Zooming into successful energy policies in Latin America and the Caribbean

reasons for hope

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In a nutshell

Due to the lack of systematic policy evaluations, identifying successful policies in the Latin American and the Caribbean (LAC) region is a hunting task. Nevertheless, this type of analysis is crucial to inform policymakers in their decision-making process. Herein we contribute to filling this gap by assessing the progress in terms of energy services since the year 2000 and reviewing the policies that have led us to where we are.

We focus on three fundamental dimensions in the definition of energy services: access to electricity and clean fuels for cooking, affordability of those energy services and quality considering both service's interruptions and energy losses. We find that countries that have improved in all these dimensions simultaneously, catching up with the best performers in the region, are the ones that have implemented integrated policies that are part of a pluriannual plan, implemented in a strong institutional environment.

Aside from macroeconomic differences, successful energy policies have in common the following characteristics: (i) important institutional reforms already in place by the end of the century; (ii) state-led plans that measure performance accounting for most dimensions simultaneously and including mechanisms to enforce preestablished objectives in targeted population; (iii) appropriate financing mechanisms to ensure affordability; and (iv) partnership with private stakeholders when their participation increases efficiency, adoption of innovation and ensure maintenance, either directly or through the involvement of local communities.

Even if the discussion is presented dimension by dimension, two countries appear like having implemented successful integrated policies: Peru and Ecuador. Despite their institutional differences, they have succeeded in increasing access to affordable electricity that is more reliable (with less frequency and duration of interruptions). Additionally, Ecuador has also enhanced efficiency through electricity loss reduction thanks to enforceable performance-based regulation.

Aside from these two countries, other countries have also implemented successful policies that have greatly improved one or two of the dimensions mentioned but fail to tackle all the issues simultaneously. This is the case of El Salvador with access to clean cooking and fuel subsidy reform, for example. Similarly, Nicaragua appears as an example in bridging the gap in access and Brazil, Colombia and more recently Argentina are implementing a mechanism to target demand-side subsidies based on verifiable economic means.

Access

Highlights

1

a) The region has greatly improved both in terms of access to electricity and in terms of access to clean fuels and technology for cooking.

This was possible due to state-led access programs pursuing an increase in welfare.

b) Most of the progress in terms of electricity access took place in rural areas.

State-led initiatives materialized in electrification plans that contemplated several important aspects:

i) **financial sustainability,** usually using cross subsidies from big consumers to small ones and between different distributing firms. These transfers between electricity distributing firms were implemented to compensate for the increasing cost of serving last-mile consumers and the fact that rural-poor usually benefit from social tariffs;

ii) **partnerships with private** stakeholders and international organizations, many times in the format of Public Private Partnerships (PPPs).

iii) **subsidies** targeted to the poor, both in the case of electricity and for clean fuels;

iv) **communities´ involvement,** to ensure efficient operation and maintenance of new installations and associated equipment;

c) Due to the disperse nature of rural population in some countries, decentralized solutions have spread as costs of the technologies decreased.

Most of the decentralized solutions implemented in the region in recent years relies either on individual photovoltaic panels or on mini-solar grids with storage, which is in line with the SDGs and SE4All objectives.

1 Access

1.1 ACCESS TO ELECTRICITY SERVICES

The benefits of electrification are multiple, depending on the type of service ensured by the connection. Basic lighting increase time for productive activities like studying and working and allow hospital operation at night. When additional services are provided, like charging facilities, communication repeaters or additional appliances like refrigeration or pumps for water, the benefits increase significantly. Numerous studies have tried to quantify those benefits both in terms of living standards, increase in productivity and community development in general. As an example, Pakhtigian et al. (2019) show that the average unelectrified household in Haiti would gain an annual benefit of US$16.20 from reduced kerosene consumption for lighting and US$10 from reduced cell phone charging expenditures (that is 3.2% of savings as compared to 2019's yearly minimum wage of US$817).

The region has made great improvement in terms of electricity access. Between 2000 and 2017 access to electricity increased from 78.2% to 97%, progression that is significant as compared to the 10% progress that has been made worldwide. Electricity access rates achieved are comparable with those from Europe & Central Asia.

Figure 1. Evolution in electricity access rates in % of total population, 2000 – 2016 (2018 for LAC)
Source: Own elaboration using data from the World Bank (2018) and SIER-OLADE (2019)

In 2000, 59.4 million people had no access to electricity in LAC, representing 11.7% of the total population. In 2018 this number has more than halved, with less than 19.04 million people without access to electricity, which represents 3% of the total population (SIER-OLADE, 2019). Most of the progress was observed in terms of rural electrification.

