fully used at its design capacity (thermal or otherwise).[13] Under this concept, for example, a line would receive payment of half of its economic cost if it is used 50% of its capacity. Thus, payment for a line would vary each year in accordance with its use, and in practice it would never fully cover its investment costs if not fully used all the time. This was a faulty regulated tariff design, which precluded private investment in new transmission facilities.

Third, Law 28832 established a new institutional setup of the system operator (COES), in which all power sector agents are represented in the General Assembly (the highest governing body of COES). COES was previously composed only of generation and transmission companies, thus raising concerns regarding its independence. After Law 28832, demand was given direct representation by organizing COES agents in four subcommittees: one of generating companies, one of transmission companies, one of distribution companies, and one representing large "free" users (with a maximum demand over 10 MW). COES's corporate governance and independence was also strengthened by Law 28832. The Board of Directors is composed of five members, one for each of the indicated four group members and a President. COES' board members cannot be employees or direct representatives of the agents, but independent professionals who will provide transparency to the actions of the system operator.

Despite introducing extensive and positive changes to the Peruvian electricity market, full implementation of Law 28832 took more than four years. Before bylaws for generation supply auctions were enacted in 2010, a temporary auction regime was adopted between 2006 and 2009 to "regularize" contractual obligations of distribution companies. In transmission, the first transmission plan prepared by COES was developed in 2010.

A new law for Rural Electrification was also enacted in this period. Although, a specific law promoting rural electrification was passed in 2002 (Law 27744), the law was never put into force due to contradictions with other existing territorial and Regional Governments laws. In June 2006, a new general law of rural electrification (Law 28749) was enacted to replace the previous one. This new law clearly defined the Rural Electrification System, the sources of financing and organize rural electrification works through the National Rural Electrification Plan.

3.4 2010-2019: Out-of-market adaptations to pursue public policy objectives

Peru has been one of the pioneers in the region in implementing renewable energy auctions, which have helped to promote biomass, wind, solar and small hydropower plants (see further details in Annex F). The first Renewable Energy Generation (REG) auction was carried out in 2010 in two rounds, in February and August. In March 2011, before the second REG auction, the government approved upgraded regulations through DS Nº 012-2011-EM. Between 2011 and 2014, the second and third REG auctions were carried out. Finally, at the beginning of 2016 the fourth REG auction was successfully completed.[14]

The original Peruvian power market design has also been adapted by the government to pursue public policy objectives. Indeed, the government adapted the competitive power market by forcing the

[13] Transmission regulation contemplated a capacity margin in the definition of fully loaded line, as well as an initial period of usage ramp-up before reaching full usage. Used capacity was established each tariff review period (every year in the case of transmission).

[14] The last (fourth) auction showed record lower prices for solar and wind projects, in the order of 48 US$/MWh and 37.7 US$/MWh, respectively. During the 6-years period of REG auctions, there has been projects' bids price reductions of 78% in solar power and of 53% in wind power. By the end of the fourth auction, a total of 66 projects have won bids (5 Biomass, 7 Wind, 7 Solar and 47 small hydroelectric); with a total installed capacity of 1,305 MW and 6,087 GWh of contracted energy.

development of gas-fired generation in the south of the country. “Reserve” power plants were auctioned in the south of the country, with the objective of financing new gas pipelines from Camisea, particularly the southern gas pipeline (Gasoducto Sur Peruano). Additional costs required to finance these forced (i.e. out-of-market) gas-fired generation assets were passed-through to final customers by an additional charge bundled with transmission tolls at a national level. The market was also adapted by the government by establishing technology-specific take-or-pay hydro-power auctions with government guarantees, backed by state-owned ElectroPeru. An auction was held expecting high competition, but only a few hydro power plants were awarded (about 1500 MW) at relatively high prices (65-75 US$/MWh).

In 2015 the government passed new legislation (DL Nº 1221, of September 2015) modifying the legal and regulatory framework of electricity distribution (specifically 23 articles of the original legislation of 1992-1993 were changed). The calculations and procedures for distribution tariff setting were changed and incentives for network modernization like metering, smart grids, innovation, efficiency and distributed generation were introduced. Investment planning and financing for state-own distributors were also introduced through DL Nº 1208, to solve some problems of these companies.

During the first years after the reform of the electricity sector, private investment in generation, transmission and distribution increased every year until reaching a peak of about US$ 507 million in 1999, followed by a steep decline until 2003, when it was only US$ 81.1 million. From 2004 to 2012, investment in the sector grew at a yearly average rate of about 20%, reaching a new investment peak record of about US$ 2,467 million in 2012. Investments in the sector have slowed down in recent years, reaching US$ 766 million in 2018, partly due to the reduction of the GDP growth rate. Nevertheless, the Peruvian power sector has received an impressive quantity of private investment, totaling about US$ 16,600 million between 1995 and 2015, of which 67.6% was in generation, 16.0% in transmission and 16.4% in distribution.

4 Sector Performance

Reforms are a means to improve performance of the power sector. As previously described, Peruvian reforms aimed primarily at improving security of supply, financial sustainability and efficiency of the power sector. Peru implemented both standard textbook reforms (such as independent regulation), and tailored mechanisms for ensuring security of supply.

This section analyzes performance of the Peruvian power sector, and the relevance of specific institutional factors in determining these outcomes. Performance and institutions are analyzed under the following four dimensions:

1. Investment and security of supply.
2. Access and affordability.
3. Utility efficiency and financial sustainability.
4. Tariffs and cost-recovery.

4.1 Investment and security of supply

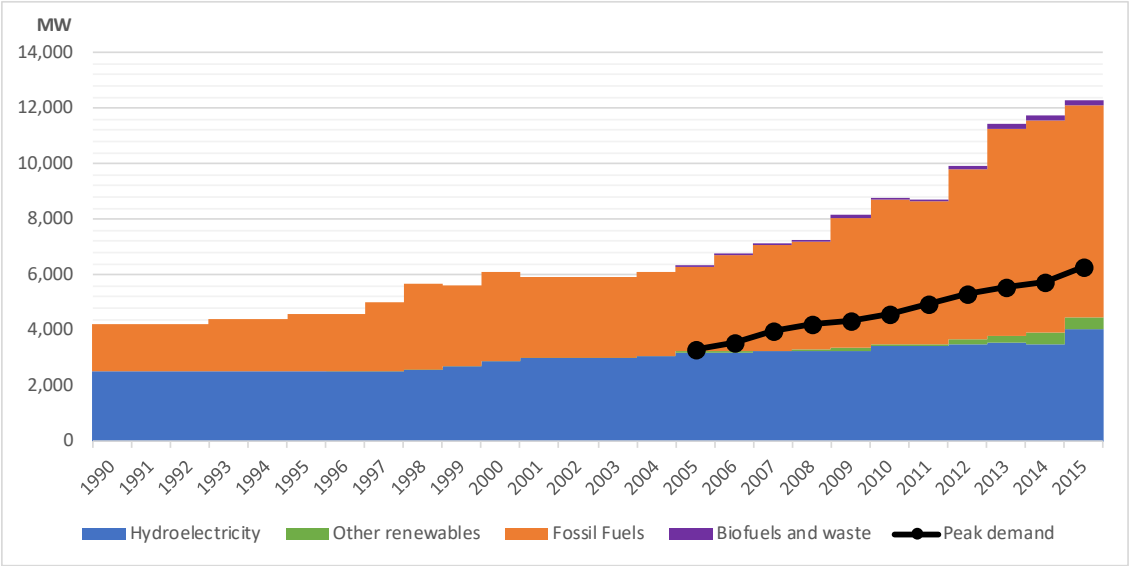
4.1.1 Performance

Originally, power sector reforms expected private investors to independently pursue investments in generation and transmission infrastructure, following market signals. Although energy supply was opened to competition through competitive bilateral contract markets and a spot pool market, regulated tariffs remained very important for generators, and proved inadequate to incentivize investment. Additionally, a regulated capacity market based on peak-load pricing theory was established to ensure enough capacity is available to meet peak-demand.

By 2006 it was clear that the existing framework did not attract adequate levels of investment to efficiently meet growing electricity demand. Following the second wave of reforms in 2006, Peru's power sector is subject to a combination of a central planning and competitive markets for generation expansion, while transmission is based on mandatory centralized planning. As a result, investments in the generation segment surged from US$ 235 million in 2005 to US$ 1,829m in 2015 (inflation adjusted to 2015). Nonetheless, some degree of government-led centralized planning has also been re-introduced to the sector's expansion framework since 2010.

Following the development of Camisea natural gas fields since 2004, power generation in Peru, once dominated by hydro generation, has been successfully diversified through natural gas generation (see Figure 5). In 2003, before coming into operation the Camisea natural gas project, hydroelectric production accounted for 85% of total electricity generation. Between 2004 and 2008, new natural gas-fired electric power capacity, primarily less-costly but also less-efficient open-cycle technology, expanded rapidly in Peru. By 2015 gas-fired thermoelectric generation represented 50% of total electricity production. Abundant supply of cheap natural gas facilitated this expansion. Natural gas has become the fundamental energy fuel of Peru. As a result, the reserve margin in Peru soared from 35% in 2005 to 81% in 2017.

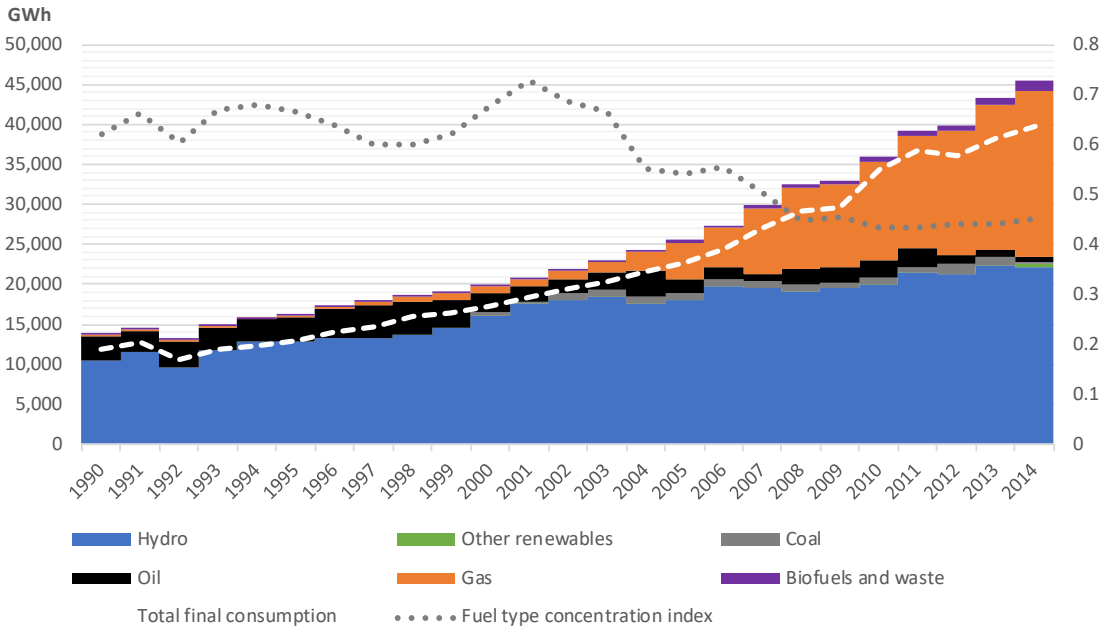
Figure 3-1: Effective generating capacity and peak demand (GW)



Source: Rethinking Power Sector Reform project.

Peru's shift towards electricity generation fuel diversification is evident in the evolution of electricity generation (see Figure 6). In 1990 most of electricity demand in Peru was supplied by hydropower, whereas natural gas contributed about 21 TWh to total generation during 2014, nearly the same as hydropower. Thus, the fuel type concentration index plunged to less than 0.5 in recent years, after hovering between 0.6 and 0.7 between 1990 and 2003.

Figure 3-2: Peru electricity generation by fuel type.



Source: Rethinking Power Sector Reform project.

Despite rapid expansion after 2006 reforms, thermal power plants are concentrated in the center zone of the country, around the capital city Lima. Given chronically weak natural gas transport and electricity transmission networks, MINEM determined risks for security of supply to be excessive, especially for the southern zone of the country. To address these risks, Law 29970 was enacted in 2012 to increase energy security. The law allocated new responsibilities to MINEM, related to the promotion of energy diversification, reduce geographical "concentration" of energy generation, and redundancy of transport networks, among others. As a result, 2035 MW of diesel / natural gas fired power plants have been developed in the southern region of the country, along with additional natural gas pipelines (OSINERGMIN, 2017).

Central planning has also promoted specific technologies in generation expansion. An increase of "cold" generation reserves was promoted through auctions for new power plants conducted by ProInversión since 2010, accumulating 1,145 MW of new generating capacity between 2013 and 2018. Furthermore, Peru also promotes specific hydro projects through auctions conducted by ProInversión. As a result, 1,469 MW in new hydro-power capacity were commissioned between 2015 and 2016 (Quintanilla, 2016).

4.1.2 Institutions

The economic reform of the 1990s separated and defined the role of the public sector, essentially limiting it to regulation and supervision. In the case of the power sector, although planning is still a function of the Ministry of Energy and Mines (MINEM), in the reform process this activity was given a referential character, without greater weight in the decision-making activities of expansion in the sector. The practical result has been the periodic production of a document of little practical value, called "Reference Electricity Plan", which uses the same models and methodologies of a centralized view of the sector, in which the dynamics of private participation in new investment decisions is not considered. Very few of the recommendations stated in the Reference Electricity Plan are translated into sector policy decisions or private sector investments.

Regarding generation, Law 28832 of 2006 established a competitive auction mechanism for the supply of regulated customers. These auctions, conducted by distribution companies under terms approved by OSINERGMIN, award PPAs with durations ranging between 5 and 20 year. Long-term (20-year) PPAs are bankable, facilitating development of new power plants. Furthermore, auctions for renewable projects established in 2010 (Supreme Decree 10002) have promoted efficient commissioning of wind, solar PV, small hydro and biomass projects. Although rapidly growing, total integration of renewable resources is still very limited.

Since 2010, investment in specific generation projects has been promoted by MINEM through auctions conducted by ProInversión, as well as the development of new natural gas pipelines. Costs of these measures aimed at attaining public policy objectives are passed through to final customers primarily through a surcharge on transmission tolls.

Regarding transmission, little attention was given to its regulation when the initial reform was designed, mainly because it was not considered initially for privatization.

Investment in transmission was expected to rely mainly on private initiative. However, by 2005, investment in the bulk-transmission system was quite limited and started to be a cause of alarm because of increasing congestion in important transmission lines. This low level of investment was attributed mainly to the transmission tariff scheme, which did not provide enough guarantees for the recovery of

investments. Although consumers were paying for the bulk-transmission system through a "postage stamp" charge, the calculation of this charge was not based on real costs of the system but on OSINERGMIN's estimates, which many investors perceived to be an arbitrary scheme. Tariffs for the use of the secondary transmission system by third parties were also established by OSINERGMIN through cumbersome procedures, constantly disputed by the owners of these facilities.

Establishment of the Technical Commission for drafting new generation regulations by the Peruvian Congress, through Law 28447, was also an opportunity to reexamine and correct the transmission regulation deficiencies, for promoting investments in required transmission facilities. Second generation reforms of 2006 introduced centralized planning for the expansion of the main transmission system, as well as competitive market-driven pricing for new transmission facilities to ensure cost-recovery[15]. The transmission expansion plan is the result of a periodic planning study carried out by the system operator, COES, every two years. COES develops transmission planning under terms of reference and procedures dictated by the regulator OSINERGMIN, while MINEM approves the recommended transmission plan. The facilities contemplated in the plan (transmission lines, substations and other complementary equipment and installations) are competitively bid out as BOOT assets, and the resulting tariffs are passed-through to final tariffs by the regulator.

Considering that by its very nature the expansion of electrical transmission systems must simultaneously deal with the expansion of generation, COES transmission planning methodology involves the examination of thousands of generation expansion and demand scenarios and the application of trade-off risk techniques. In the particular case of hydropower, a major Peruvian energy resource, the interrelation of transmission and generation planning is even more important, given that in many cases the cost of transmission for hydropower may result in a deal-breaker in the economic and financial assessment of a project.

With the introduction of competitive BOOT biddings for transmission investments in 2006, and the approval of the first transmission plan in 2010, investment for the reinforcement of the transmission system increased considerably. At present, the private sector practically owns all the high voltage transmission system (with the public sector owning only some sub-transmission lines to supply remote areas). Red de Energía del Perú, Consorcio Transmantaro and ISA Perú (all of them part of Interconexión Eléctrica, ISA, of Colombia) own close to 6,500 km of 500, 220 and 138 kV transmission lines, which represent more than 80% of all high voltage transmission assets.

Peru has a relatively strong institutional framework for power sector planning and procurement, when compared to other countries analyzed in this project (see Table 1). Bright spots of Peru relate to mandatory transmission planning and competitive auctions for procurement of both transmission projects and new power plants (through supply auctions). However, absence of periodical and comprehensive generation planning reduces Peru's performance in the Planning and Procurement Indicator to 77% (above the international benchmark of 70%, behind only Colombia among similar countries). The lack of an effective government body responsible for comprehensive energy sector planning has been pointed as the source of problems such as insufficient transmission expansion, weak

[15] Peruvian regulations establish two types of transmission facilities: (1) guaranteed system, including facilities considered to be essential for the proper technical and economic operation of the system; and (3) complementary system, comprising transmission facilities not within the guaranteed system. Expansion in the guaranteed system are centrally planned and competitively procured. In turn, development of the complementary transmission system is left to private initiative, although the regulator establishes tariffs for third-party usage of these facilities.

coordination of hydropower and natural gas expansion, and weak coordination with social and environmental objectives (World Bank, 2012).