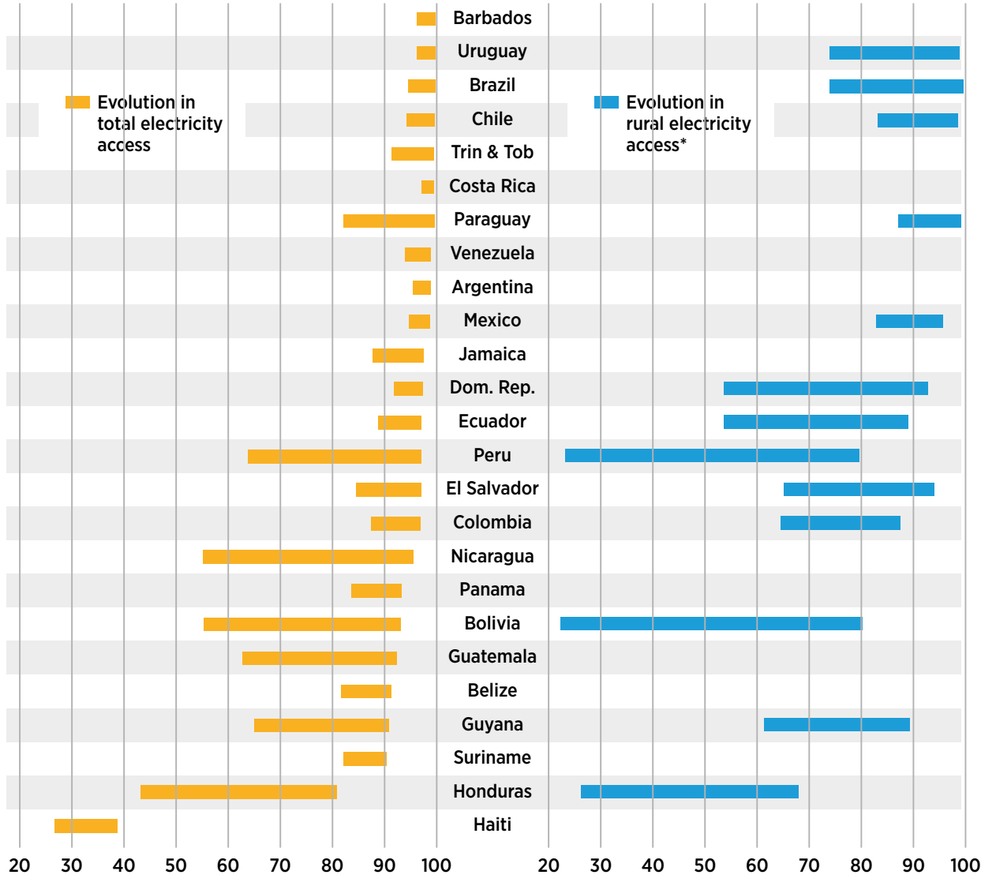
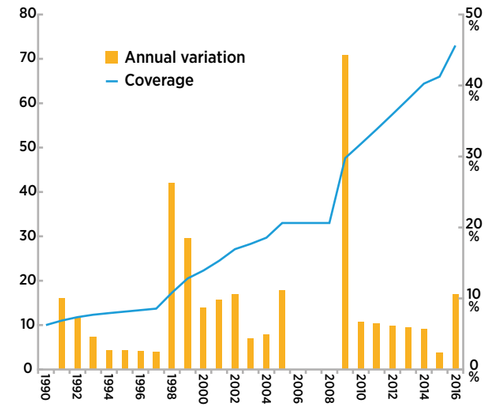


Figure 2. Evolution in electricity access rates in % of total population, 2000 - 2018
Source: Own elaboration using data from SIER-OLADE (2019) / *Information is only available for countries listed

1 Access

We distinguish two group of countries that have made important progress: the ones that have almost reached universal access coming from having important access gaps around 2000 and the ones that, despite the great improvement, are still far from being able to reach last-mile consumers. In the first group we find Nicaragua (from 55% to 95,6%), Bolivia (from 55% to 93,06%), Peru (from 64% to 97%) and Guatemala (from 63 to 92%). These countries have had a country-wide electrification plan, usually with a specific rural component, that serves as a platform for several specific electrification initiatives. Given the high cost of last-mile consumers, the electrification plans usually include cross subsidies from highly profitable consumers to less profitable ones to ensure financial sustainability for the Utilities providing the service. Subsidies are targeted to ensure affordability by poor households and include plans to enforce payment and the involvement of local communities in the efficient usage of resources as well as on equipment maintenance. The most striking example of this is Peru and, to a lesser extent, Bolivia. State-led investments (partially funded by multilateral institutions) increased electricity coverage and partnerships with private firms, many times as PPPs, made possible the incorporation of decentralized generation in isolated regions. The institutional environment in which these policies took place is the natural continuation of the reforms occurred in the 90s. Such reforms included, in many cases, separation of generation, transmission and distribution activities as well as the creation of a regulatory agency with power to enforce different type of service standards as well as to decide on tariff structure and subsidies.

We find a second group of countries that have shown great progress but are still far from reaching universal access (Haiti has less than 40% access, Honduras around 80% and a group of countries still struggles to go beyond 90%). Countries from this group have implemented specific plans that have been successful, but they have failed to implement the comprehensive group of policies needed to bridge the gap in terms of electrification. The most salient example is Honduras that has made an impressive improvement from 43% to 80,82% due to the *Proyecto de Infrastructura Rural (PIR)* that built Energy and Water and Sanitation Infrastructure in rural areas as from 2005. Box 1 details the main programs that took place in the five countries just mentioned.