Table 1: Institutional arrangements for power sector planning and procurement in Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International Benchmark
Planning and Procurement	**95%**	**77%**	**59%**	**59%**	**70%**
Generation Planning	86%	43%	71%	71%	56%
Procurement of Generation	95%	90%	100%	50%	85%
Transmission Planning	100%	75%	50%	100%	72%
Transmission Procurement	100%	100%	17%	17%	64%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details refer to the Annex and the project website at http://www.esmap.org/rethinking_power_sector_reform

4.1.3 Summary

Peru has had ample reserve margins and very high generation-level security of supply over the past decade. Security of supply is not currently a serious issue in Peru, but rather efficiency may be called into question due to the 81% reserve margin and very low wholesale prices, which signal a capacity surplus that should fall in the future. The aggressive capacity expansion is a result of both market-driven reforms of 2006 and out-of-market public policies since 2010. Second-wave reforms in 2006 introduced competitive supply auctions which have been successful in attracting private investment to supply regulated customers (mostly households and small businesses). Furthermore, public policy objectives such as the diversification of the energy mix through development of the domestic natural gas industry, and increasing reliability in specific geographical zones, have also driven significant generation investment. Indeed, problems are currently related primarily to the natural gas transport and power transmission networks, which require further investments to relieve bottlenecks and increase security of supply in specific zones and also to increase system-wide efficiency.

4.2 Access and affordability

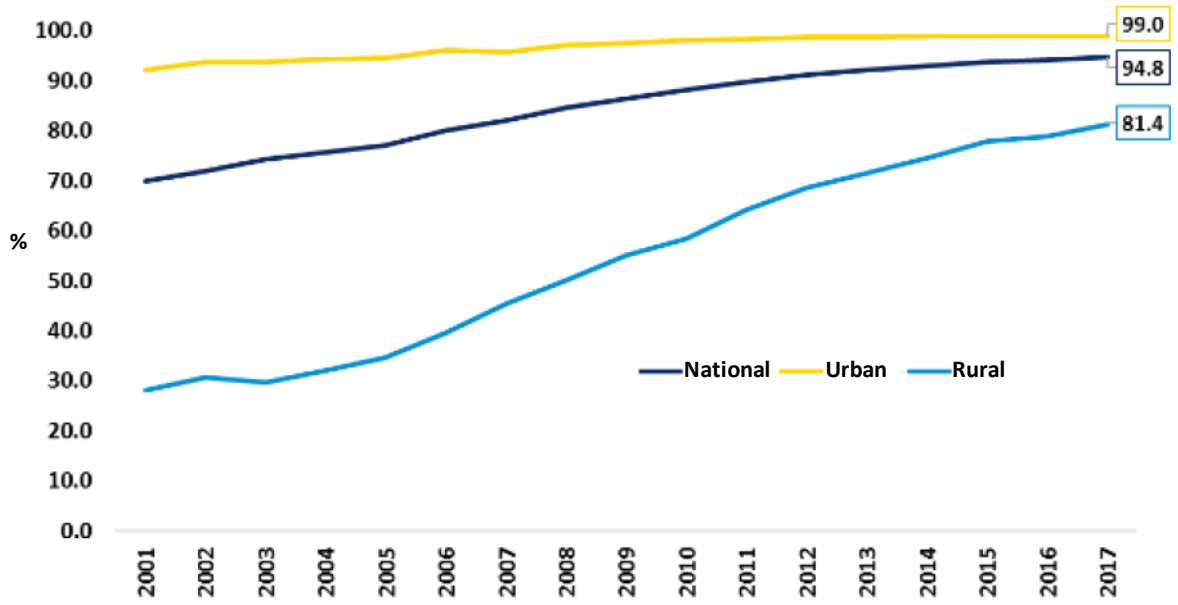
4.2.1 Performance

Although electricity access has expanded in Peru since 2001, serious gaps remain in rural and remote areas. Electricity service is considered satisfactory in urban areas, and the commercial side of the industry is generally functioning pretty well (including large mining operations). At the end of 2017 the official national electrification coverage in the country was 94.8% of households, and the rate of electrification in urban areas was 99.0% (and has been historically very high, see Figure 7).

However, the situation is quite different in the rest of the country, particularly in rural and remote areas. With only 82% electricity access in rural areas, overall electrification of Peru is one of the lowest in Latin America. Moreover, there are important disparities between regions; with some regions reaching less than 85% electrification (like Ucayali and Loreto in the Amazon region) and others with more than 97% (such as Lima, the capital city of Peru; see Figure 8) (OSINERGMIN, 2018). Despite the significant level of

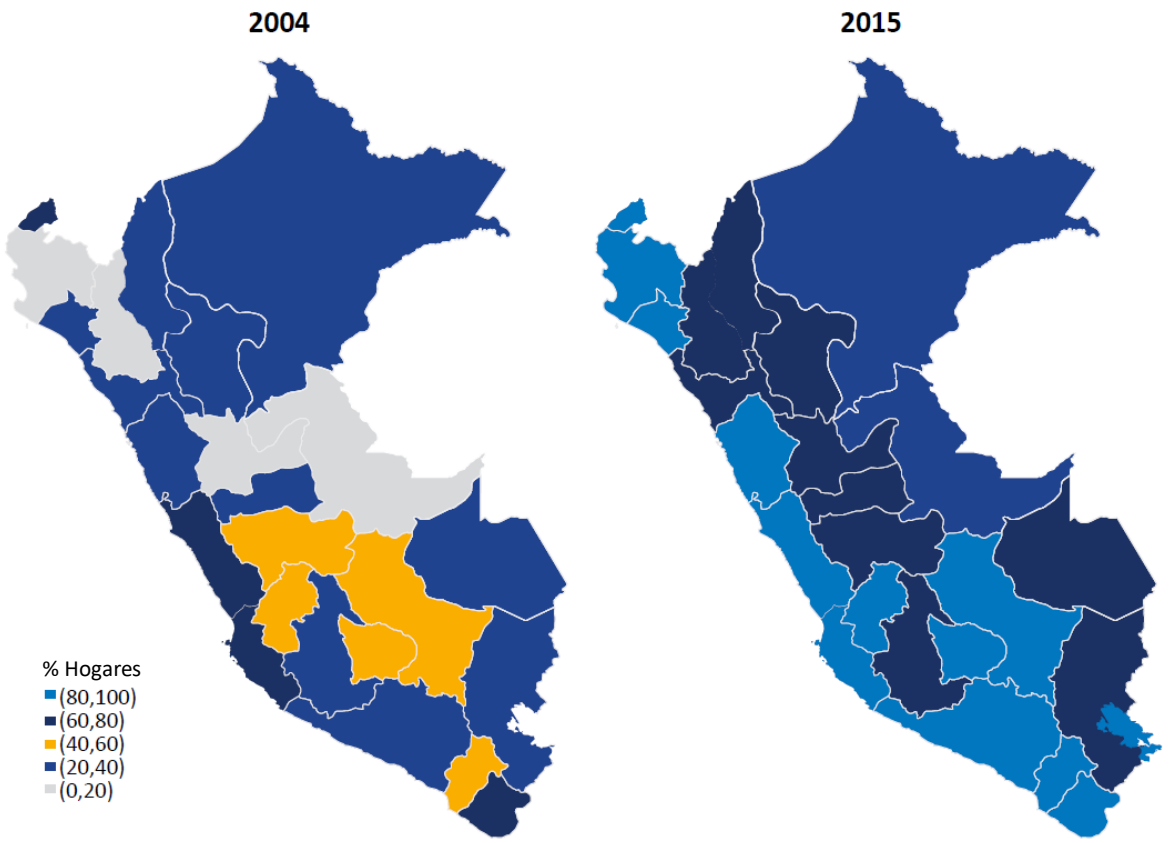
investment in rural electrification in the last 10 years (electricity access in rural areas has had a compound growth rate of 10.8%), by 2017 close to 500,000 households were without access to electricity. Difficulties in expanding coverage to remote areas are related to scarce transmission infrastructure, geographical constraints and the lower economic incentive for developing new electricity infrastructure (OSINERGMIN, 2018).

Figure 3-3: Households with electricity access (%), 2001-2017.



Source: GPAE-OSINERGMIN 2017-II report.

Figure 3-4: Geographical proportion of households with electricity access (%), 2004 and 2015.



Source: (OSINERGMIN, 2016).

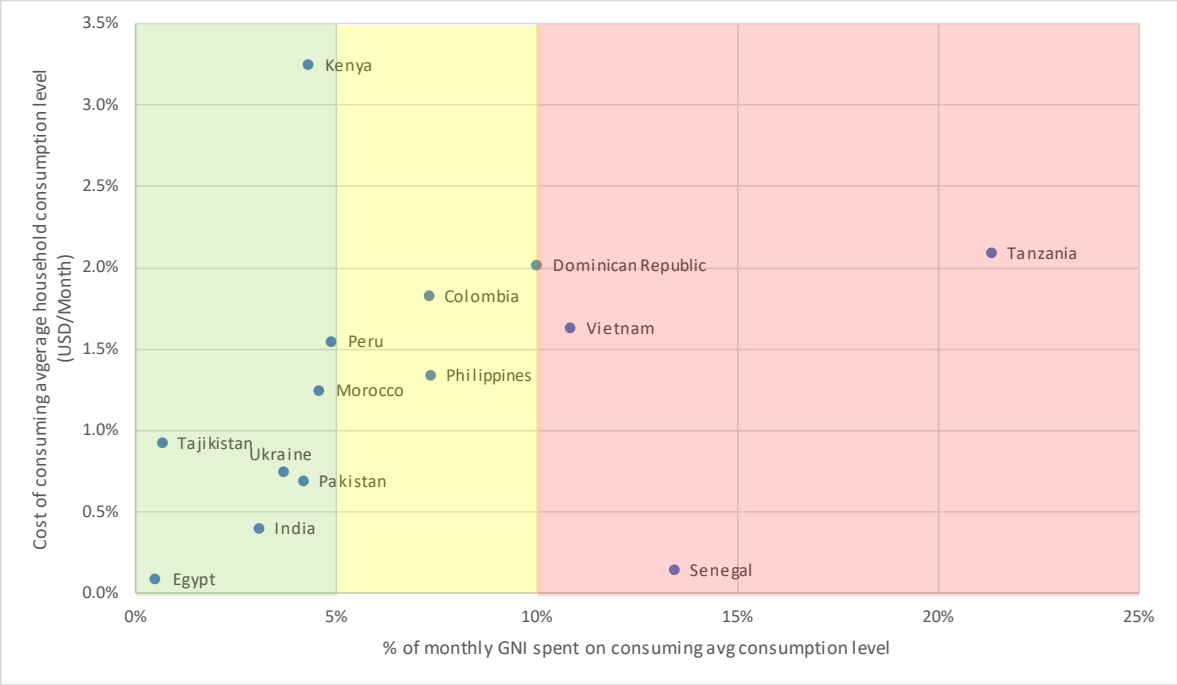
Furthermore, low service quality in rural areas is a crucial problem that will require special attention of sector authorities. The majority of rural systems have poor quality, measured by the SAIFI and SAIDI indicators. The national average SAIFI and SAIDI indicators in 2015 were 15.2 and 36.4, respectively. In the case of the electrical systems serving Madre de Dios, the worst performing, the SAIFI and SAIDI indicators in 2015 were 49.5 and 117.9, respectively; more than three times as much as the national average (Apurimac, Ayacucho, Cusco, San Martín y Loreto are other Departments/regions with poor quality of electricity service). The Madre de Dios electrical systems are part of Electro Sur Este Distribution Company, the worst performing company by service quality in 2015.

Along with the lack of other infrastructure services, limited access and quality of electricity service leads to lower quality of life, bad health care and poor education, therefore limiting opportunities for economic development. The incidence of poverty in rural areas made it more necessary the provision of basic infrastructure such as electricity, as part of a national rural development agenda. According to OSINERGMIN's 2018 survey, median household consumption in rural areas is 16 kWh/month, dramatically below the 85 kWh/month median for households in urban areas. In turn, median expenditure was 12 Soles/month for rural households, 70 Soles/month for urban households (OSINERMING, 2018). For non-

extreme poor households, the median expenditure in electricity of 48 Soles/month represents 3.5% of annual expenditures[16].

According to affordability indicators developed for this project, Peru ranks seventh among all 16 developing countries considered for this study (see Figure 9). Considering a subsistence household consumption of 30 kWh/month, the annual cost of electricity represents about 1.5% of annual income for households in the bottom 40% of Gross National Income.

Figure 3-5: Affordability of subsistence consumption in Peru, 2016



Source: RISE, 2018

Electricity tariffs for household customers in Peru is heavily influenced by generation (51% of the final tariff), followed by distribution (26%) and transmission (23%, see an example in Table 2). The transmission component of Peru's household tariffs is very large by international standards. Transmission charges are high partly because the costs of public policies are bundled in the transmission toll. These public policies include, for example, the development of natural gas infrastructure and thermal / hydro power plants deemed necessary by the government.[17] Given regulations for pass-through to final customers, free

[16] According to Peru's statistic bureau, 42% of rural population is poor, i.e. spends less than 344 Soles/month per capita, or 1376 Soles/month for a four-person household (see press release available online at https://www.inei.gob.pe/prensa/noticias/pobreza-monetaria-disminuyo-en-12-puntos-porcentuales-durante-el-ano-2018-11492/). Matching this maximum expenditure with median electricity expenditure for non-extreme poor households (48 Soles/month) yields 3.5% of total expenditures. Lacking more detailed data, such a gross approximation is provided for referential purposes only, since a more precise calculation should consider average or median expenditures both in total and in electricity services.

[17] Among public policy costs passed-through final customers, a charge for financing the controversial Gasoducto Sur Peruano (GSP) was included until it ceased to exist in 2017. GSP, originally developed with Odebrecht's participation, has recently been

customers can lower their final tariff by shifting consumption off the peak period, thus lowering their contribution to the transmission toll and aforementioned public policy actions.

Table 2: Example of household electricity tariff component disaggregation (Lima Norte, May-2018)

Item	Cost component (US$/MWh)	Cost component share (%)
Generation	74.6	51%
Transmission	34.3	23%
Distribution	38.8	26%
Unit cost	**147.7**	**100%**

Source: sample May-2018 tariffs, according to OSINERGMIN (2019b). Values for household residential customers (BT5B) in Lima Norte. These values vary across customer types, voltage levels, distributors and time, and are only included here for illustration purposes.

4.2.2 Institutions

A cross-subsidy mechanism was established in 2001 (FOSE, established by Law 27510), to subsidize consumption of households with monthly consumption below 100 kWh. The subsidy is funded by customers with consumption higher than 100 kWh/month. During its first years of operation, the cross-subsidy FOSE mechanism was found to be inadequately targeting poor households, with 56% of the total subsidy funds benefitting non-poor households (OSINERG, 2005). Following recent adjustments to the FOSE mechanism, its contribution to final household tariffs are summarized in Table 3. Furthermore, in 2016 another compensation mechanism (MCTER) was introduced to reduce gaps in final tariffs across different regions of Peru, and among customers in interconnected and isolated systems (OSINERGMIN, 2016).

Table 3: Tariff cross-subsidies of the FOSE mechanism.

System	Typical sector	Customers with consumption at or below 30 kWh/month	Customers with consumption between 30 and 100 kWh/month
Interconnected system	Urban	25% off the energy charge	7.5 kWh/month off the energy charge
	Urban-rural and rural	50% off the energy charge	15 kWh/month off the energy charge
Isolated system	Urban	50% off the energy charge	15 kWh/month off the energy charge
	Urban-rural and rural	77.5% off the energy charge	23.25 kWh/month off the energy charge

Source: OSINERGMIN (2016)

brought to the spotlight due to formal investigations on possible political corruption associated to the Lava Jato scandal across Brazil and other Latin American countries.

In recent years the government has strengthened its commitment to reduce the electrification gap. Since the passing, in 2006-2007, of the General Law for Rural Electrification (Law 28479) and its legal framework, MINEM has markedly increased public investment, increasing rural and overall national electrification coefficients between 2007 and 2015, from 29% to 78% and from 74% to 93%, respectively. Investments in rural electrification (a responsibility of MINEM's General Directorate of Rural Electrification – DGER in Spanish) have been strong in the last ten years, with a total of US$ 1,335 million, a yearly average slightly over US$ 120 million.

Although extending rural networks has been the traditional way of increasing rural electrification in Peru, household and community-based photovoltaic solar systems installations have also been used increasingly. As electrification projects try to reach farther away rural populations, unitary investment costs of new system expansions increase and stress existing distribution networks, which supply these new installations. There is a perception in MINEM that network extensions for rural electrification has reached a limit and additional access and supply expansion requires a different viability and technological model.

MINEM has thus pushed for a massive household solar photovoltaic program to cover most of the un-served rural population. Bylaws enacted in 2013 aim at promoting renewable resources to improve quality of life in off-grid locations, through auction mechanisms for development of solar photovoltaic systems in the locations determined by MINEM (Supreme Decree Nº 020-2013-EM). In this context, the first auction for off-grid systems was awarded in 2015, and as a result by July 2019 over 133 thousand autonomous systems have been installed in households, health institutions and schools (OSINERGMIN, 2019c).

Peru scores very similar to the international benchmark when it comes to the energy access regulation indicator (Table 4), given weak regulations for solar home systems and mini-grids.

Table 4: Regulatory framework for electricity access in Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International Benchmark
Energy Access Regulation	**67%**	**57%**	**74%**	**7%**	**58%**
Regulation of New Connections	68%	88%	57%	14%	65%
Regulation of solar home systems	100%	50%	100%	0%	66%
Regulation of mini-grids	33%	33%	67%	NAV	44%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

4.2.3 Summary

Peru has maintained very high access in urban areas, reaching 99% in 2017. However, serious gaps remain in access and minimum service quality for poor customers in rural and isolated areas. About 81% of rural households have electricity access, but receive mostly unreliable service with frequent interruptions. MINEM has made many efforts to expand coverage to rural areas through expansion of existing networks were economically feasible, and also through massive programs for rooftop solar photovoltaic systems.