PROGRAM	RESULTS IN TERMS OF ELECTRIFICATION
BOLIVIA	
kfW rural electrification - 2003	
Its objective was the sustainable use of renewable energies using the existing water resource in some areas (La Paz and Potosí). Small hydroelectric power stations provided electricity to rural populations far from the National Interconnected System (SIN) or for its interconnection to the SIN.	By 2014, 157 kW of new power generation benefited 581 rural families. With the completion of the program it is expected that 1,177 kW will be generated, benefiting 2,478 families. A slow advance has been verified: the figures represent 13% of the program goal.
BOLIVIA	
IDTR rural electrification - 2003	
The program included the provision of photovoltaic systems as well as the extension and densification of national electricity grids.	30,000 families gained access to electricity in the departments of Potosí, La Paz, Pando, Oruro, Tarija, Cochabamba, Santa Cruz and Chuquisaca. It ensured the provision of 7,564 home photovoltaic systems, 136 photovoltaic systems in educational centers, delivery of 4,055 portable basic lighting systems (Pico PV) to rural households in the Chaco, Chiquitanía and Amazonia.
Eurosolar rural electrification - 2003	
Done with hybrid solar and wind systems.	5,566 families benefited in 59 community in the departments of Potosí, Oruro, Cochabamba, Santa Cruz and Chuquisaca.
EDAU-GPOBA rural electrification - 2007	
Installation of home photovoltaic systems, portable solar lamps and photovoltaic systems in educational centers.	7,564 domiciliary systems installed. 5,705 portable solar lamps installed. 136 systems installed in educational centers.
PEVD - 2008 on	
It consists of several sub-programs or the continuation of pre-existing ones: PERER, KFW, IPER, AFEM, PER II, IDTR I and II, EDAU-GPOBA, Eurosolar.	 The coverage rate in rural areas went from 33% in 2008 to 73% in 2016.
PER II rural electrification - 2011	
It seeks to increase access to electricity in rural areas and contribute to the reduction of poverty. The program is financed by the IDB and carries out projects at the national level, which are prioritized by the departmental governments.	18,720 beneficiaries through the extension of electricity distribution networks. 1,800 photovoltaic systems delivered.

PROGRAM	RESULTS IN TERMS OF ELECTRIFICATION
GUATEMALA	
Program of Rural Electrification (PER) - 1996	
The goal was to connect 280.639 new households by investing in 28 substations and 1.283 km of transmission lines.	The program reached 2.564 communities and 241.892 users between the years 1999 and 2014. Rural electrification went from 49% to 90% in 10 years, i.e. 1 million of new users.
HONDURAS	
Rural Electrification Program - 2005	
The objective of the program was to interconnect communities to the national electrical system through the extension of the network.	140 projects executed in 286 communities implying: - 94,212 people benefited. - 15,702 homes connected to the National Electric System. - 844.5 km of transmission and distribution lines.
PROSOL - 2005	
Program based on partnerships between the Government and the private sector to promote rural electrification of economically depressed areas through the installation of photovoltaic systems.	8,979 home systems installed. 248 community systems installed. 61,314 people benefited with photovoltaic systems. 556 kW of installed capacity. 115,484 tons of CO2 avoided.
NICARAGUA	
National Program for Sustainable Electrification and Renewable Energy (PNESER) - 2012-2016	
The goal was to bring electrification to 164.046 urban homes and 146.643 rural homes with an estimated impact for 1.7 million people for an investment in network expansion of 404 million USD as well as micro hydroelectric dams and PV in isolated communities. The goal in the Caribbean Coast was to increase coverage to 95% with special attention to the following regions: Bilwi, Waspam, El Tortuguero y La Cruz del Río Grande. A specific goal of 85% rural electrification was established.	From 28% of population lacking electricity in 2011 the country reaches 94% of coverage in 2017.
PERU	
***Fondo de Compensación Social Eléctrica* (FOSE) - 2001 on**	
This policy initiative ensured at the same time access and affordability of lower income households in isolated areas. To ensure financial sustainability of providing access for isolated communities, the policy implied that the regulator, OSINERGMIN, decided on the monthly compensation transfers between firms.	The companies receive the anticipated tariff revenues. Surcharges to the biggest consumers did not imply significant reductions in their consumption level. Low administration cost.

PERU	
***Fondo de Compensación Social Eléctrica* (FOSE) - 2001 on**	
It also served the complementary objective of improving affordability with a cross subsidy that slightly increased (2% increase in the tariff) the bill of consumers of more than 100 kWh per month to favor smaller consumers as detailed in Table 1.	Low exclusion of consumers targeted by the program and negligible inclusion of higher consumption consumers[1].