Electricity service affordability in Peru is the lowest among all 15 countries analyzed in this study: the annual cost of electricity during 2016 represents over 7% of annual income for households in the bottom 40% of Gross National Income. Cross-subsidies have been established since 2001, but have been inadequately targeted in the past.

4.3 Utility efficiency and financial viability

4.3.1 Performance

Utility-level performance is further analyzed for two sample Peruvian distribution companies: Luz del Sur, which supplies Lima, and Hidrandina. Performance is analyzed with respect to operational efficiency, financial management and service continuity.

The evolution of distribution-level electricity losses highlights the gains of tariff regulation after 1992 reforms (see Figure 10). Distribution losses in Peru fell from 22% in 1993 to 9% in 2002, and has since stabilized around 7%-8%, considered an efficient loss level. Falling losses did not seem to be directly related to privatization, since utilities that were privatized and then returned to government ownership retained their gains. An important explaining factor for plunging losses is the incentives provided through "supplementary distribution losses". These losses, which decreased gradually from 9% in 1993 to 0% in 2006, were added to "efficient losses" recognized by the regulator (Anaya, 2010).

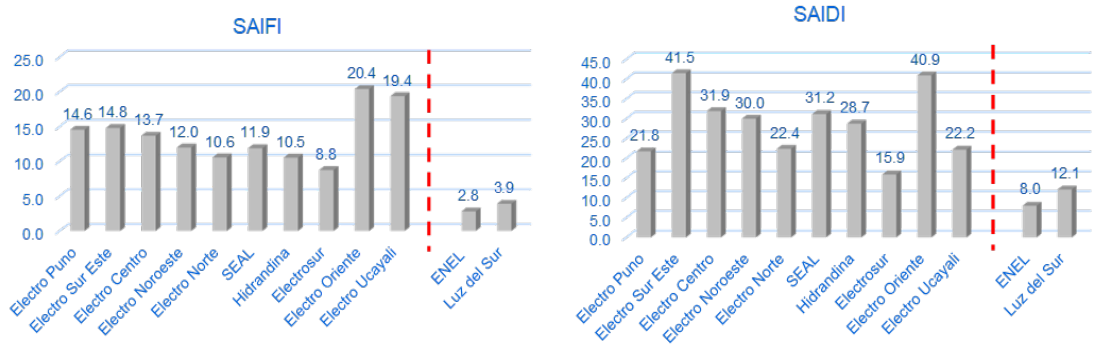
Box 4. Hidrandina and the Case of Public Utilities in Peru

There are 10 public distribution utilities (Discos) in Peru that are responsible for providing electricity in their exclusive concession areas outside of Lima[1]. The 10 discos have a large performance range and it is difficult to designate just one as representative of all them. The author's decision to choose Luz Del Sur and Hidrandina is purely based on having a sample of two sufficiently large discos in the country with different ownership set up, where data availability would not be an issue. The author's do not claim that Hidrandina is representative of all the public utilities in the country.

Hidrandina, part of Distriluz holding company- that includes Electronoroeste, Electronorte, and Electrocentro as well- has a much larger concession area and number of customers than a typical public disco in Peru. While Hidrandina's performance has been studied extensively in the case study and its operational and financial performance is detailed below, it would be important to understand some of the concerns that sector regulators and operators have raised about the public distribution companies.

While public discos have improved over the last few years, figure B4.1 below, clearly shows the wide difference of performance on system interruption. While Electrosur, Hidrandina and SEAL have relatively better performance, utilities such as Electro Oriente and Electro Ucayali perform quite poorly. Furthermore, complaints related to quality of service have seen a three-fold jump among public discos from 2013 to 2018.

Figure B4.1: SAIDI and SAIFI comparisons, (Osinergmin Technical Reports, 2018)

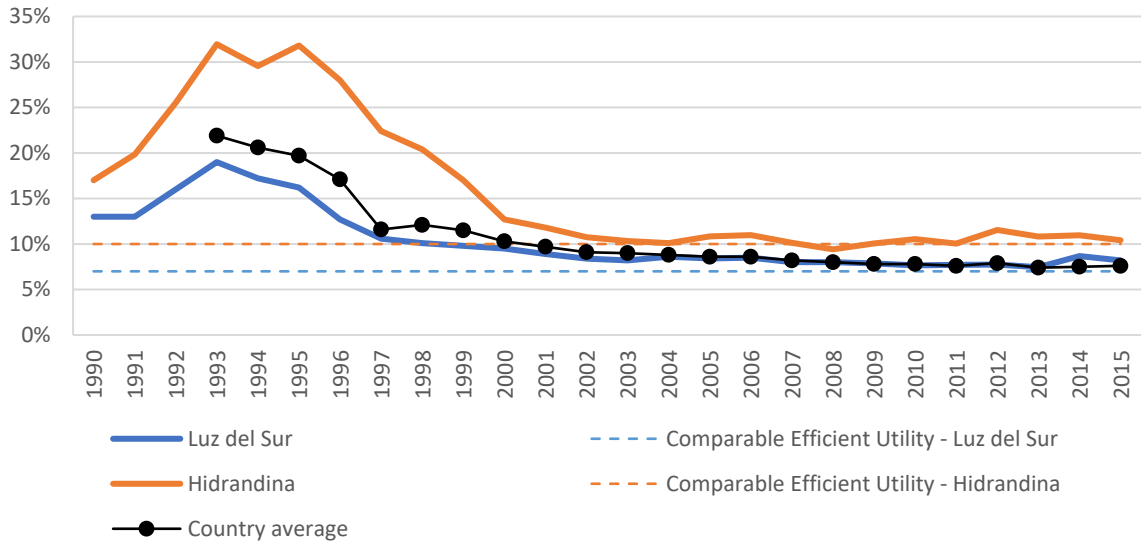


The poor performance of the public utilities is directly linked to insufficient investments in the more vulnerable less developed regions and networks of the country. The public discos have struggled to attract long term financing given the limitations on how much long-term debt (over 12 months) they can accrue without a cumbersome approval process, limiting the investments they can make in the network. In fact, only 33.2 percent of investments in the 2017-2021 transmission investment plan (PIT) has been executed by the public utilities. This has left several systems at risk of severe outages in some of the secondary cities of the country and has limited the ability of the discos to expand and serve more customers.

Similar trends can be observed for Luz del Sur and Hidrandina, highlighting also the surge in losses after 1990 due to the lack of investment in the distribution segment. Luz Del Sur was created in 1994 with the unbundling of Electrolima. From 1990-1994, Luz del Sur's (then Electrolima) distribution losses were rising,

and increased from 13% to 17% in 1994, well above the 7% loss level for a comparable efficient utility. After 1992 reforms, Electrolima was unbundled and privatized between 1994 and 1996, giving birth to Luz del Sur. Privatization enabled further efficiency gains in terms of electricity losses, which fell to 12% in 1996, and stabilized around 8% since 2002. In the case of Hidrandina, which has been a majority state-owned company throughout its history, losses surged from 1990 to 1995, reaching 32%, and has since fallen and recently stabilized around 10%, considered efficient for comparable utilities in the region.

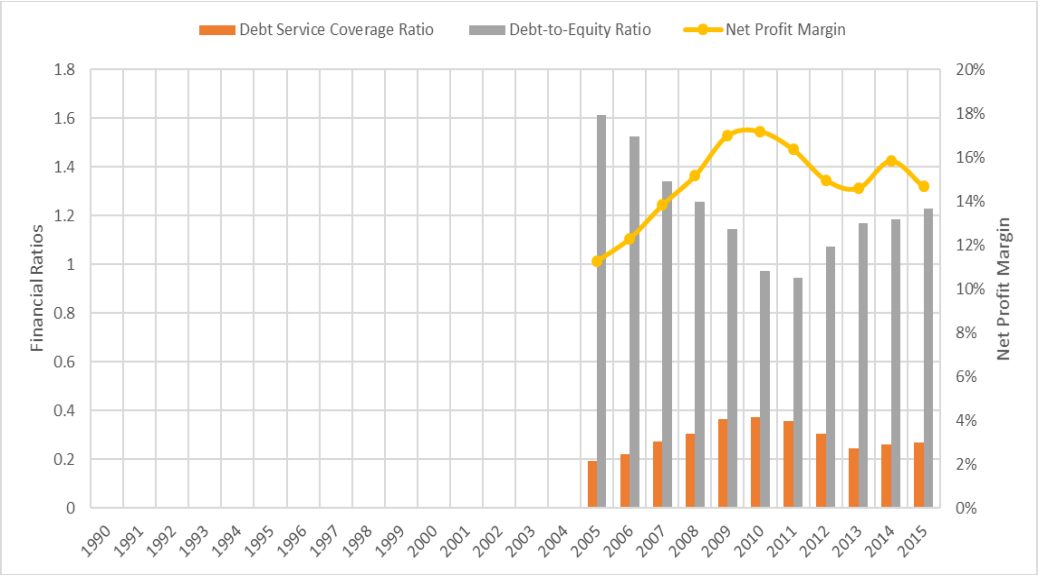
Figure 3-6: Electricity losses in Peru's distribution segment, 1990 – 2015.



Source: Rethinking Power Sector Reform project, and OSINERGMIN.

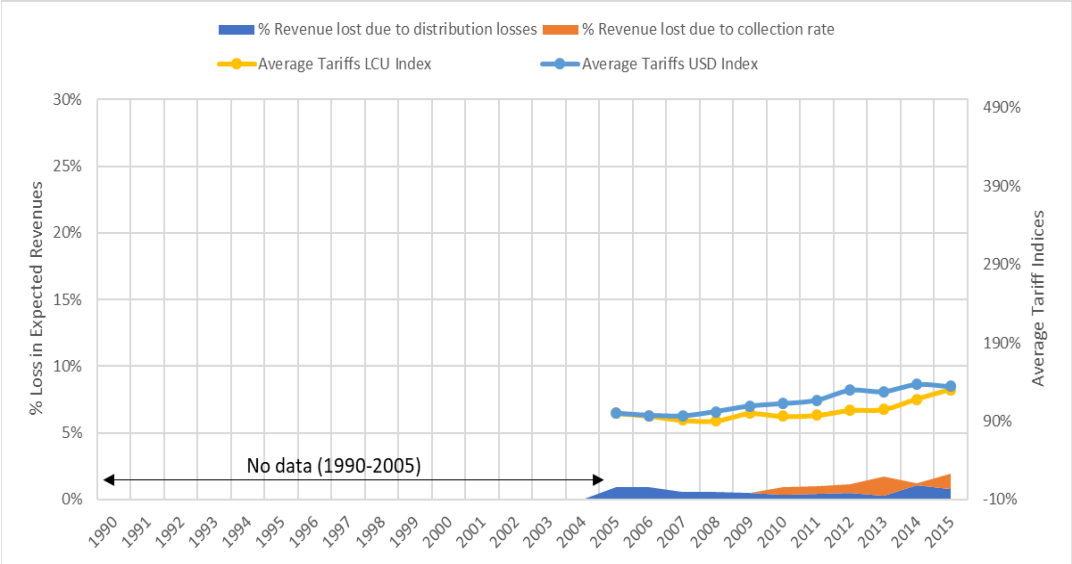
Luz del Sur appears to be very efficient according to the data and indicators developed in this project. Since 2005, the utility has consistently shown a healthy profit margin, debt service coverage ratio and debt equity ratio (see Figure 11). The utility has maintained distribution losses slightly above the benchmark "efficient loss" level of 7%, reaching 8% in 2015; collection rates have also been very high, resulting in very low lost revenues due to inefficiency (see Figure 12).

Figure 3-7: Evolution of Luz del Sur's profit margin and debt ratios, 2005-2015



Source: Rethinking Power Sector Reform Project

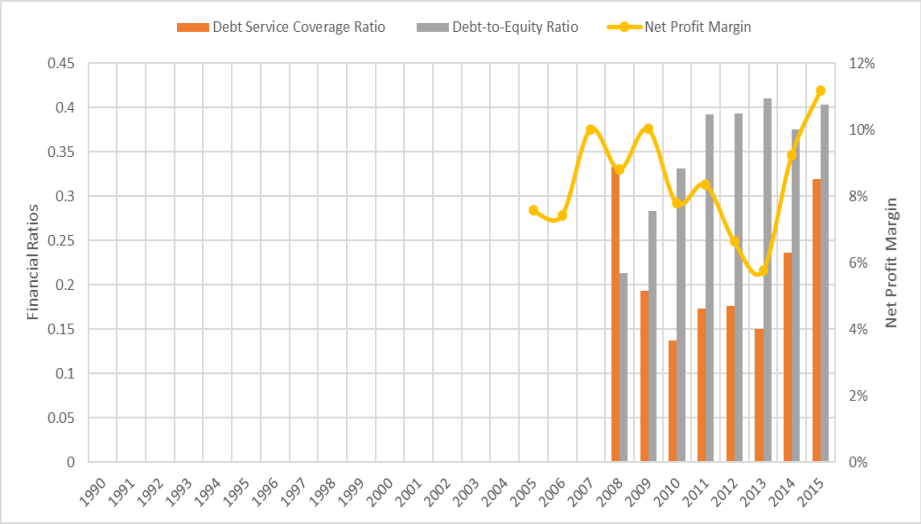
Figure 3-8: Evolution of Luz del Sur's operational inefficiencies and average tariffs, 2005-2015



Source: Rethinking Power Sector Reform Project

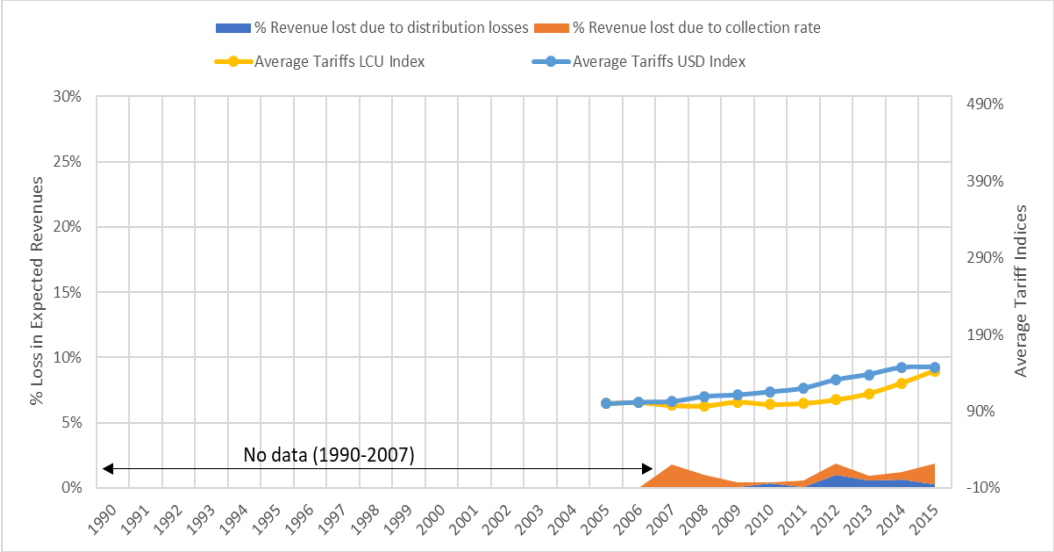
Hidrandina also appears to be efficient, although behind Luz del Sur. Since 2005 Hidrandina has consistently shown a healthy profit margin above 5%, although the debt service coverage ratio has been below 0.4 during the analyzed period, raising concerns regarding the availability of cash flows to cover debt; indeed, the debt-to-equity ratio has also increased in recent years (see Figure 13). The utility has successfully controlled distribution losses, keeping them slightly above the benchmark "efficient loss" level of 10% for a comparable utility; and collection rates have also been very close to 100%, resulting in very low lost revenues due to inefficiency (see Figure 14).

Figure 3-9: Evolution of Hidrandina's profit margin and debt ratios, 2005-2015



Source: Rethinking Power Sector Reform Project

Figure 3-10: Evolution of Hidrandina's operational inefficiencies and average tariffs, 2005-2015



Source: Rethinking Power Sector Reform Project

Service quality in Peru is high on average but varies significantly across distribution companies, being relatively low in the Northern and Rural zones. Firm-level data collected by the 2017 World Bank Enterprise Survey indicates that electricity outages experienced by firms operating in Peru are mostly below the average for LAC countries (see Table 5). However, outage indicators vary significantly across different locations within Peru. For example, firms in Lima report relatively few outages (below the LAC average), while firms in Piura report many and more prolonged outages (above the LAC average).

Table 5: Firm-level indicators of supply reliability

Indicator	Peru						Latin America & Caribbean
	Country average	Lima	Arequipa	Trujillo	Chiclayo	Piura	
Percent of firms experiencing electrical outages	52.0	47.9	69.2	68.6	31.4	81.2	64.8
Number of electrical outages in a typical month	0.5	0.2	1.6	1.0	0.6	2.0	2.1
Average duration of outage (hours)	4.6	5.1	4.2	5.7	2.4	3.9	2.7
Average sales lost due to outages (% of annual sales)	2.1	1.6	2.8	3.1	3.1	4.0	1.7
Firms owning or sharing a generator (%)	17.5	17.4	14.0	20.0	16.7	39.2	26.0
Average proportion of electricity from own generator (%)	6.6	6.5	7.2	5.4	5.2	8.2	14.5

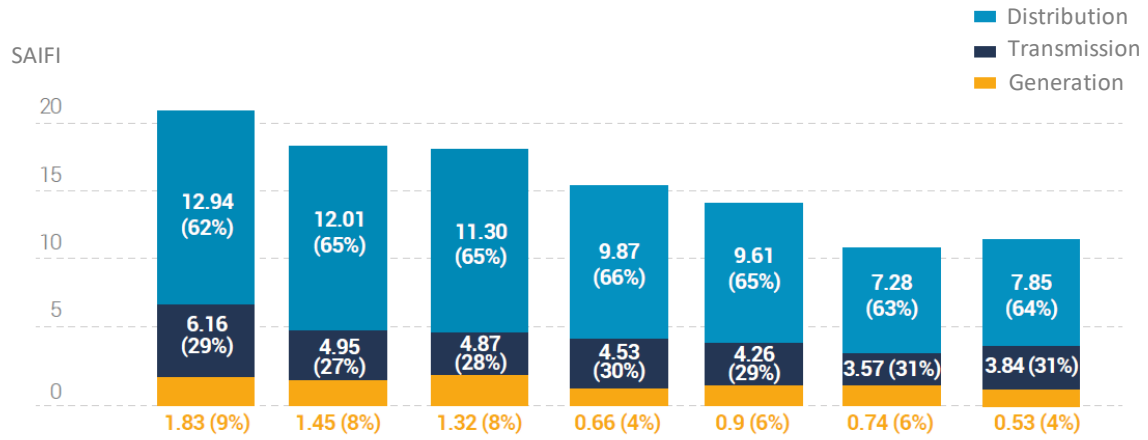
Source: 2017 World Bank Enterprise Survey.
Cities with the worst indicator are highlighted with an orange background.