Table 1: Detail of FOSE discounts

USER	SECTOR	Bill discount for consumption	
		<= 30kWh/ month	> 30 & <= 100 kWh/month
Interconnected System	Urban	25%	7,5 kWh/month
	Urban-rural & rural	50%	15 kWh/month
Isolated System	Urban	50%	15 kWh/month
	Urban-rural & rural	62,5%	18,75 kWh/month

***Fondo de Inclusión Social Energético* (FISE) - 2012 on**	
This comprehensive program had many objectives: 1 the increase in the use of renewable energy; 2 the massification of natural gas for homes and vehicles; 3 access to LPG (domestic gas balloons) in vulnerable urban and rural areas; and 4 compensation of residential electric tariff to ensure affordability. Financed by surcharges to: - users of natural gas transport systems; - large electricity consumers; - large suppliers of liquid hydrocarbon-derived products. The program has raised US$ 146 millions so far.	As of 2017, the Photovoltaic Massive Program for Isolated Areas Not Connected to the Network (collateral from the FISE) had put into operation one photovoltaic panel per household in 26,544 households, touching a total of 106,000 inhabitants in rural areas.
***ACCIONA Microenergía Perú* (AMP) - 2009 on**	
ONG created by the Spanish group ACCIONA and led by The Energy and Water Foundation: gave individual PV systems for a monthly rate of 3 dollars for 20 years, which constitutes the lifespan of the panel.	As of 2018 the program reached 4000 households, 17 community centers and 12 *Centros Luz en Casa* (i.e. small businesses) in the isolated areas of Cajamarca. 1500 tons of CO_2 and 1.64 disposable batteries where avoided. 214.000 hours of additional homework. Includes a gender component where more than 120 women participate in the PV electrification committee. The program involves the communities in the installation and operation of the panels. Affordability of the energy itself is ensured by the FOSE program.

Box 1. Improving access to electricity: review of selected policies

Source: Own elaboration using content from Iorio and Sanin (2019) and SE4All, Gap Analysis for Nicaragua (2013)

1 This mechanism targets consumers by their quantity consumed. We will discuss the problems related to this targeting scheme in the next section.

1 Access

1.2 ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

Haiti appears as the worst performer in the region reaching only 38% of the population in 2017. It is worth mentioning the determinants behind Haiti's struggle to increase electricity access. Stuebi and Hatch, (2018) mention the difficult institutional environment that hinders partnership with the private sector as a crucial determinant. They underline the lack of clarity in *Electricité d'Haiti* (EDH)'s monopoly rights, the non-existence of a regulator as well as the lack of transparency and accountability.

Three key benefits are related to the incorporation of clean fuels in the household. The first one consists in the reduction in time, money, and work needed to acquire the fuel. The second benefit relates to the fact that clean fuels improve health by reducing exposure to household air pollution for women and household dependents. Each year, almost 4 million people die prematurely from illness attributable to household air pollution related to the use of polluting stoves paired with solid fuels and kerosene[2]. Finally, the third one is related to the environmental benefits derived from the reductions in anthropogenic climate change and deforestation. 3 billion people still cook using polluting open fires or stoves fueled by kerosene, biomass (wood, animal dung and crop waste) and coal (Shankar et al., 2014). Important progress in terms of cooking can be reached simply by changing cookstoves (what we call improved cook stoves (ICS policies). This was the case of Ecocina in El Salvador, where new ICS still used wood as the main fuel but the design reduced emissions and wood use by 68% and 50%, respectively. When the transition implies a change in the fuel used, as in the case of Peru and the introduction of LPG as a cooking fuel, the infrastructure needed is more important. The same happens with the introduction of electric cookstoves, that has low penetration in the region.

In terms of access to clean fuels and technologies for cooking[3], the region improved much less than in terms of electricity access. According to the World Health Organization (World Bank, SE4All database from WHO 2016), in 2016, 87.1% of the population had access to clean cooking as compared to 78,4% in 2000, that is just 8.7% progress in 15 years. Thirteen countries have a rate of more than 90% of access.