Measured by distribution-level data, quality of service in Peru has improved markedly between 2012 and 2018, exhibiting fewer and shorter interruptions on average (see Figure 15 and Figure 16). The distribution-level SAIFI fell from 13 interruptions in 2012 to 8 in 2018, while SAIDI fell from 30 hours in 2012 to 18 in 2018. According to OSINERGMIN, these performance improvements are the result of the regulator's oversight efforts targeted at locations with the lowest quality of service. Indeed, while distribution-level quality of service remained stable in Lima since 2010, SAIDI and SAIFI has shown sustained improvements in the rest of the country.

Nonetheless, quality still varies widely across distributors, with Luz del Sur averaging 4 interruptions and 12 hours in 2018, compared to Electro Pangoa averaging 51 interruptions and 114 hours in 2018 (see Figure 3-13).[18] Quality of service also improved significantly for companies operating in high density areas during the first years of reform. For example, SAIFI and SAIDI for Edelnor fell by 75% and 77% respectively between 1995 and 2001, but there was no noticeable trend between 2002 and 2007 (Anaya, 2010).

[18] Public data available online at: http://gisem.osinergmin.gob.pe/vmap/PowerOutages/Start

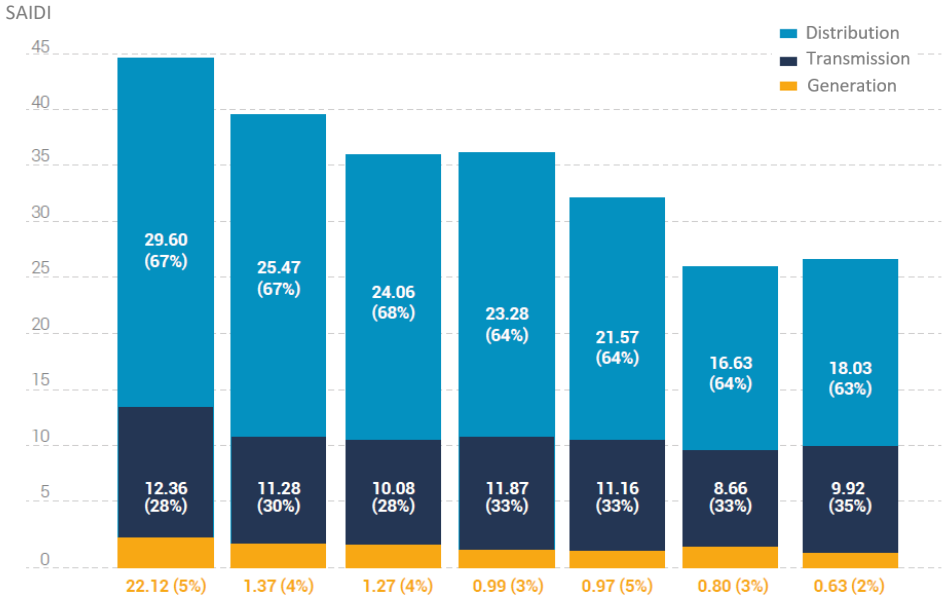
Figure 3-11: SAIFI in Peru, 2012-2018.



	2012	2013	2014	2015	2016	2017	2018
SAIFI	20.9	18.4	17.5	15.1	14.8	11.6	12.2

Source: (OSINERGMIN, 2019a).

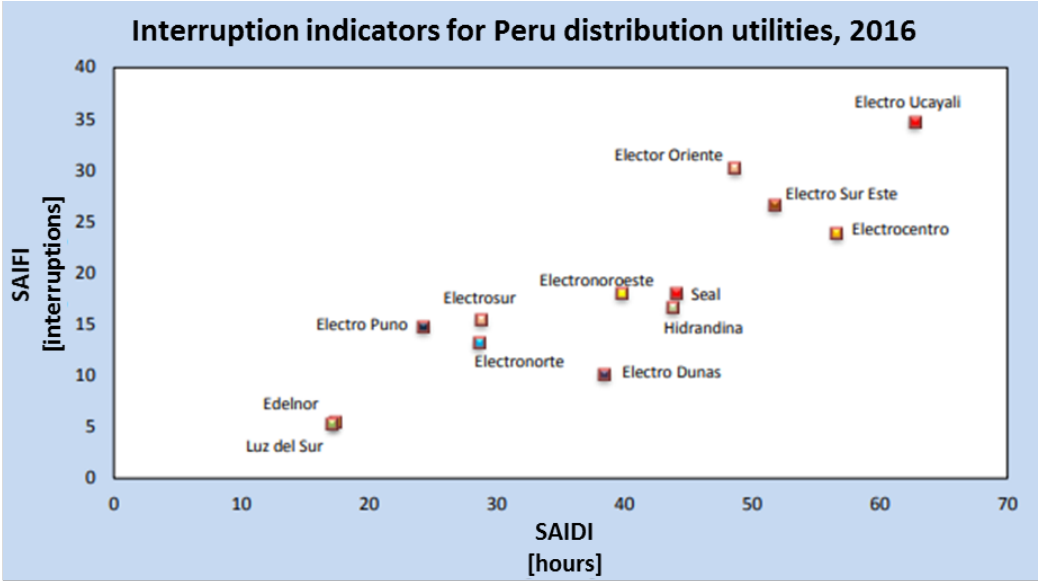
Figure 3-12: SAIDI in Peru, 2012-2018.



	2012	2013	2014	2015	2016	2017	2018
SAIDI	44.1	38.1	35.4	36.1	33.7	26.1	28.6

Source: (OSINERGMIN, 2019a).

Figure 3-13: SAIDI and SAIFI for Peru distribution utilities, 2016.



Source: OSINERGMIN.

4.3.2 Institutions

Peru's power sector reform comprised a relatively high degree of vertical unbundling and private sector participation across the electricity supply chain (see Table 6 and Annex D). Peru's power sector before reforms was entirely government-owned. Within the reform package, unbundling and private sector participation increased during the 1990 decade, especially for the generation and transmission segments. However, the initial impetus of privatization receded in the 2000's, and currently government ownership in the distribution sector remains above 90%. Thus, regarding restructuring and private sector participation, Peru scores high relative to the international benchmark, lagging only Philippines among comparator countries.

Table 6: Extent of utility restructuring and private sector participation in Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International Benchmark
Utility Restructuring	**35%**	**73%**	**100%**	**47%**	**45%**
Vertical Unbundling	70%	80%	100%	60%	55%
Horizontal Unbundling	0%	67%	100%	33%	34%
Pvt sector participation	**49%**	**61%**	**62%**	**10%**	**24%**
PSP in Generation	63%	78%	84%	31%	41%
PSP in Distribution	35%	19%	39%	0%	16%
PSP in Transmission	50%	88%	66%	0%	14%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

Corporate governance of sample Peruvian utilities is widely variable, being very high for privatized Luz del Sur and very low for state-controlled Hidrandina, relative to comparators (Table 7). Luz del Sur is a privately managed company, controlled by California-based Sempra Energy, scoring very highly in Corporate Governance indicators (85%). In turn, Hidrandina scores 40% in corporate governance, well below the international benchmark for the project (62%). Hidrandina is part of Distriluz, controlled by the government through FONAFE with a majority stake of 95%. Hidrandina's low score is related to the lack of a transparent processes for board selection and appointment and the little room provided to the board to make business decisions.

Table 7: Corporate governance of utilities in Peru and comparators, 2015

	Colombia		Peru		Philippines		Vietnam		International
	EPM	CODENSA	Luz del Sur	Hidrandina	MERALCO	BENECO	NPC	HCMPC	benchmark
Corporate Governance	**76%**	**96%**	**85%**	**40%**	**100%**	**83%**	**8%**	**8%**	**62%**
Accountability	*75%*	*92%*	*92%*	*58%*	*100%*	*67%*	*17%*	*17%*	60%
Autonomy (SOEs)	*78%*	*100%*	*78%*	*22%*	*100%*	*100%*	*0%*	*0%*	63%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

The utility management indicator is very high for Luz del Sur (85%, the highest among comparator utilities, see Table 8), due to their solid financial discipline, transparent accounting system, formal operation procedures and usage of latest technologies key for the business. Hidrandina also scores above the international benchmark and among top comparator utilities in the management indicator, with weaknesses related to financial discipline given that common practices in privately-managed companies have not been fully implemented.

Table 8: Utility management index of utilities in Peru and comparators, 2015

	Colombia		Peru		Philippines		Vietnam		International
	EPM	CODENSA	Luz del Sur	Hidrandina	MERALCO	BENECO	NPC	HCMPC	benchmark
Utility Management	**83%**	**43%**	**85%**	**70%**	**81%**	**68%**	**65%**	**65%**	64%
Financial Discipline	*76%*	*69%*	*86%*	*65%*	*71%*	*53%*	*53%*	*53%*	59%
Human Resource	*86%*	*60%*	*90%*	*71%*	*79%*	*86%*	*50%*	*50%*	62%
Information and Technology	*87%*	*0%*	*80%*	*73%*	*93%*	*67%*	*93%*	*93%*	71%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

4.3.3 Summary

Reforms implemented in Peru resulted in full vertical unbundling but partial distribution privatization. The reform package promoted efficiency and productivity gains in the power sector, with gains most evident for private distribution utilities. Country-average distribution losses fell from 22% in 1993 to 9% in 2002, and has since stabilized around an efficient loss level of 7%-8%. Quality of service has also improved, particularly since 2012 following oversight and sanctioning efforts by OSINERGMIN. However there are large disparities between regions and utilities with some performing at international best practice levels while others performing quite poorly. Two Peruvian distribution companies were further analyzed,

privately-owned Luz del Sur and government-owned Hidrandina. Both utilities have performed relatively well, with positive profit margins, near-efficient losses and high collection rates. These utilities also score relatively high compared to utilities in other developing countries regarding operational and financial performance. Privately-owned Luz del Sur has adopted best international management practices and processes, scoring as the best utility among comparators. Although government-owned Hidrandina is relatively well managed overall, it lags behind comparator utilities in some aspects such as corporate governance (due to insufficient autonomy).

4.4 Tariffs and cost recovery

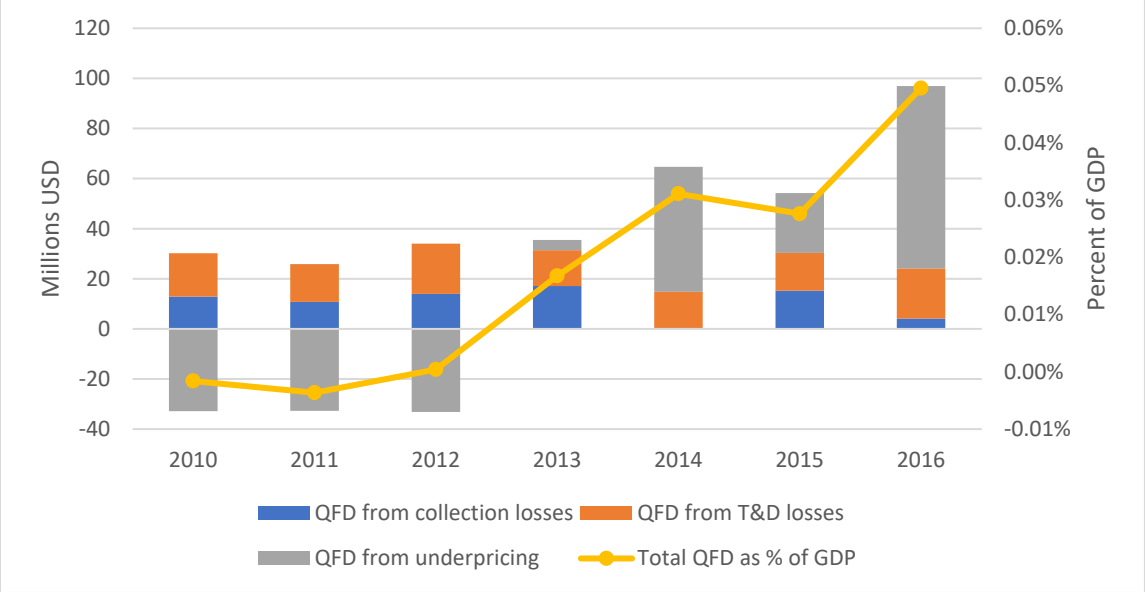
4.4.1 Performance

Financial viability of the two Peruvian utilities is analyzed next in terms of the degree of cost recovery for the 2010-2016 period. This analysis focuses on Luz del Sur, a private distribution company serving 30 districts in Lima, with 940 thousand customers; and Hidrandina, a majority state-owned distribution company serving Ancash, La Libertad, and part of Cajamarca, with over 800 thousand customers. First, the Quasi-fiscal Deficit (QfD) is used to quantify and decompose Luz del Sur and Hidrandina's revenue gap, which is close to or equal to zero. Second, tariffs are compared to different cost-recovery levels. Third, subsidies, cross-subsidies and revenue per customer group is compared to cost-recovery levels. Fourth, standard financial ratios are presented for 2016.

The revenue gap in a power utility can be measured using the quasi-fiscal deficit (QfD), a measure that compares the revenues that would be captured by an 'ideal utility' with the revenues captured by the actual utility. The ideal utility would charge cost recovery tariffs, fully collect revenues and keep distribution losses to a technical minimum. Thus, the gap between the ideal and the actual utility can be decomposed according to the portion attributable to under-recovery of costs through tariffs depressed below cost-recovery levels, the portion attributable to the under-collection of revenues due to commercial inefficiencies, and the portion attributable to excessive distribution losses.

The small quasi-fiscal deficit (QfD) attributable to Luz del Sur and Hidrandina is caused by under-collections (Figure 17). The total QfD attributable to Luz del Sur and Hidrandina was USD 96 million (0.05% of GDP) in 2016. A rising trend is observed in the QFD from the period 2010-2012 when there was no QFD (Pricing cancelled losses from collections and T7D). The rise in QFD can be entirely attributed to under recovery of costs which have gone up from -$32 million in 2010 to $73 million in 2016, constituting 96% of the QFD. Distribution losses were close to the target loss of 5% and did not contribute to the QFD.

Figure 3-14: Quasi-Fiscal Deficit Attributable to Luz del Sur and Hidrandina

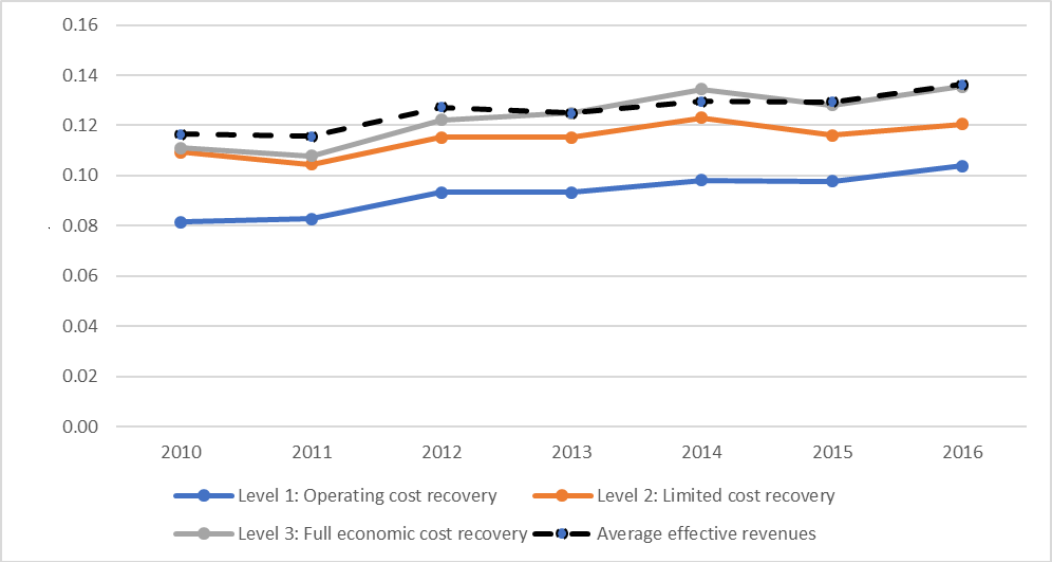


Source: Rethinking Power Sector Reform project

Financial viability of the power sector largely depends on achieving cost-reflective tariffs. To assess Peru's progress toward cost recovery, a detailed analysis of Luz del Sur and Hidrandina's financials was conducted. The analysis sets benchmarks for three levels of cost recovery: (i) operating costs only (A1 level); (ii) operating costs plus limited capital costs, such as debt service (A2 level); and (iii) full capital costs on current and planned future investments (A3 level). The financial viability analysis does not account for costs associated with service delivery that are covered separately by other parties, for example if a donor provides concessional capital. In a second stage, the analysis evaluates the sector against a full-cost-recovery benchmark that incorporates any costs that are currently subsidized. Data for the analysis were available for the period 2010–2016.

Average tariff revenues for Luz Del Sur are just above the complete cost recovery level accounting for current and future capital investments. Apart from 2014 when the average tariff could not cover this level, tariffs at Luz Del Sur have always been above full cost-recovery level (A3, see Figure 18).