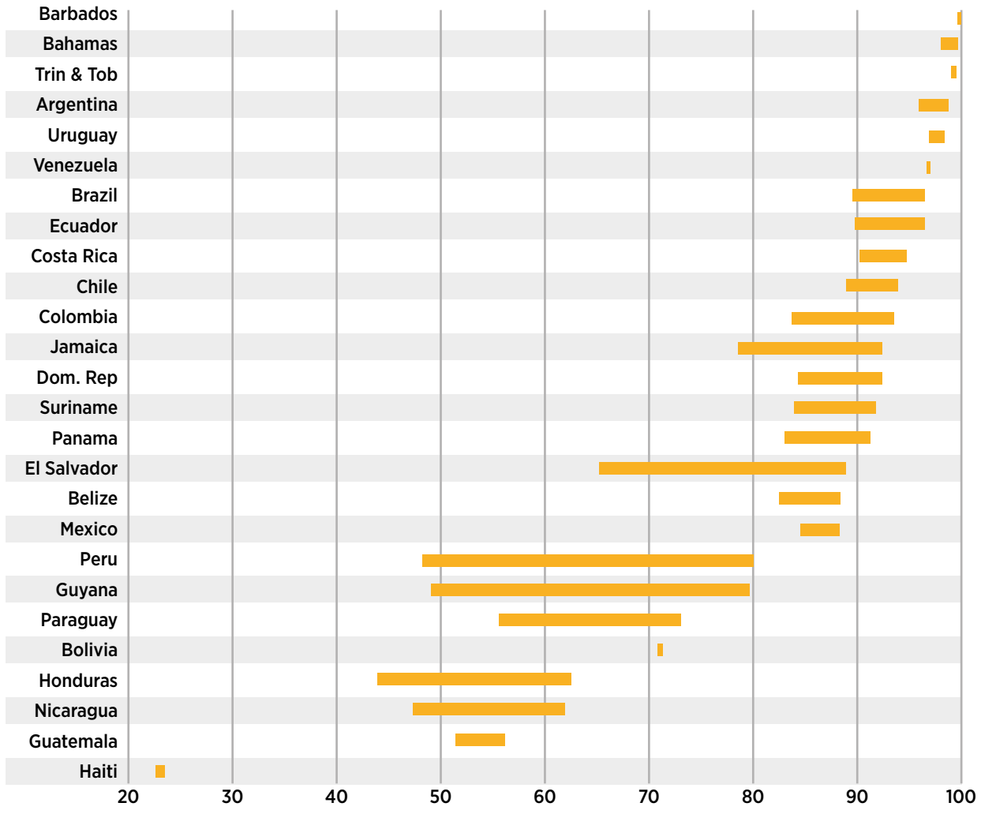


Figure 4. Access to clean fuels and technology for cooking: evolution rates in %, 2000 - 2016
Source: Own elaboration using data from World Bank, SE4All database from WHO (2016)

2 World Health Organization, Fact sheets on House Air Pollution and Health, 2018. https://www.who.int/news-room/fact-sheets/detail/household-air-pollution-and-health

3 Data for access to clean fuels and technologies for cooking are based on the World Health Organization's (WHO) Global Household Energy Database. The data refers to the percentage of total population primarily using clean cooking fuels and technologies for cooking. Under WHO guidelines, kerosene is excluded from clean cooking fuels.

1 Access

1.2 ACCESS TO CLEAN FUELS AND TECHNOLOGIES FOR COOKING

El Salvador emerges as a country that has made great improvement, almost reaching the best performers in the region. A similar progress, even if further efforts are needed to reach 80%, can be observed in Peru (from 35.3% to 75%), and Guyana (from 36.3% to 74.5%). Improvement in this regard derived from setting ambitious regional targets and from building partnerships not only with the private sector that was responsible for installation and maintenance but also with international organizations to take advantage of global knowledge and experience in generalizing the use of new cooking technologies despite cultural barriers. El Salvador, for example, joined the Global Alliance for Clean Cookstoves (GACC) launched in 2010 as a PPP with the goal of fostering adoption of clean cookstoves and fuels in 100 million households by 2020. As stated by Ekowevi (2013), these projects require detailed upstream studies and a group of interdisciplinary specialists since there are consumer barriers to changes the traditional way of cooking as well as a lack of awareness of the benefits from such changes.

PROGRAM	MAIN RESULTS
EL SALVADOR	
Programs are centered on specific stove models: the manufacturers are responsible for marketing, installation, training, and quality control with or without partnership with other institutions. The most salient stove model was “Ecocina”, produced by the “Stove Team” Group with fuel savings of 50% and emissions savings of 68%.	Wood savings, reduced smoke exposure, time saving. **Ecocina:** The stoves have been either sold at half of the US$60 list price or provided for free. About 10,000 units have been distributed between 2006 and 2012. In the latest phase of the program the new models are bigger and more sophisticated than the original version and are sold at full market price, from US$113 to US$250. These stay profitable due to a change in habitus and the removal of LPG subsidies (50% of the market price in average), as we will see in the next section.
PERU	
Fondo de Inclusión Social Energético (FISE) - 2012 on	
This comprehensive program had many objectives, among which: 1 - the massification of natural gas for homes and vehicles; 2 - access to LPG (domestic gas cylinder) in vulnerable urban and rural areas: free LPG cookstoves and 50% discount on LPG cylinders to targeted population. Criteria for targeting the LPG discount voucher: (1) live in a district with a high level of poverty; (2) have an electricity consumption below 30 kWh/month; (3) have a yearly income of around USD 5500; (4) have a residence constructed from poor materials.	At the beginning of 2016 it was operational in 97.5% of the country’s districts and vouchers were distributed to 1472,852 households. Between 2012 and 2016 providers of LPG rose from 5 to 3903. Calzada and Sanz (2018) show positive benefits in terms of welfare.

Box 2. Improving access to clean fuels and technology for cooking
Source: Own elaboration using content from Calzada and Sanz (2018) and Wang et al. (2013)

The worst performers in the region in this regard have failed to adequately tailor policies to the population still using old cooking technologies as well as to inform consumers about the advantages of the usage of these fuels. As stated by Wang et al. (2013), “In Guatemala, Honduras and Nicaragua, making tortillas on a smoky fire is a way of life”.

Afforda-bility

2

Highlights

a) Subsidies are high in the region, which could lead to important fiscal pressure

b) Tariffs are rarely linked with the cost of provision for each type of consumer

c) There are important inclusion and exclusion errors.