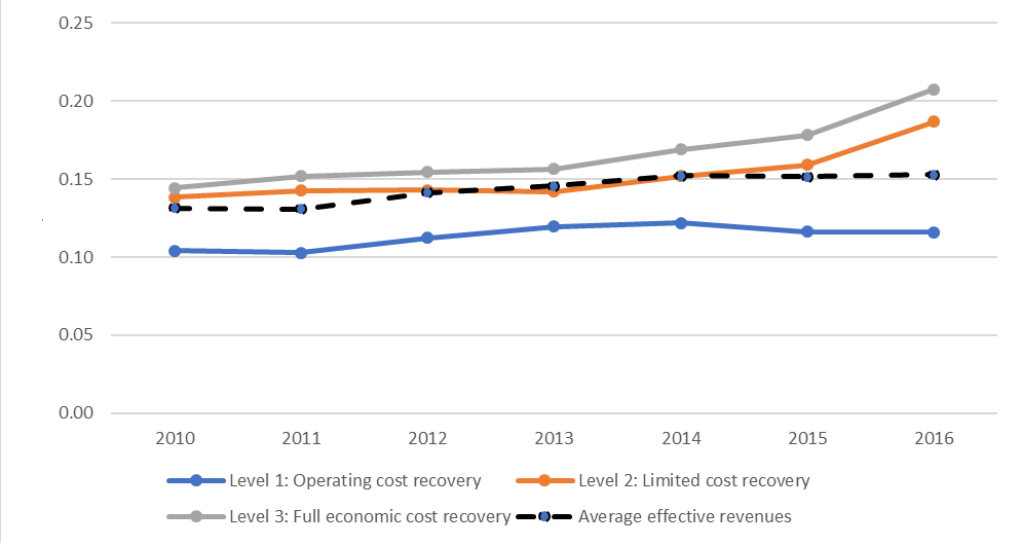
Figure 3-15: Evolution of tariff and full financial cost recovery for Luz del Sur



Source: Rethinking Power Sector Reform project

In turn, Hidrandina's average tariffs are consistently at or below limited cost-recovery level (see Figure 19). The average tariff revenues at the SOE have struggled to reach level 2- the limited capital cost recovery level though it has remained quite close to it. In 2016 this trend is broken, with Hidrandina's tariffs significantly lower than the levels required to cover the capital costs.

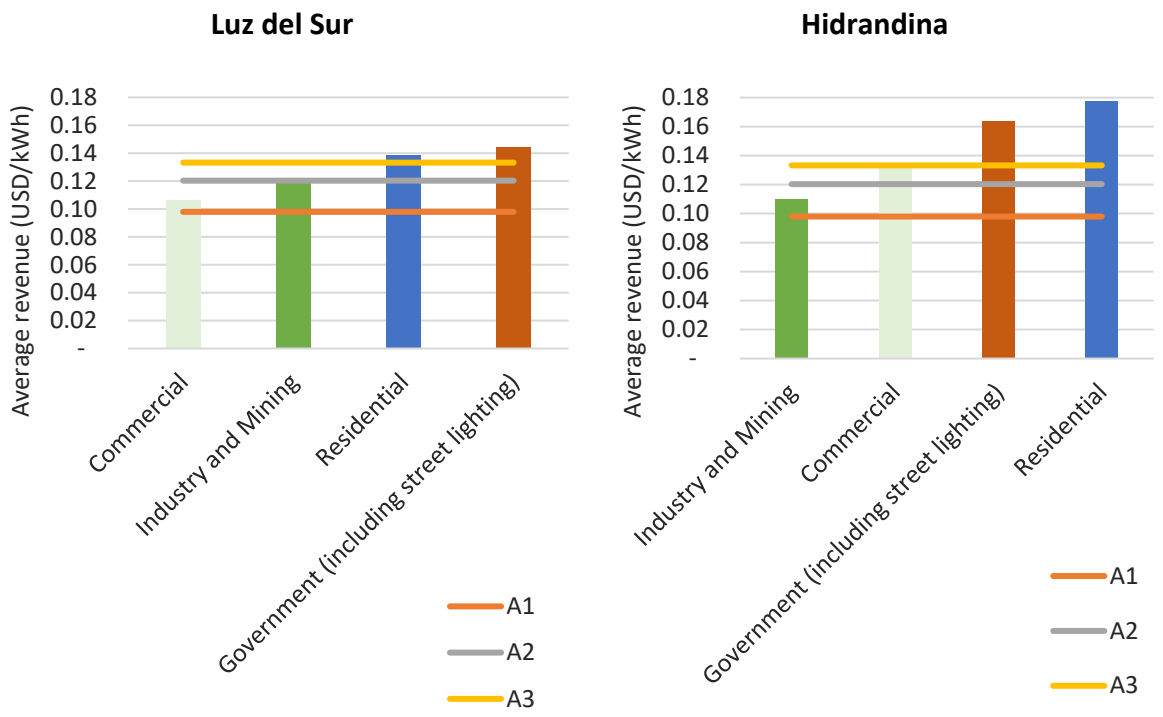
Figure 3-16: Evolution of tariff and full financial cost recovery for Hidrandina



Source: Rethinking Power Sector Reform project

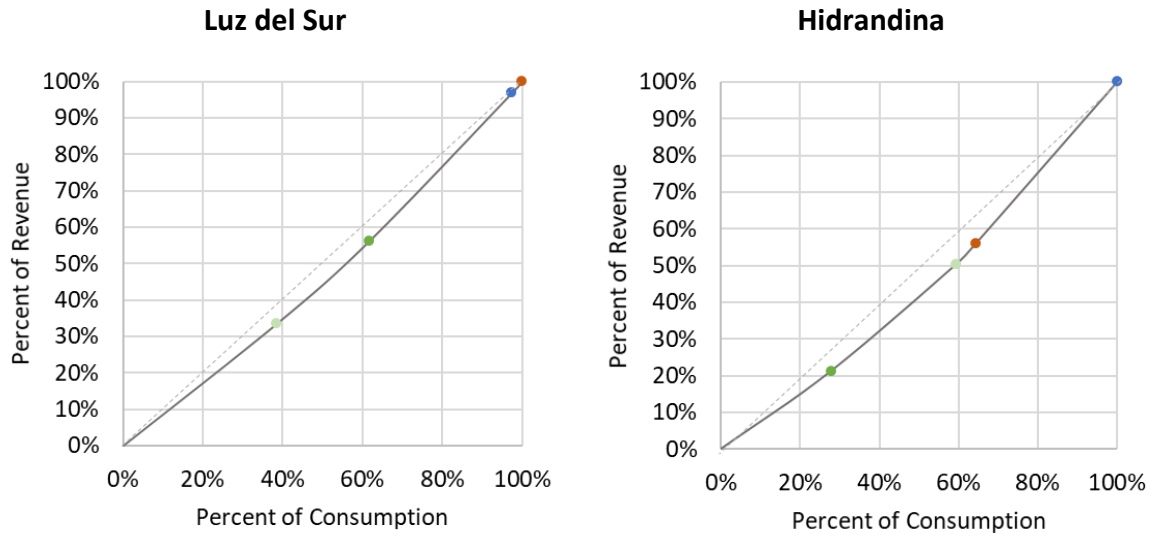
Residential customers contribute a higher share of revenues than their share of consumption. Hidrandina shows a greater level of disparity between the share of revenue and the share of consumption from residential customers than Luz del Sur. Hidrandina's residential customers make up 36% of consumption but 44% of revenues; Luz del Sur's residential customers also make up 36% of consumption but only 41% of revenues. For both utilities, industrial and commercial customers contribute a lower share of revenues than their share of consumption, but it is possible that they also have lower costs of service than the average across customer classes. Figure 20 shows the average tariff revenue for each customer class compared to cost-recovery levels A1-A3. Figure 21 compares the percent of consumption for each customer class to the percent of revenue from that class.

Figure 3-17: Average Tariff Revenue and cost recovery by customer group, 2016



Source: Rethinking Power Sector Reform project

Figure 3-18: Percentage of revenue against percentage of consumption by customer group, 2016



Source: Rethinking Power Sector Reform project

No subsidies are provided directly to the utilities, but support for rural electrification is provided through a cross-subsidy from urban customers and funding from the Ministry of Energy and Mines. Urban areas have 100 access, but rural areas are still struggling, with a rate of 75.6 percent. As electrification projects reach more distant populations, the costs of electrification increase. Distribution companies cover some of the costs of electrification through a surcharge paid by urban customers, but the majority of these costs are subsidized. Urban end-user tariffs (including urban residential, industrial, and commercial customers) include an earmarked surcharge for supporting electrification and social tariffs in rural areas. The Ministry of Energy and Mines also provides subsidies for rural electrification works. Electrification works taken on by Hidrandina, for example, are approximately 80 percent subsidized by the state.

Luz del Sur and Hidrandina are profitable and able to fund investments through a combination of inflows from operations and external financing. Luz del Sur has made a profit in each year 2011-2016, although it has seen a slight decline in the profit margin and EBITDA margin over time.

Hidrandina has also made a profit in each year and has seen an upswing in the profit margin and EBITDA margin since their lows in 2013. Both companies have been able to pay out dividends in each year 2010-2016. However, given that Hidrandina is a public distribution utility that is controlled by the government through FONAFE, it does not get to spend these revenues itself. Under the FONAFE system, all government controlled utilities send the revenues to FONAFE who then provides annual investment funding.

Both utilities have positive cash flows from operating activities and are more reliant on cash flows from operations than external financing to fund investments, with negative external financing index ratios. Overall, investments in the sector grew at an average annual rate of 20% in 2004-2012 to reach a peak of USD 2,467 million in 2012. Annual investments are substantially lower now but have remained steady in recent years, with investments totaling USD 145 million in 2016 (12 percent of revenues). The sector has attracted USD 16,600 million in private investment in the last 20 years. The average borrowing rate,

meanwhile, has increased from 4.7% in 2011 to 5.5% in 2016, but even a borrowing rate of zero percent would not bring Peru to full financial cost recovery.

Table 9: Summary of Financial Indicators against Sample Average

Financial indicator	Luz del Sur	Hidrandina	Sample Average*
Net profit (loss) margin (%)	13%	11%	-12%
EBITDA margin (%)	24%	24%	6%
Current ratio	0.59	0.52	0.79
Debt service coverage ratio	0.79	1.00	-4.56
External financing index ratio[19]	-0.26	-0.39	6.92
Investment as percentage of revenues (%)	12%	12%	18%
Average borrowing rate (%)	6%		6%
Government transfers as percentage of utility revenue (%)	0%		6%
Net capital cost recovery ratio[20] (%)	75%		16%

Note: samples average includes Tanzania, Senegal, Peru, Colombia, Pakistan, the Philippines, Vietnam, Kenya, Uganda, Tajikistan, the Indian states of Rajasthan, Odisha, and Andhra Pradesh, Egypt, and Ukraine.

4.4.2 Institutions

Before 1992 reforms, electricity tariffs settings and review was a function of an ad-hoc entity called Electricity Tariff Commission (CTE), a decentralized institution of MINEM, with technical and some functional autonomy. Although the CTE had ample technical autonomy, the Ministry of Economy and Finance had a veto power to the final approval of CTE tariff proposals.

The Electricity Concession Law introduced in 1992 maintained the CTE as the technical entity in charge of electricity tariff setting and review (i.e. economic regulation of the sector), incorporating additional functions and expanding its technical, functional, administrative and financial autonomy, giving to CTE characteristics of an independent regulator (CTE board composition changed, reducing its members to 5 and providing more independence and autonomy to the board). Electricity sector oversight, supervisory and sanctioning functions were kept under MINEM itself. CTE overviewed, from the regulatory point of view, all the privatization processes in the sector, establishing the starting electricity rates prior to privatization and the subsequence tariffs resetting after privatization.

At the end of 1996, by Law N° 26734, the government established OSINERG, the Supervisory Body of Energy Investment, transferring the oversight, supervisory and sanctioning sector functions from MINEM. In 1999, by Law N° 27116, the name and functions of CTE were changed (to Energy Tariffs Commission), expanding its activities to regulate also the pipeline transport of liquid hydrocarbons and natural gas transport and distribution.

The split of regulatory functions between CTE and OSINERG continued till 2000 when the government approved the Law N° 27332, the Framework Law of Private Investment Regulatory Bodies in Public

[19] *External financing index ratio* measured as net cash flow from financing divided by the net cash flow from operations.
[20] *Net capital cost recovery ratio* is the percent of full capital costs that can be recovered through tariff revenues net of operating costs.

Services. The third final provision of this law established the merger of CTE and OSINERG in one entity, which was named OSINERG. In 2007, OSINERG also assumed the responsibility of monitoring the mining sector, renamed as OSINERGMIN.
OSINERGMIN has the following functions established by law:

(i) Supervisory function: It includes the power to verify the fulfillment of the obligations of supervised agents, the established sectoral regulations and in the contracts under the scope of competence of OSINERGMIN;

(ii) Regulatory function: It includes the power to set the tariffs for public electricity and natural gas services under its scope, which includes resolving, as the only administrative body, the review actions that the interested parties interpose;

(iii) Regulatory function: It includes the exclusive power to dictate, in the scope and in the field of its respective competence, the regulations on the procedures under its responsibility; including special administrative procedures that govern the administrative processes related to the supervisory, specific supervisory and sanctioning functions;

(iv) Fiduciary and sanctioning function: It includes the power to carry out actions leading to impose sanctions on agents for breach of obligations established in the sectoral regulations under the scope of OSINERGMIN; as well as for non-compliance with regulations issued by the regulatory body;

(v) Dispute resolution function: this includes the ability to reconcile competing interests between agents within their sphere of competence, and between them and large/free users or independent consumers of natural gas;

(vi) User complaints solution function: it includes the power to resolve, in the second administrative instance, the appeals filed by regulated users of electricity and natural gas services against those resolved by the distribution companies that provide such services; and

(vii) Specific supervisory function: it includes the power to verify the fulfillment of the obligations established in the contracts derived from the processes of promotion of private investment, related to the activities under the scope of OSINERGMIN.

OSINERGMIN has a clear and detailed governance structure and are self-governing to define their technical guidelines, analysis and evaluations, and its objectives and strategies. Notwithstanding OSINERGMIN (as the other regulatory agencies) can define its expenditure policy, this has to be done in accordance with the central government policy defined in the Organic Law of the Executive Branch. The general and extended practice of the Peruvian regulatory bodies of public services has been of full autonomy of their decisions and their independence from government and regulated companies influence.
OSINERGMIN scores 83% in this project's indicators for regulatory governance, being the highest among comparator regulators and well above the international benchmark of 59% (see Table 10). The Peruvian electricity sector regulator also scores very high across all regulatory governance subcategories.

Table 10: Formal regulatory governance in Colombia and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Regulatory Governance	**45%**	**83%**	**48%**	**32%**	**59%**
Accountability	**75%**	**85%**	**95%**	**64%**	**83%**
Regulatory Oversight	67%	67%	100%	67%	81%
Legal Appeals	100%	100%	100%	100%	100%
Transparency	57%	89%	85%	25%	67%
Autonomy	**60%**	**98%**	**51%**	**50%**	**71%**
Decision-Making Autonomy	64%	92%	79%	36%	79%
Budgetary Autonomy	88%	100%	50%	50%	80%
Leadership Autonomy	88%	100%	75%	14%	66%
Managerial Autonomy	0%	100%	0%	100%	59%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

Economic regulators in Peru have implemented relatively advanced **transparency and accountability** practices, even more than the central government. For example, regulators are accountable to the Ministry of Economy and Finance (MEF by its Spanish acronym) in budget execution and to the President of the Ministers Council (PCM by its Spanish acronym) in strategic plans. Although regulators are not required to send annual performance reports to Congress, reports are submitted whenever requested.

Regulators publish their regulatory projects before they come into effect, and conduct transparent public consultation processes for some regulations. OCDE's best practices aim to establish consultation for all types of regulation issued. It is also recommended to publish the justification for the regulation. In addition, Law 28964 requires regulators to establish User Councils, aiming to ensure participation of interested parties in the regulatory process, contributing to formalization of the relationship between public institutions and sector stakeholders. Nevertheless, regulators also conduct consultations with individuals for some specific cases. To reduce the risk of regulatory capture, all transparency and consultation practices must be formalized and systematically applied.

Regulators publish indicators focused on the quality of services, the effectiveness of the budget exercised, the efficiency and results of its programs, among others. Nevertheless, indicators measuring compliance with public policy objectives (such as contributing to economic growth) are scarce.

OSINERGIM also carries out Regulatory Impact Assessments (RIAs) which consider the possible costs and benefits stemming from the regulation, both from the private as from the societal point of view. The RIA imparts transparency to the decision-making process leading to the adoption of a particular regulatory option. OSINERGMIN clearly states the rationale for altering the current scenario, indicating the objectives that are pursued, the comparison of regulatory options that allow reaching those objectives, and the examination of the effectiveness of the proposed intervention. These analyses are disseminated to

interest groups and the general public, according to guidelines officially approved on 2016 by OSINERGMIN Board of Directors[21]. Direct stakeholder participation is one of the most important components of RIA development, going beyond a simple submission of comments to regulatory drafts. Through this participation process, OSINERGMIN collects information to define the best policy option that meets the objectives set, as well as the analysis of the costs and benefits of regulatory proposals.

The **regulator's autonomy** is legally established by Law N° 27332, the Framework Law of Private Investment Regulatory Bodies in Public Services, which clearly stipulates that the regulatory institutions will have administrative, functional, technical, economic and financial autonomy. Furthermore, members of the Board of Directors are elected in accordance with current regulations, and hold their positions with full autonomy and independence of judgment. Board members are appointed by means of a public competition of professional experience, knowledge and merits.

Article 37 of OSINERGMIN bylaws establishes that the supervisory and sanctioning function can be exercised ex officio, or by denunciation of part. The sanctions will be imposed by the General Management. Its resolutions may be appealed to the Board of Directors, which resolves in the second and last administrative instance. Every act that OSINERGMIN issues in the exercise of its functions is an administrative act that is performed in the exercise of the *"ius imperium"* of the State. In order to challenge the decisions issued by OSINERGMIN, a contentious administrative proceeding must be filed. In other words, in those cases in which an affected party is not in accordance with what was resolved by OSINERGMIN - in the second instance - the Judicial Power must be sought to exercise control over the performance of the public administration.