These errors are mainly due to:

i) supply-side subsidies (e.g. subsidies to distribution firms for providing access in remote areas) that lead to inclusion errors due to the difficulty in distinguishing final consumer beneficiaries;

ii) demand-side subsidies that are poorly targeted since most social tariffs are based on quantity of consumption, which is weakly linked to poverty due to discontinuities in energy consumption, e.g. poor insolation of households made with non-permanent materials induces high energy consumption in poor households;

iii) the high political cost of subsidy reform that most prime ministers are unwilling to pay.

1. Rebalancing energy tariffs could increase efficiency and help improve financial sustainability while preserving affordability if accompanied with direct transfers.

2. Energy efficiency and other energy conservation measures can help increase affordability.

3. Energy efficiency policies should be accompanied with campaigns to generate habitus in energy conservation and bill payment.

4. Political acceptability of subsidy reform by higher income households can be promoted with campaigns showing the welfare gains of such reforms.

2 Affordability

2.1 AFFORDABLE ELECTRICITY

Figure 5 shows electricity subsidies per country as a percentage of GDP. Electricity subsidies are calculated as the difference between the total payed (including taxes) by consumers (residential, industrial, commercial and public sector) and the sum of the cost of generation, transmission and distribution. We observe there is great heterogeneity among countries: while in some cases subsidies represent more than 3% of GDP, in some other subsidies are null. There is also heterogeneity regarding the way subsidies are financed. In the case of Bolivia, for example, subsidies to poor households are financed directly with transfers from the central government. Instead, in many countries, electricity subsidies are implemented as a cross subsidy from households that consume more than a threshold to households that consume less than a threshold. The specific threshold varies among countries.

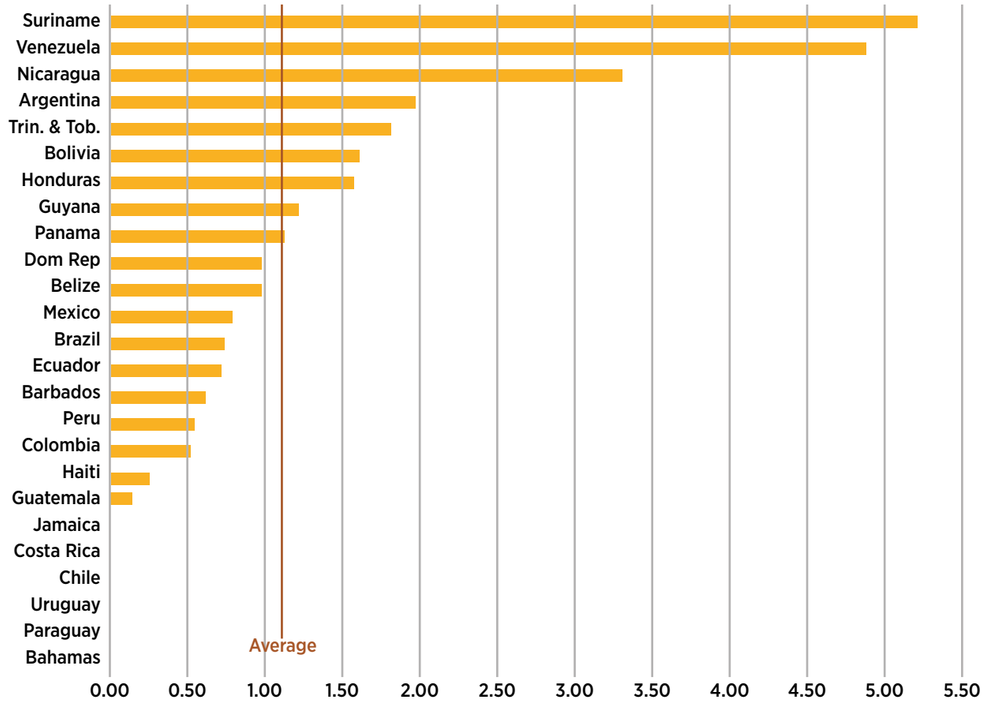


Figure 5. Electricity subsidies as a percentage of GDP, average 2008-2014
Source: Own elaboration using data from Marchan et al. (2017)