Moving on to regulatory substance, Peruvian regulations are very effective and above international benchmarks for almost all aspects analyzed in this project (see Table 11). Regulation of tariffs and quality of service is further discussed below, while further details can be found in the Annexes.

Table 11: Formal regulatory substance in Colombia and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Regulatory Substance	**81%**	**83%**	**95%**	**85%**	**76%**
Tariff Regulation	**92%**	**100%**	**93%**	**83%**	**77%**
Regulatory Framework for Tariffs	100%	100%	86%	100%	90%
Determination of Tariffs	83%	100%	100%	67%	64%
Quality Regulation	**100%**	**100%**	**92%**	**71%**	**75%**
Quality of Service Standards	100%	100%	100%	75%	82%
Quality of Service Enforcement	100%	100%	83%	67%	68%
Market Entry Regulation	**50%**	**50%**	**100%**	**100%**	**77%**
Permitting New Entrants	50%	100%	100%	100%	90%
PPA Approvals	50%	0%	100%	NAP	57%

[21] "Guide for the Realization of the RIA in OSINERGMIN", Agreement No. 01-13-2016 in accordance with the "Country Program".

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

A solid regulatory framework for **tariff determination** is in place in Peru, thus scoring 100% in the tariff regulation indicator. The Peruvian electricity price/tariffs regime has been designed on the basis of full cost recovery for the provision of the electricity service, in each of the three segments: generation, transmission and distribution. While transmission and distribution and regulated segments, the generation segment is subject to competition. The rates/tariffs for regulated segments are established by OSINERGMIN, based on the allocation of efficient investment and O&M costs to the different types of electricity users. Tariff determination follows a written formula that prescribes how end-user tariff levels are to be set, it is publicly available, and the regulator must adhere to it. General tariff principles are outlined next, and further details are provided in Annex C.

Generation is subject to competition in Peru. A transparent cost-based power pool serves as competitive spot market for generation scheduling and dispatch. Final tariffs depend mostly on contracts between customers and generation companies. While eligible customers can enter into freely negotiated contracts with generation companies, small customers (mostly households and small businesses) are subject to price regulation for the generation component. The generation tariff for these regulated customers is nonetheless based on results from competitive supply auctions that distribution companies must independently organize to serve their forecast loads. Although there has been no regulatory intervention directly in contracts, it is worth noting that there has been some degree of ex-post intervention in the spot market through out-of-market payments to achieve public policy objectives (such as developing the domestic natural gas industry or increasing supply reliability in specific geographic zones).

For monopoly activities such as distribution and transmission, only efficient costs (those that guarantee cost recovery for company with efficient management) are passed on to tariffs. Regarding transmission, Law 28832 of 2006 established that expansion is determined by a centralized planning process, and competitive tenders are used to award the developer and clear the price of new transmission projects. Transmission facilities from before the competitive tender process are priced according to efficient costs determined by the regulator.

Distribution tariffs are calculated every four years, following technical studies carried out by the distribution companies and reviewed by OSINERGMIN (these charges/tariffs are updated yearly). Distribution remuneration is based on a bottom-up approach known as model company remuneration, aiming at incentivizing efficiency. The model distribution company is a theoretical company built “from scratch” using the most efficient available technologies, network topologies to serve customers, and management structure, without considering past decisions, assets or structure of the real company. Cost-recovery revenues known as Distribution Added Value (VAD by its Spanish acronym) of this fictional company are provided to the real distribution company, to incentivize efficiency in terms of investment, maintenance, losses and management.

Quality of service regulation is also strong in Peru, scoring 100% in the respective indicator. In October 1997, MINEM approved quality standards (the Technical Standard for Quality of Electric Services - NTCSE) to measure the quality and conditions of service provided by electricity companies in urban zones, allowing a period of two years for compliance. If a minimum level of quality of service is not provided

(such as minimum SAIDI and SAIFI indicators), electricity companies are subject to fines and penalties imposed by OSINERGMIN, as well as to monetary compensatory mechanisms for customers who received sub-standard service. In 2008, MINEM approved the Technical Standard for Quality of Rural Electricity Services (NTCSER), establishing the minimum levels of quality of Rural Electrical Systems (SER) developed within the framework of The General Law of Rural Electrification N° 28749 and its regulations. In addition to the usual technical quality standards, the NTCSER also establishes the obligations of entities, directly or indirectly involved in the provision and use of this service, in terms of quality control, seeking an adequate balance between the provision of the service and the tariffs paid by users.

Beyond penalties, fines and compensations, quality of service is also incentivized through tariff uplifts. The linkage between performance and tariff was first introduced in 2015 by Legislative Decree 1221. The Decree allows distribution companies to collect an additional charge for up to 5% of the VAD (revenue base for the distribution company), associated to technological innovation and energy efficiency, according to plans developed by each company and approved by OSINERGMIN. However, few investment plans have been approved by the regulator. According to OSINERGMIN, quality of service improvements have primarily been the result of its own overseeing and sanctioning efforts, which has been focused in zones with low degrees of compliance with established quality indicators. Nonetheless, concerns have been raised regarding the institutional and financial capacity of state-owned distribution companies to invest in their networks.[22] Excessive government controls and restrictions imposed on SOEs may explain their lower performance compared to privately-owned utilities. Specifically, the restriction on raising long term debt (over 12 months) without cumbersome approval process is cited as particularly egregious. Other factors such as lower customer density, rurality and lower income customers also weigh in on performance (World Bank, 2012).

4.4.3 Summary

Power sector regulation in Peru is effective and adequately designed. The regulator is highly autonomous and an adequate oversight framework is in place. These institutions ensure that the regulator can properly execute its multiple functions beyond regulation, such as supervisory, dispute resolution and sanctioning functions. Regulations are strong and well-functioning in terms of tariffs and quality of service, both in theory and practice as reflected by the closely related De Jure and perceived indicators (see Table 12). Difficulties seem to relate primarily to state-owned distribution companies. Excessive government controls and restrictions imposed on SOEs has restricted their ability to invest in the network and has impacted network performance. Public discoms also see tariffs below full cost-recovery levels, and lower performance in terms of quality of service compared to private utilities (especially for utilities serving rural areas). Regarding the generation segment, out-of-market adaptations have been introduced to pursue public policy objectives (such as fuel diversification). These adaptations may undermine the market's performance, at least in the short term.

[22] See (Beltrán Villegas, Benites Velasquez, & Jerí Rojas, 2019) and https://gestion.pe/economia/empresas/a-proposito-de-los-deficientes-servicios-de-las-distribuidoras-electricas-estatales-se-deben-privatizar-noticia/

Table 12: Power sector regulation in Peru: de jure vs perceived performance, 2015

Indicators	De Jure	Perceived
Overall regulation	**70%**	**67%**
Regulatory Governance	**83%**	**80%**
Accountability	**85%**	**81%**
Regulatory Oversight	67%	67%
Legal Appeals	100%	100%
Transparency	89%	78%
Autonomy	**98%**	**98%**
Decision-Making Autonomy	92%	92%
Budgetary Autonomy	100%	100%
Leadership Autonomy	100%	100%
Managerial Autonomy	100%	100%
Regulatory Substance	**83%**	**83%**
Tariff Regulation	**100%**	**100%**
Regulatory Framework for Tariffs	100%	100%
Determination of Tariffs	100%	100%
Quality Regulation	**100%**	**100%**
Quality of Service Standards	100%	100%
Quality of Service Enforcement	100%	100%
Market Entry Regulation	**50%**	**50%**
Permitting New Entrants	100%	100%
PPA Approvals	0%	0%

Note: Scores based on index developed for the Rethinking Power Sector Reform Project. For more details go to project website at http://www.esmap.org/rethinking_power_sector_reform

5 Conclusion

Peru implemented comprehensive reforms during the 1990's, under a context of wider economic reforms and sustained political support. Despite efficiency and performance gains from reforms, privatization of distribution utilities proved difficult and stalled definitively in the early 2000's, leaving about 40% of the segment under state ownership. Some distributors have improved performance significantly, but quality of service vary widely across regions. During the early 2000's transmission and generation investment were also lacking. A comprehensive reform of the sector was launched in 2006, introducing competitive tenders for transmission and generation investment. Although the new framework proved very effective, out-of-market adaptations were introduced after 2010 to pursue public policy objectives, such as fuel diversification through the development of the domestic natural gas industry or increasing reliability in the southern zone of the country.

The results of Peru's efforts to reform its power sector along the four dimensions of security of supply, access and affordability, utility efficiency, and cost recovery are summarized in Table 13 and in the succeeding paragraphs.

Table 13: Summary of Colombia's power sector reform efforts

Dimension	Performance	Institutions
Investment & Security of Supply	Aggressive capacity additions have led to ample reserve margins, significantly reducing the system-wide risks of security of supply. However, this calls into question the efficiency of the system. Furthermore, challenges remain in the gas and electricity transport networks.	Regulated mechanisms introduced at the beginning of reforms proved ineffective at attracting investment. Mandatory supply auctions, to be organized by distribution companies, were introduced in 2006, thus introducing a direct linkage between market-clearing prices and final customer tariffs. Out-of-market adaptations to pursue public policy objectives have also been introduced since 2010, leading to a capacity surplus. The independent system operator is responsible for transmission expansion planning.
Access & Affordability	Peru has maintained very high access in urban areas, reaching 99% in 2017. However, serious gaps remain in access and minimum service quality for poor customers in rural and isolated areas. Despite enormous advances since 2000, only 81% of rural households had electricity access by 2017, and service is frequently interrupted.	MINEM has made many efforts to expand coverage to rural areas through expansion of existing networks were economically feasible, and also through massive programs for rooftop solar photovoltaic systems. Cross-subsidies have been established since 2001, but have been inadequately targeted in the past. Moreover, costs of public policy measures directly contribute to higher electricity tariffs for residential customers.
Utility Efficiency & Financial Viability	Distribution losses fell from 22% in 1993 to 9% in 2002. Quality of service also improved, with distribution-level SAIFI	Reforms implemented in Peru resulted in full vertical unbundling but partial distribution privatization. Privately-owned

Dimension	Performance	Institutions
	falling from 13 interruptions in 2012 to 8 in 2018, and SAIDI from 30 hours in 2012 to 18 in 2018. However, results vary significantly across distribution companies, with better indicators in urban areas. Both privately-owned Luz del Sur and government-owned Hidrandina perform well, with healthy profit margins above 5%, collection rates close to 100% and losses close to efficient levels (7% for Luz del Sur and 10% for Hidrandina).	Luz del Sur has adopted best international management practices and processes, scoring as the best utility among comparators. However, Hidrandina, a public discom lags comparator utilities in aspects such as corporate governance, highlighting a big concern for public discoms in the country.
Tariffs & Cost Recovery	Tariffs for private distributor Luz del Sur have been closely linked to full cost-recovery, including operating and capital costs. In turn, tariffs for state-controlled Hidrandina have been at or below limited cost-recovery levels, curbing their capacity to fully recover capital costs. The total QfD attributable to Luz del Sur and Hidrandina was mmUSD 96 (0.05% of GDP) in 2016 primarily due to undercollection. No subsidies are provided by the state, but cross-subsidies are established from high income to low-income customers.	Tariffs are set by the regulator through a formally established, transparent and organized process. However, there is room for improvement in incentive regulation, especially for ensuring investments by state-owned enterprises and in rural areas.

Security of supply is not currently a serious issue in Peru. Instead, the market's efficiency may be called into question due to the 81% reserve margin and very low wholesale prices, which signals a capacity surplus that should fall in the future. Aggressive capacity expansion over the past decade is a result of both market-driven reforms of 2006 and out-of-market public policies since 2010. Second-wave reforms in 2006 introduced competitive supply auctions which have been successful in attracting private investment to supply regulated customers (mostly households and small businesses). Furthermore, public policy objectives such as the diversification of the energy mix through development of the domestic natural gas industry, and increasing reliability in specific geographical zones, have also driven significant generation investment. Indeed, problems are currently related primarily to the natural gas transport and power transmission networks, which require further investments to relieve bottlenecks and increase security of supply in specific zones.

On access and affordability, Peru has substantially expanded coverage to rural and remote areas through public policies focused in expanding existing networks, and more recently through massive rooftop solar photovoltaic projects for off-grid locations. However, there is still a long way ahead for expanding coverage to remote or isolated zones which cannot be economically interconnected to existing distribution systems.

On utility efficiency, the Peruvian reform package promoted efficiency and productivity gains in the power sector, with gains most evident for private distribution utilities, although quality still varies widely across distributors especially among public utilities. Distribution losses fell for both private and state-owned

utilities, and quality of service improved, especially during the first years of reforms and between 2012-2018. These gains probably accrue to better management practices, improved corporate governance and incentive regulation introduced by reforms. Two sufficiently large Peruvian distribution companies with different ownership set up and where data availability would not be an issue were further analyzed; privately-owned Luz del Sur and government-owned Hidrandina. Both utilities have performed relatively well, with healthy profit margins, near-efficient losses and high collection rates. These utilities also score relatively high compared to utilities in other developing countries regarding operational and financial performance, although government-owned Hidrandina is lagging in corporate governance (especially autonomy).

On cost-recovery, tariffs allow privately-owned Luz del Sur to fully recover costs and investments, while tariffs for government-owned Hidrandina's are below full cost-recovery levels. Overall, difficulties seem to relate primarily to state-owned distribution companies, whom exhibit limited investment capacity (partly due to excessive government constraints) and lower performance in terms of quality of service compared to private utilities (especially for utilities serving rural areas). Power sector regulation in Peru is adequately designed, with an independent regulator that executes multiple functions, including supervisory, dispute resolution and sanctioning functions. Regulations are strong and well-functioning in terms of tariffs and quality of service, both in theory and practice.

Peru's experience with power sector forms offers some lessons for other developing countries which are currently considering or in the implementation process of similar reforms.

First, the introduction of incentive regulation, oversight and corporate governance enables efficiency and productivity gains, especially in the distribution segment. High-quality regulation and oversight following sound cost-recovery and governance principles is key to improving performance. The institutional framework put in place allows the independent Peruvian regulator, OSINERGMIN, to adequately perform its functions which also comprise oversight, sanctioning and dispute resolution, thus promoting efficiency gains and quality of service improvements among distribution companies. Although gaps remain, especially for utilities serving rural areas, there is ample evidence of the gains from the overall reform package.

Second, continued political support is paramount for completing reforms, especially privatization initiatives. Profound power sector reforms were implemented amidst wider economic reforms and a rather favorable political context in the early 1990's. Privatization also proceeded rather smoothly during the 1990's, backed by a strong political commitment. Although successful in transmission and generation, privatization stalled in the 2000's for the distribution sector after the political landscape changed and public support was lost. By 2018, the government still retained ownership of about 40% of the segment (in terms of sales). Poor corporate governance and excessive constraints imposed by the government may curb performance gains by public distribution companies, compared to private companies in Peru.

However, privatization efforts do not guarantee efficiency gains by themselves. Although private companies have shown marked performance improvements, state-owned utilities have also shown progress (albeit slower or to a lesser extent). Furthermore, factors such as higher rurality and lower customer density also drive poorer performance of SOEs serving such areas, compared to private distribution companies that serve primarily urban areas. Hence, improved regulation and public policies for rural areas, stronger corporatization and adoption of better management practices should be pursued besides privatization, as a mean of increasing performance.

Third, private capital delivers greenfield generation and transmission investment under adequately designed tariffs and procurement mechanisms. Reforms initially implemented in Peru relied on regulated pricing mechanisms for generation and transmission, which did not ensure stable cost-recovery revenues linked to market fundamentals. In the case of generation, pricing of the supply of regulated customers (mostly households and small businesses served by distribution companies) was based on expected marginal costs (spot prices) determined by theoretical simulations. Resulting generation tariffs were uncertain and deviated significantly from real market dynamics, thus limiting investor appetite for the segment and driving a contract deficit by the early 2000's. Transmission investment was also lacking, due to a lack of centralized expansion planning and the fact that marginal pricing did not ensure cost recovery. In response, the government launched a second wave of reforms in 2006, based on competitive supply auctions for generation, and centralized transmission expansion planning along competitive bidding for new transmission facilities. Investors would thus receive a more predictable long-term revenue, directly linked to their bids and underlying market fundamentals. These second wave reforms proved successful in attracting investment and increasing security of supply. Competitive auctions for renewable power has also been very successful in attracting investment and delivering falling prices, consistent with falling investment costs in wind and solar PV.

Fourth, direct state participation or guidance in the power sector can be very effective at attaining public policy objectives, although such success may come at the expense of efficiency. State participation and guidance has been key in increasing electricity service coverage and access in remote areas. Furthermore, out-of-market adaptations implemented since 2010 have been rather successful in the pursue of public policy objectives such as fuel diversification and increased reliability of specific zones. However, a reserve margin above 80% and depressed wholesale prices signal a (probably temporary) imbalance of the market. Sustained state participation in the generation segment risks introducing inefficiencies to a sector in which competitive forces have worked relatively well, especially if the framework for planning is not revamped (for example, through the creation of a dedicated technical unit for referential energy planning). Improving service quality and coverage in remote rural zones, as well as affordability for low income customers, should now be a more pressing concern given the current generation capacity surplus. Despite numerous regulatory and public policy efforts in this regard (such as cross-subsidies and off-grid initiatives), more progress is needed.

Reforms of the Peruvian power sector since 1992 have been successful in many respects. Independent tariff regulation and restructuring has yielded efficiency, productivity and quality of service improvements for the country, especially in urban areas. The power sector is financially sustainable and generation investments have outpaced growing demand, albeit through a mix of market forces and government-led policies.