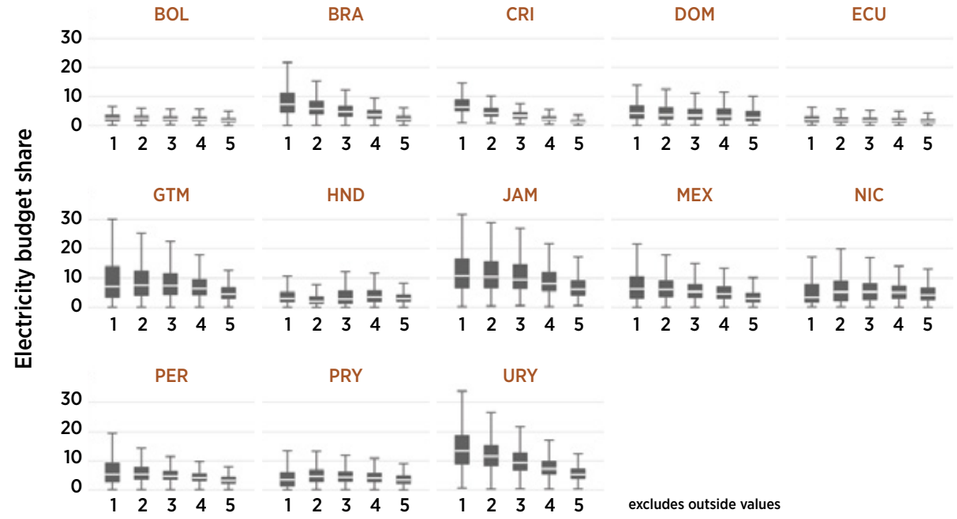


Figure 6. Electricity expenditure as a percentage of income per quintile in selected countries
Source: Own elaboration using household surveys (2012-2016)

Figure 6 shows that in countries with large electricity subsidies as a percentage of GDP like Nicaragua and Bolivia, the percentage of income spent in electricity is much lower than 10% of total income across income deciles[4]. It also shows that countries without subsidies like Uruguay and Jamaica show a great difference between poor and rich households in terms of percentage of income spent on electricity.

In this regard, Marchan et al. (2017) have studied the redistribution impact of reforming subsidies in LAC. They show that 21% of the savings gained from a flat increase in electricity prices of 5 cents of a dollar per kWh would be enough to compensate the bottom 40% of households for their welfare losses. In the same vein, several have praised the benefits of rebalancing tariffs to reflect true costs of generation, transmission and distribution and compensate the welfare loss of this change with a direct transfer to low income households (Hancevic et al., 2019 and Urbiztondo et al., 2018, among other).

4 Boardman (1991) first established the 10% of income threshold to define fuel poverty in the UK. Since then, many studies have been done for different countries covering different energy sources. As an example, Fisher, Sheehan and Colton (2003) introduced a model that calculated the dollar amount by which home energy bills exceed affordable home energy bills county-by-county in the US. The 2016's update of this study establishes that energy in the home ceases to be affordable if it exceeds 6% of the household's income, in average.

2 Affordability

2.1 AFFORDABLE ELECTRICITY

Despite the fiscal effort in subsidies, a great part of the population declares they had trouble paying the electricity bill at least once in the last 12 months. Indeed, subsidies fail to increase affordability of electricity for about 31% of the population (see Figure 7).

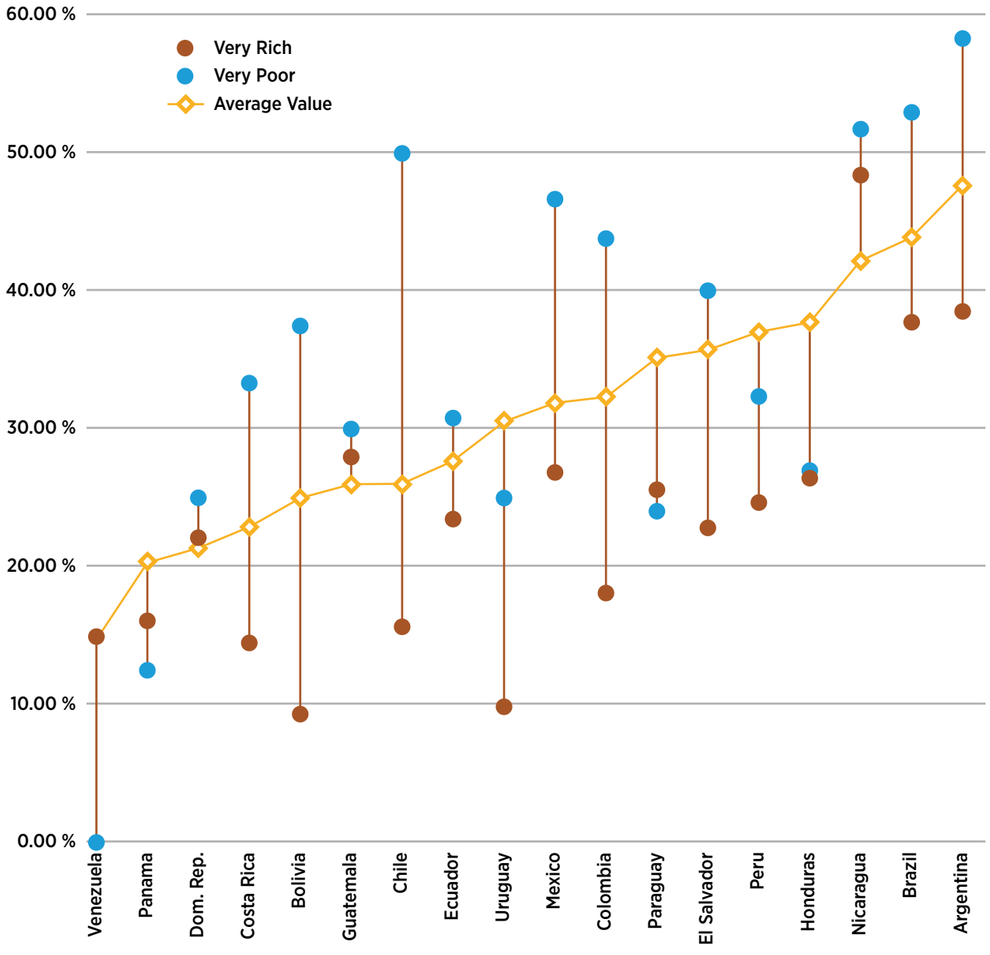


Figure 7. Percentage of population that state to have difficulties paying the bill in the last 12 months
Source: Corporación Latinobarómetro (2018): Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Uruguay and Venezuela