However, outstanding challenges include achieving universal coverage, increasing affordability and quality of service in remote areas, and improving the performance of government-owned distribution companies. Incentive regulation, especially for ensuring investments by state-owned enterprises in rural areas have been hindered by excessive controls on SOEs and need to be revisited. At the same time SOEs have not been able to match the private sector when it comes to adopting best corporate governance practices.

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Annex A. Detailed RPSR Indices

A. Global reform index

The standard package of reforms prescribed by international donors in the 1990s included four principal components: restructuring (vertical and horizontal unbundling of power utilities); private sector participation; creation of an independent regulator; and competition in power generation.

In order to aggregate across the four dimensions of power sector reform considered in this study, a simple Power Sector Reform Index is constructed. The index gives each country a score on an interval of 0 to 100 on each dimension of power sector reform. The scores are based on giving equal weight to each step on each dimension of the reform continuum (see tabulation below). The average of the four 0-100 scores is used to provide an overall summary of the extent of reform.

Regulation	No regulator = 0			Regulator = 100	
Restructuring	Vertically integrated = 0	Partial vertical unbundling = 33		Full vertical unbundling = 67	Vertical & horizontal unbundling = 100
Competition	Monopoly = 0	IPPs = 25	Single Buyer Model = 50	Bilateral Contracts = 75	Competitive market = 100
Private Sector Participation	0.5*(Percentage of generation capacity with private sector participation) + 0.5*(Percentage of distribution utilities with private sector participation)				

Legend	
○	Satisfactory result
●	Unsatisfactory result
NAP	Not applicable
NAV	Not available

B. Generation and transmission planning index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Planning and Procurement	95%	77%	59%	59%	70%
Generation Planning	86%	43%	71%	71%	56%
Country has a generation master plan	○	○	○	○	94%
Country has an overall energy plan	○	○	○	○	65%
Competent entity is responsible for producing the plan	○	●	○	○	88%
Inter-governmental committee oversees the planning unit	○	●	○	●	29%
Power generation system plan is mandatory	●	●	●	○	19%
Plan leads to timely initiation of procurement	○	●	●	○	38%
Planning process is transparent and participatory	○	○	○	●	59%
Transmission Planning	100%	75%	50%	100%	72%
Competent entity is responsible for producing the plan	○	○	○	○	100%
Explicitly linked to power generation plans	○	●	○	○	88%
Plan is mandatory	○	○	●	○	29%
Planning process is transparent and participatory	○	○	●	○	71%

C. Generation and transmission procurement index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Procurement of Generation	95%	90%	100%	50%	85%
There is a framework for procurement	○	○	○	●	82%
Country allows International competetive bidding or public auctions for procurement	○	○	○	○	94%
Types of procurement methods allowed-					
Unsolicited bids	○	●	●	●	29%
Direct negotiation	○	●	●	○	47%
International competitive tendering	●	○	○	○	88%
Public auctions	○	○	●	●	41%
Stand-alone capacity market	●	●	●	●	0%
Auction design score	0.86	0.71	NAP	NAP	80%
Country uses public auctions for procurement	○	○	●	●	41%
Clear and comprehensive established rules	○	○	*NAP*	*NAP*	100%
Credible penalties for violating the rules	○	○	*NAP*	*NAP*	86%
Guarantees and penalties to ensure timely completion	○	○	*NAP*	*NAP*	86%
Standard, non-negotiable contracts	○	○	*NAP*	*NAP*	86%
Stapled financing terms or risk mitigation instruments	○	●	*NAP*	*NAP*	86%
No concerns regarding the transparency and fairness of the auction	●	●	*NAP*	*NAP*	14%
Efforts to inform and attract bidders to the auction	○	○	*NAP*	*NAP*	100%
Transmission Procurement	100%	100%	17%	17%	68%
There is a framework for procurement of new transmission lines	○	○	●	●	59%
Methods used to procure new transmission-	○	○	●	●	71%
Competitive tender	○	○	●	●	71%
Direct negotiation	●	●	●	●	29%
All projects are awarded to the incumbent transmission company	●	●	○	○	47%

D. Access policy framework index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Energy Access Regulation	**67%**	**57%**	**74%**	**7%**	**58%**
Regulation of New Connections	**68%**	**88%**	**57%**	**14%**	**65%**
Roles of regulator, utility, rural electrification agency clearly defined	○	○	○	NAV	93%
Utilities have regulatory obligation to connect new customers	○	○	○	○	94%
Regulatory entity has authority to approve connection charges for new customers	○	○	○	●	71%
Connection charges are set using shallow entry	●	○	●	NAP	58%
Government provides subsidy for new connections	●	●	●	●	53%
Connection has to be provided in a specified time	○	○	○	●	94%
Regulatory entity monitors tiem taken to provide new connections	●	○	●	●	44%
Regulator has authority to levy penalties for not connecting customers on time	NAP	○	NAP	NAP	71%
Time taken to provide connections publicly available	○	○	●	●	24%
There are connection charges	○	○	○	NAV	94%
Customer pays limited connection charges	●	●	●	NAP	43%
Connection charge is publicly available	○	○	○	●	71%
Regulation of solar home systems	**100%**	**50%**	**100%**	**0%**	**66%**
Minimum technical standards and post-installation warranty requirements for solar home systems	○	○	○	●	71%
Regulator reviews and approves prices of surplus SHS sales of electricity to the grid operator	NAV	●	○	NAV	62%
Regulation of mini-grids	**33%**	**33%**	**67%**	**NAV**	**44%**
Privately owned mini-grids legally allowed to operate	○	○	○	NAV	81%
Clear options for mini-grid operator when the interconnected grid reaches the area, including compensation	●	●	●	NAV	7%
Subsidy or other mechanism to help mini-grid operators recover their costs	●	●	○	NAV	47%

E. Corporate governance- accountability index for Peru and comparators, 2015

Corporate governance	Vietnam		Philippines		Colombia		Peru		International benchmark
	NPC	HCMPC	MERALCO	BENECO	EPM	CODENSA	Luz del Sur	Hidrandina	
Accountability	**17%**	**17%**	**100%**	**67%**	**75%**	**92%**	**92%**	**58%**	**60%**
Private or public shareholders appoint board	●	●	○	○	●	○	○	○	36%
Transparent process exists for Board selection	●	●	○	○	●	○	○	●	36%
Board members cannot be removed at will	●	●	○	●	●	○	○	●	29%
Chairperson & CEO are separate positions	●	●	○	○	○	○	○	○	75%
Function of Company Secretary exists	○	○	○	○	○	○	○	○	82%
Board Sub-Committees for different issues	●	●	○	●	○	○	●	●	68%
Audit committee of the Board	●	●	○	○	○	○	○	○	71%
Board Code of Conduct exists	●	●	○	○	○	○	○	○	64%
Requirement to declare conflicts of interest	●	●	○	○	○	○	○	○	75%
Utility has carried out any third party transactions in last five yrs	●	●	○	●	○	●	○	●	46%
Minority shareholders' rights are protected	●	●	○	●	○	○	○	●	39%
Utility publishes an Annual Report	○	○	○	○	○	○	○	○	93%

F. Corporate governance- autonomy index for Peru and comparators, 2015

Corporate governance	Vietnam		Philippines		Colombia		Peru		International benchmark
	NPC	HCMPC	MERALCO	BENECO	EPM	CODENSA	Luz del Sur	Hidrandina	
Autonomy	**0%**	**0%**	**100%**	**100%**	**78%**	**100%**	**78%**	**22%**	**63%**
Board is the final body to take decision on-									
Defining corporate strategy	NAP	NAP	○	○	○	○	○	●	96%
Approving business plans	NAP	NAP	○	○	○	○	○	●	96%
Setting and monitoring performing objectives	NAP	NAP	○	○	○	○	○	○	92%
Selecting, appointing and overseeing the CEO	NAP	NAP	○	○	○	○	○	●	56%
Raising capital from debt	NAP	NAP	○	○	○	○	○	●	68%
Raising capital from equity	NAP	NAP	○	○	●	○	○	●	48%
Major capital expenditures	NAP	NAP	○	○	○	○	○	●	88%
Deciding and implementing tariff adjustments	NAP	NAP	○	○	●	○	●	●	24%
Human resource hiring and firing decisions	NAP	NAP	○	○	○	○	●	○	72%

G. Utility management- financial discipline index for Peru and comparators, 2015

Utility management	Vietnam		Philippines		Colombia		Peru		International benchmark
	NPC	HCMPC	MERALCO	BENECO	EPM	CODENSA	Luz del Sur	Hidrandina	
Financial Discipline	**53%**	**53%**	**71%**	**53%**	**76%**	**69%**	**86%**	**65%**	**59%**
Utility has a credit rating	●	●	○	●	○	○	○	●	36%
Utility can issue new bonds	●	●	●	●	○	○	○	●	36%
Utility can issue new equity	●	●	○	●	●	NAV	○	●	26%
Utility pays dividends to shareholders	●	●	○	●	○	○	○	●	29%
Public service obligations are explicitly defined	○	○	○	○	○	○	●	○	46%
PSO is publicly disclosed	●	●	○	○	●	●	NAP	○	38%
PSOs are costed	●	●	●	●	●	●	NAP	●	0%
PSOs are compensated by government	●	●	●	●	●	●	NAP	●	0%
Utility required to meet financial performance targets	●	●	●	●	○	○	○	○	52%
System of internal financial controls exists	○	○	○	○	○	●	○	○	96%
Internal audit function exists	○	○	○	○	○	●	○	○	93%
Utility is subject to state auditing procedures	○	○	●	●	○	○	●	○	71%
Financial accounts are produced	○	○	○	○	○	○	○	○	96%
Financial accounts are audited by external auditor	○	○	○	○	○	○	○	○	93%
Financial accounts are publicly disclosed	○	○	○	○	○	○	○	○	79%
Financial accounts meet national standards	○	○	○	○	○	○	○	○	82%
Financial accounts meet international standards	○	○	○	○	○	○	○	○	57%

H. Utility management- human resources index for Peru and comparators, 2015

Utility management	Vietnam		Philippines		Colombia		Peru		International benchmark
	NPC	HCMPC	MERALCO	BENECO	EPM	CODENSA	Luz del Sur	Hidrandina	
Human Resource	50%	50%	79%	86%	86%	60%	90%	71%	62%
Annual staff performance reviews exist	○	○	○	○	○	NAV	○	○	93%
Employees receive performance related bonuses	○	○	○	○	●	NAV	○	○	70%
Employees can be fired for poor performance	○	○	○	○	○	○	○	○	79%
Government employment regulation don't apply	●	●	○	○	●	NAV	○	●	26%
Wages not based on government pay scales	●	●	○	○	○	NAV	○	●	48%
Staff training policy exists	○	○	○	○	○	○	○	○	86%
Managers are free to hire employees	●	●	●	●	○	●	NAV	●	12%
Managers are free to fire employees	●	●	●	●	○	●	NAV	●	24%
Managers can execute budget	●	●	○	○	○	●	NAV	○	60%
Managers can implement investment projects	●	●	●	○	○	●	NAV	○	44%
Recruitment involves advertisment of positions	●	●	○	○	○	○	●	○	71%
Recruitment involves short-listing candidates	○	○	○	○	○	○	○	○	89%
Recruitment involves interviewing candidates	○	○	○	○	○	○	○	○	82%
Recruitment involves reference checks	○	○	○	○	○	○	○	○	75%

I. Utility management- information & technology index for Peru and comparator, 2015

Utility management	Vietnam		Philippines		Colombia		Peru		International benchmark
	NPC	HCMPC	MERALCO	BENECO	EPM	CODENSA	Luz del Sur	Hidrandina	
Information and Technology	93%	93%	93%	67%	87%	0%	80%	73%	71%
SCADA system	○	○	○	○	○	NAV	○	○	93%
IT system to support incidence resolution	○	○	○	○	○	●	○	○	75%
IT system to support distribution management	○	○	○	○	○	●	○	○	79%
IT system to support energy management	○	○	●	●	○	●	○	●	64%
Geographic Information System (GIS)	○	○	○	○	○	NAV	○	○	78%
KPIs are used to monitor quality of supply	○	○	○	○	○	NAV	○	○	100%
Advanced Metering Infrastructure (AMI)	○	○	○	○	●	NAV	●	●	52%
Accurate customer database	○	○	○	○	○	NAV	○	○	96%
Call center for dealing with customer complaints	○	○	○	○	○	NAV	○	○	96%
Website for submission of customer complaints	○	○	○	●	○	NAV	○	○	85%
Customer satisfaction regularly monitored	○	○	○	○	○	NAV	○	○	59%
Commercial management system (CMS)	○	○	○	●	●	NAV	○	○	41%
Resource Management System (RMS)	●	●	○	●	○	NAV	○	○	35%
KPIs are used to monitor commercial cycle	○	○	○	○	○	●	●	●	86%
KPIs are used to monitor corporate resource management	○	○	○	●	○	●	●	●	54%

J. Regulatory governance- accountability index for Peru and comparators, 2015

Regulatory governance		Colombia	Peru	Philippines	Vietnam	International benchmark
Accountability		**75%**	**85%**	**95%**	**64%**	83%
Regulatory Oversight		67%	67%	100%	67%	81%
Regulator's objectives formally stated in law		○	○	○	○	100%
Regulator required to report on its activities		○	○	○	●	88%
Independent third party evaluations of regulator have taken		●	●	○	○	56%
Legal Appeals		100%	100%	100%	100%	100%
Legally established process to challenge/appeal regulatory		○	○	○	○	100%
Transparency		57%	89%	85%	25%	67%
Publicly availabe annual reports		○	○	○	○	94%
Recommendations are required to be made public		NAP	○	●	●	33%
Government body receiving recommendations required to respond publicly		NAP	●	●	●	33%
Regulator is required to publish its decisions on-	End-user tariffs	○	○	○	NAP	100%
	Licensing generation or supply	NAP	NAP	○	NAP	100%
	Wholesale or PPA prices and contract terms	○	○	○	NAP	100%
	Market design	○	NAP	○	NAP	100%
	Oversight of regulated utilities	NAP	○	○	NAP	85%
Regulatory decision-making process legally requires the participation of non-government stakeholders in case of-	End-user tariffs	●	○	○	○	69%
	Licensing generation or supply	NAP	NAP	○	●	69%
	Wholesale or PPA prices and contract terms	●	○	○	●	38%
	Market design	●	NAP	○	●	30%
	Oversight of regulated utilities	NAP	○	○	●	38%

K. Regulatory governance- autonomy index for Peru and comparators, 2015

Regulatory governance		Colombia	Peru	Philippines	Vietnam	International benchmark
Autonomy		**60%**	**98%**	**51%**	**50%**	**71%**
Decision-Making Autonomy		**64%**	**92%**	**79%**	**36%**	**79%**
Areas where entity has a mandate to regulate-	End-user tariffs	○	○	○	○	100%
	Quality of supply and service	○	○	○	○	100%
	Electrification or increased access to energy	●	○	●	●	53%
Decision of the regulatory entity are legally binding in the area of-	End-user tariffs	○	○	○	●	88%
	Grid access charges	○	○	○	●	87%
	PPA/wholesale prices	○	○	○	●	92%
	Quality of supply/service	○	○	○	●	87%
	Market design	○	NAP	○	●	50%
	Licensing	NAP	NAP	○	●	85%
	Utility oversight	NAP	○	●	●	71%
Government body rejecting or modifying regulatory decisions		NAP	●	●	●	17%
Law precribes decision making process for-	End-user tariffs	●	○	○	○	94%
	Grid access charges	●	○	○	○	81%
	Quality of supply/service	●	○	○	○	87%
Budgetary Autonomy		**88%**	**100%**	**50%**	**50%**	**80%**
Funding for regulator established by law		○	○	○	○	100%
Percentage of regulator's budget that comes from levies or taxes		0.752	1	0	0	59%
Leadership Autonomy		**88%**	**100%**	**75%**	**14%**	**66%**
Legal basis for existence is primary legislation		○	○	○	○	100%
Power to determine own organizational structure and rules		○	○	●	●	50%
Power to determine the allocation and use of budget		○	○	○	●	44%
Legal requirements or restrictions regarding professional profile leadership		○	○	○	●	94%
There is a fixed term for the leadership of the regulatory entity		○	○	○	●	88%
Legal provisions under which leadership an be removed from office		○	○	○	●	75%
Current leadership of entity connected to government or utilities		●	○	●	●	25%
Over 60% of employees are in technical positions		○	○	○	NAV	57%
Managerial Autonomy		**0%**	**100%**	**0%**	**100%**	**59%**
Pay scale not linked to govt pay scale or is 90% of utility pay		●	○	●	NAV	53%
Not required to follow govt employment regulations		●	○	●	○	63%

L. Regulatory substance- tariff regulation index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Tariff Regulation	92%	100%	93%	83%	77%
Regulatory Framework for Tariffs	100%	100%	86%	100%	90%
Objectives in determining tariffs mentioned explicitly in policy or legal mandate	○	○	○	○	100%
Principles of tariff-setting clearly articulated	○	○	○	○	88%
Authority over the tariff level	○	○	○	○	94%
Clear definition of "cost recovery"	○	○	○	○	88%
Legitimacy of costs is used as a basis for tariff calculations	○	○	○	○	88%
Tariff-setting based on a clearly specified regulatory framework	○	○	○	○	88%
Frequency and schedule of revisions determined by law or regulation	○	○	●	NAP	75%
Determination of Tariffs	83%	100%	100%	67%	64%
Publicly available written formula is to be used for tariff setting and utilities are legally required to adhere to it	○	○	○	○	88%
Avoid passing-through inefficient costs to customers	○	○	○	○	76%
Requirement to submit financial information according to set standards	○	○	○	○	53%
Users bear the costs of incentive mechanisms for renewable energy generation	○	○	○	●	75%
Regulatory mechanisms to compensate generators for the provision of firm capacity or ancillary services	○	○	○	○	58%
Utilities are compensated for the costs of stranded assets	●	○	○	●	25%

M. Regulatory substance- quality of supply index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Quality Regulation	100%	100%	92%	71%	75%
Quality of Service Standards	100%	100%	100%	75%	82%
Requirement to meet quality of service standards	○	○	○	○	100%
Specific quality of service standards are formally written and publicly available for- quality of the product, quality of the service	○	○	○	○	97%
Performance on quality of service standards is public	○	○	○	○	71%
Fines for failing to meet quality of service standards	○	○	○	●	59%
Quality of Service Enforcement	100%	100%	83%	67%	68%
Requirement to report technical data on a periodic basis	○	○	○	○	100%
Regulator specifies how to collect technical performance data	○	○	○	○	71%
Regulator reviews or validates technical performance data	○	○	○	●	47%
Automated information management systems are required to measure the quality or reliability of the power supply	○	○	●	○	71%
Measurements of the quality or reliability of power supply are made public	○	○	○	○	65%
Financial incentives to meet customer service standards or increase customer satisfaction	○	○	○	●	53%

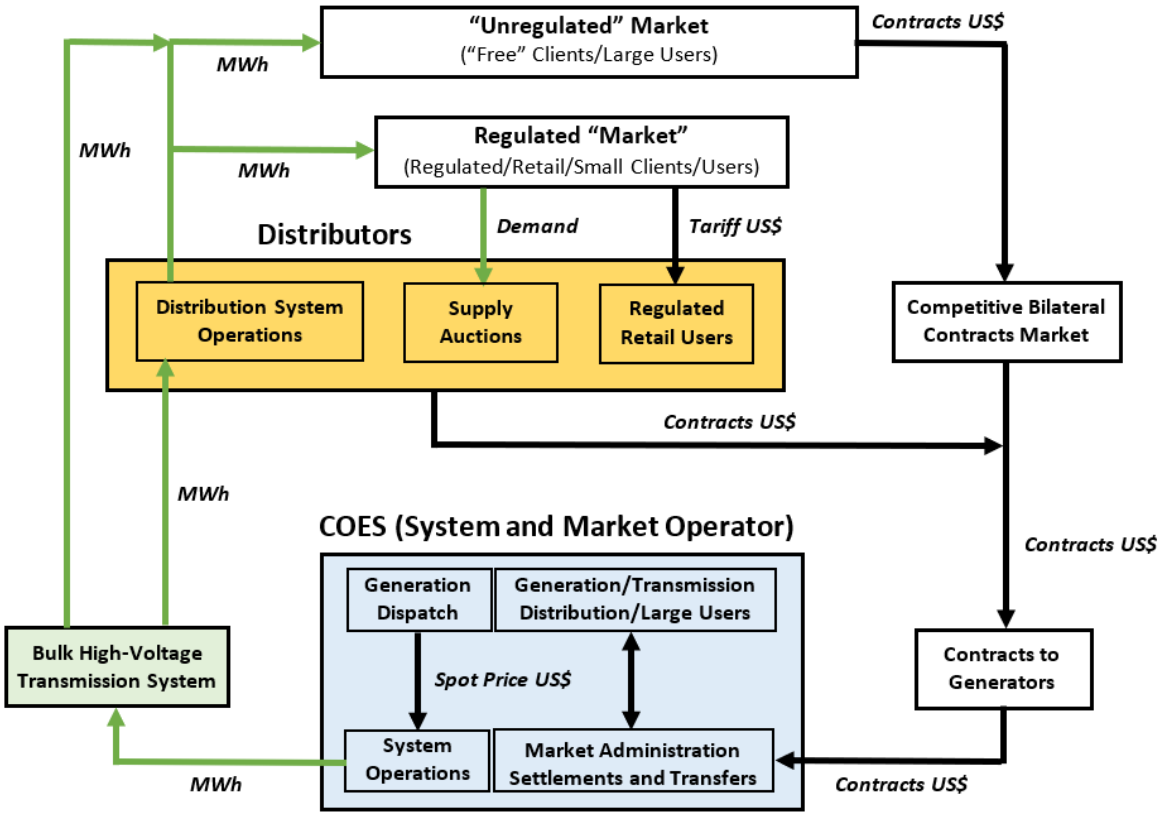
N. Regulatory substance- market entry index for Peru and comparators, 2015

	Colombia	Peru	Philippines	Vietnam	International benchmark
Market Entry Regulation	**50%**	**50%**	**100%**	**100%**	**77%**
Permitting New Entrants	50%	100%	100%	100%	90%
Responsible for monitoring compliance with the terms of the license or permit	●	○	○	○	88%
Authority to impose penalties for violating license or permit terms	NAP	○	○	○	100%
Penalties are formally written and publicly available	NAP	○	○	○	80%
Provisions to force companies to relinquish licenses or permits for violation	○	○	○	○	100%
PPA Approvals	50%	0%	100%	NAP	57%
Legally required to approve all power sales contracts either directly or indirectly	●	●	○	●	59%
Approve or refuse a proposed PPA in a legally specified period of time	NAP	NAP	○	NAP	60%
Authority over the process by which utilities can select or procure power from IPPs	○	●	○	●	50%

Annex B. Peruvian power market setup

In Peru, real-time generation dispatch is a function of COES, which follows a procedure based on the "merit order" of operating costs of generating units (cheapest units first), regardless of existing bilateral contracts or supply auctions results. Transactions between generators, distributors and large users in the wholesale market are made at the marginal or "spot" energy price (operating costs of the last unit in the order of merit). COES administers the wholesale market (the balance of "transactions" between the generators, large users and distribution companies), and supervises the obligations between the different parties. Figure 22 depicts the organization of Peru's competitive power market, further discussed by Rudnick & Velasquez (2019).

Figure B-1: Depiction of Peru's power market organization.



Source: Rethinking Power Sector Reform project.

Annex C. Unbundling

Unbundling of generation, transmission and distribution activities was clearly established in the Electricity Concession Law. Article 122 of such law stipulated that generation and / or transmission activities in the main/bulk electrical system and / or distribution of electric energy, may not be carried out by a single company, holding company or company group, or by any person or company who directly or indirectly exercises control of the former, except as provided in the Law.

In November 1997, the Peruvian government passed a complementary regulation to supervise and control the vertical and horizontal concentration in the electricity sector, subjecting these activities to a prior authorization procedure in accordance with the terms established in the Law N° 26876, in order to avoid acts of concentration that have the effect of reducing, damaging or impede free competition in the electricity and related markets. The Commission of Free Competition of the National Institute of Competition Defense and Protection of Intellectual Property - INDECOPI, is in charge of analysis and approval of concentration activities solicitations.

Sector companies must request a prior authorization in respect to buying or selling assets or mergers involving, directly or indirectly, companies that carry out activities of generation and / or transmission and / or distribution of electricity, representing a percentage: (i) equal to or greater than 15% of the market in horizontal operations; or (ii) equal to or greater than 5% of any of the markets in vertical operations. INDECOPI will be responsible for knowing and resolving the cases in the first and the second instances. The regulator, OSINERGMIN, is responsible for the semi-annual determination of the percentages of market share held by electricity companies in generation, transmission and distribution activities.

INDECOPI may impose two types of conditions or remedies in order to approve a concentration activity. The first type consists of structural remedies, normally associated with the sale of related assets, while the second type consists of behavioral remedies, which limit the economic/ commercial freedom of companies, subject to continuous monitoring by the competition authority to ensure compliance. In November 2014, by resolution N° 0623-2014-SDC, INDECOPI established that, without prejudice to the precedent, companies may request, when they deem it pertinent, the revocations of the behavioral conditions imposed. For this, they must identify the change of circumstances that has occurred that would merit the lifting of the established conditions.

Since the establishment of the antitrust/concentration regulation in the electricity sector, INDECOPI has examined and authorized dozens of cases; none was rejected or divestitures were imposed. In some cases behavioral remedies were required, which are being phasing-out after approval of resolution N° 0623-2014-SDC. The stakeholders, and the general public, consider that electricity sector unbundling and antitrust legislation is working reasonably well.

Annex D. Tariff regulation

The Peruvian electricity sector has been structured under the following fundamental characteristics: (i) the business is segmented in generation, transmission and distribution (which includes also the supply/commercial part); (ii) generation is considered a competitive segment, where prices are mainly determined by freely-negotiated bi-lateral contracts, and the results of supply auctions; (iii) transmission and distribution are regulated segments, as well as the transportation and distribution of natural gas for electricity generation; and (iv) the rates/tariffs for the regulated segments are established by OSINERGMIN, the energy regulator, based on the allocation of efficient investment and O&M costs to the different types of electricity users.

From the demand side of the market, sector legislation recognizes two general categories of electricity users, regulated and “free”, according to the level of maximum user demand. Users requiring up to 200 kW are considered Regulated Users. Users with a demand greater than 200 kW up to 2,500 kW can choose to be a Regulated User or a Free User. Finally, users with demands greater than 2,500 kW are considered Free Users. The price of electricity generation for regulated users is established by OSINERGMIN, while free users can negotiate a supply contract directly with generators or distributors for their electricity supply.

Generation dispatch and network operations are carried out by the Committee of Economic System Operation (COES). Although COES is not organized/managed as an independent system operator (ISO), its functions are very similar to an ISO. In addition to the system operation functions, COES supervise and performs the accounting of transactions in the spot market.

The Peruvian electricity price/tariffs regime has been designed on the basis of full recovery of costs for the provision of the electricity service, in each of the three segments: generation, transmission and distribution. Another important feature is that final rates to end users and payments among participants in the wholesale market are based on a two-part system; very similar to the classical scheme of payments for peak demand (a capacity payment), and for energy consumption. Capacity payment is based on annual investment and O&M costs of a peaking generating unit, of size suited to total system peak demand and reserve requirements.

The regulated energy tariff for power generation is determined annually by OSINERGMIN, according to the expected evolution of electricity demand and a merit-order simulation dispatch of generation supply availability. This simulation is carried out for a three-year period (one historical and two projected). The final generation energy rate is determined by comparing the simulation results and the average prices resulting from competitive supply auctions, which distribution companies should carry out for supplying the regulated market.

Real-time generation dispatch is a function of COES, which follows a procedure based on the “merit order” of operating costs of generating units (cheapest units first), regardless of existing bilateral contracts or supply auctions results. Transactions between generators, distributors and large users in the wholesale market are made at the marginal/spot energy price (operating costs of the last unit in the order of merit). COES administers the wholesale market (the balance of "transactions" between the generators, large users and distribution companies)

In addition to generation (capacity and energy), electricity prices to final users include payments for the use of the bulk transmission and the sub-transmission systems, and the primary and secondary (medium

and low voltage) distribution systems. Transmission and sub-transmission charges/tariffs are established and updated annually by OSINERGMIN. Distribution charges/tariffs are recalculated every four years, following evaluation studies carry out by the distribution companies and reviewed by OSINERGMIN (these charges/tariffs are updated yearly).

Depending on demand levels, eligible customers can freely negotiate prices and terms with Gencos, while regulated customers are subject to regulated prices. Besides distribution charges (e.g. investment in distribution networks), the retail regulated price comprises a combination of market-based prices resulting from supply auctions (called firm prices), and regulated prices calculated yearly by OSINERGMIN (called bar prices). Market-based prices are the average prices obtained by distributors in the supply auctions they independently organize. These market-based prices apply for the volumes of energy and power contracted in the auction. Additional consumption (i.e. above contracted volumes) is paid for by regulated customers at the regulated price. During August 2016, 89% of the generation price paid by regulated customers was determined by the results of auctions, whilst 11% corresponded to the regulated price.

The regulated "bar" prices are composed of generation level and transmission level charges. Generation level charges comprise both energy and capacity (the so-called basic prices of energy and capacity, respectively). Whilst the capacity price is calculated as the expansion cost of generation to supply peak demand (as described previously), the regulated energy price is a weighted-average of expected future marginal costs. These future marginal costs are calculated by the regulator with a computer model. Therefore, regulated energy prices are said to be more stable than wholesale spot prices (OSINERGMIN, 2016, p. 147).

The transmission level prices comprise the payment for transmission infrastructure and management as well as additional generation charges. These additional charges cover the price premium for renewable generators; charges for cold reserves; charges for emergency supply and generation variable costs exceeding marginal incomes (i.e. valued at "idealized" marginal costs); and charges for the security gas duct; among others.

It is important to note that generation surcharges bundled with transmission tolls are charged to customers based on peak-power consumption if such metering is available. Hence, there is an incentive for large customers to lower their consumption during peak hours, thus lowering the transmission charge they pay. The difference is allocated to regulated customers.

The components of the regulated retail prices are summarized next:

- Distribution charges
- Firm prices: market-based prices resulting from supply auctions
- Bar prices
    - Generation level prices
        - Basic Energy Price: weighted average of expected future marginal costs, calculated by the regulator with a computer model
        - Basic Capacity Price: generation expansion cost to supply peak demand

- Transmission level prices
  - Transmission tolls: payment for transmission infrastructure and management
  - Additional charges
    - Renewable generation premiums
    - Cold reserves
    - Emergency supply
    - Generation with variable costs exceeding marginal incomes
    - Security gas ducts
    - Others

Annex E. Market Entry

Market entry in the Peruvian power sector has no limitations in practice. There is no nationality or ownership restrictions to local or foreign companies to enter the market; there is no imposition of sector fees or duties, or particular restrictions applied only to power companies. Sector laws and regulations are applied equally to all stakeholders without discrimination or preferences. The application of the law and regulations concerning market entry in the power sector has been consistent throughout the time since the reform.

The Electricity Concessions Law, its regulations and related legislation, establishes that generation, transmission and distribution activities can be carried out by individuals or legal entities, either national or foreign (legal entities must be constituted in accordance with Peruvian law). A concession is needed for the use of public property (natural resources and potentially land use) or the need to expropriate privately owned land for an extended period of time.

The following facilities require a concession:

(i) electricity generation using hydraulic, geothermal or any renewable resources, with an installed capacity of more than 500 kW;

(ii) electricity transmission which require granting a public rights-of-way; and

(iii) electricity distribution, for public service, of more than 500 kW.

Thermoelectric generation with a capacity greater than 500 kW requires an authorization (independently of any concession required if there is use of public land or expropriation of privately owned land).

Current legislation establishes two types of concessions: temporary and definitive concessions. A temporary concession is required to carry out technical, economic and environmental studies and allows for the use of public property and the right to impose temporary rights-of-way in the study area. A temporary concession does not give exclusivity over the relevant area and can be granted to more than one petitioner (the same applies to the license for water use to conduct studies for hydropower). A temporary concession can be granted for up to two years and can be renewed only once for two more consecutive years.

Definitive concessions allow for the use of public property and the right to obtain the imposition of rights-of-way (that can be permanent and by expropriation if necessary) for the construction and operation of electricity facilities. A definitive concession can either expire (terminated if the concession period has lapsed, when some of the contract's clauses are not fulfilled or the required operating and maintenance obligations are not carried out), or can be relinquished by the concessionaire. Expansion or reduction of concession areas for electricity distribution requires explicit authorization.

Annex F. Clean Energy Regulations

Peru has been a pioneering country in the region regarding the promotion of renewable energy in the electricity sector. The main legal instrument was Legislative Decree (DL) Nº 1002 for the Promotion of Investment for Electricity Generation Using Renewable Energy (enacted in May 2008). Key characteristics of the scheme are as follows:

- Every five years MINEM will set a target limit for renewable energies. During the first five years (i.e. until 2013), that objective limit was set at 5% of the national total electricity consumption.
- Wind, solar, geothermal, biomass and tidal power are considered as renewable energy sources as well as small hydropower with capacity up to 20 MW.
- Selection of renewable energy projects will be done through periodical auctions organized by OSINERGMIN, based on minimum price offers.
- Renewable energy will have priority in the daily generation dispatch and will sell their energy production to the spot market.
- Renewable energy plants will receive the energy marginal price (spot) and a price "premium" in the event that the spot price is lower than the offered price in the renewable energy auctions.
- The price premium payments will be recovered through a surcharge to electricity rates of all users.

This promotional legislation gained from lessons learned from European countries, avoiding some pitfalls of feed-in tariffs, price mandates and quota systems. Detail regulations (DS Nº 050-2008-EM) were approved the same year, which included the administrative procedures for announcing renewable energy auctions and granting concessions for the development of renewable power generation. It also set the requirements for submitting, evaluating and awarding bids, as well as marketing procedures and renewable energy generation tariffs.

There have been four consecutive renewable energy auctions, which started in 2009. During the first auction, a total of 1,971.6 GWh were adjudicated across 27 projects totaling 429.1 MW of installed capacity. The second auction, in 2011, adjudicated 1,152.7 GWh across 10 projects representing 210 MW of installed capacity. The third auction, in 2013, adjudicated 1,278 GWh to 16 small hydroelectric projects, totaling 211 MW. Finally, in 2015 a fourth auction was carried out with the following results: 13 projects were selected with a total of 330.2 MW of installed capacity, adjudicating 1,739.2 GWh.

The Peruvian renewable energy auction system has been quite successful. In summary, by end 2015, in the four auctions, there were 66 renewable energy selected projects (5 Biomass, 7 Wind, 7 Solar and 47 small hydroelectric); a total installed capacity of 1,305.2 MW and 6,087.5 GWh of contracted energy. Of these projects, there are 473 MW of non-conventional renewable electricity generation capacity in operation in the system, representing 4.7% of total installed capacity, with a production of 1,843 GWh of electricity (4.1% of total production).

A final important point regarding the Peruvian auction scheme is its high success in reducing prices of renewable energy projects. The last (fourth auction) showed record lower prices for solar and wind projects, in order of US$ 48 per MWh and 37.7 US$/MWh, respectively. Figure III-3 shows the evolution

of energy prices in the four auctions, which cover a period of 6 years. For the case of solar there has been a price reduction of 78% and in wind a reduction of 53%.

Regarding GHG emissions in Peru, the electricity sector contributes with 34%. In 2011, Peru approved an action plan for the 2010–2021 timeframe, and at COP 21 and at the UN, it pledged to reduce 30% GHG emission by 2030, as an Intended Nationally Determined Contributions (INDC), for which it will "produce at least 40 percent of its total energy use from renewable energy."