Several countries have social tariffs in the form of discounts for electricity. The targeting mechanism is generally based on consumption thresholds. From a supply side perspective, this type of design is inefficient since the most costly consumers are the ones in isolated areas, congested areas and peak-load demanders, all of which are poorly correlated to quantity of consumption.

From the demand side, quantity consumed is misleading as a targeting device. Poor households are in general more energy inefficient due to the use of old appliances and due to the materials used to build the home which imply poor temperature insulation and greater consumption. Indeed, inclusion and exclusion errors have shown to be important in the region. Figure 8 shows that the number of beneficiaries in Dominican Republic and Paraguay are only around half of the poor households (exclusion error). On the other end, in Brazil, Ecuador and Peru there are more than 4 times more beneficiaries than extreme poor and in Jamaica this applies to the poor (inclusion errors).

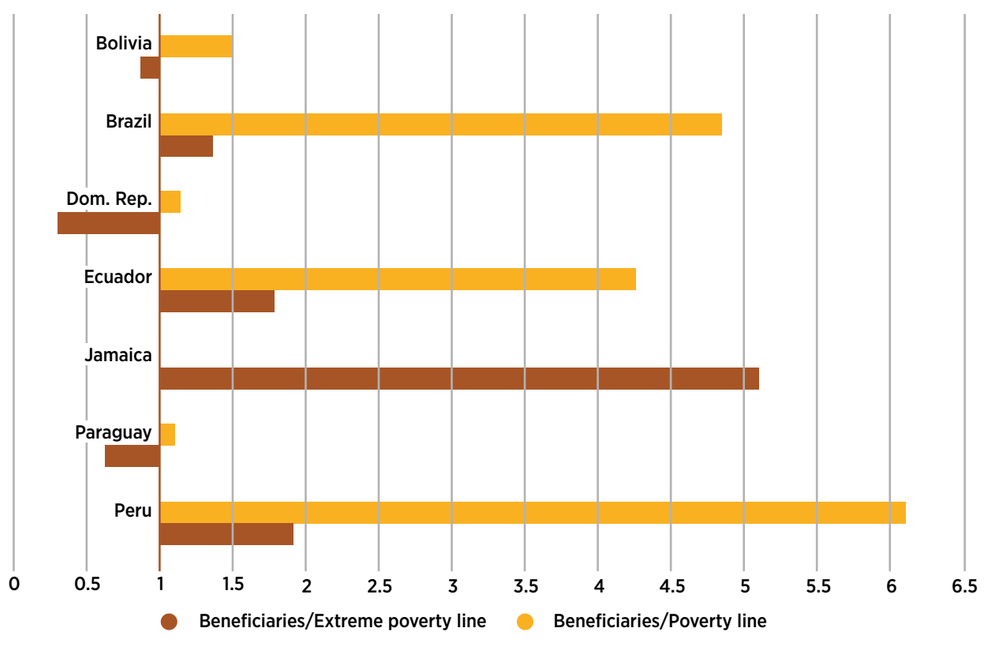


Figure 8. Ratio of Social Tariff Beneficiaries and Poverty line indicators
Source: Based on Canese (2013)

2 Affordability

2.1 AFFORDABLE ELECTRICITY

Table 2 shows similar results for Central-American countries. For example, Nicaragua has 39% of the population receiving a subsidy they should not receive while 20% of the population would need it and is not receiving it.

Country	Inclusion error	Exclusion error
El Salvador	43	8
Guatemala	22	27
Honduras	36	14
Nicaragua	39	20

Table 2. Energy subsidies performance in terms of targeting, 2016
Source: Based on Hernandez-Ore et al. (2018). Errors of inclusion and exclusion are reported as a percentage of the total population. For example, El Salvador's errors of exclusion (households living on less than US$4 per day that did not receive subsidies) account for 8 percent of the national population.

Properly targeted demand-side subsidies are indeed the best way to increase affordability for the poor. In Table 9, we observe that only three countries use mechanisms other than quantity consumed. Argentina just recently (2018) changed the target mechanism to include income and other socioeconomic markers (including georeferentiation) as the primary way to select lower income households into the social tariff beneficiaries. Brazil uses income as a targeting mechanism for the social tariffs and then applies a different discount depending on quantity consumed. Similarly, Colombia uses a second targeting variable other than quantity consumed called "strata". Colombia has a strata system that divides the population in six strata or categories of "welfare levels". To build those categories several socioeconomic variables are considered: education, health coverage, number of dependents under 5, income, characteristics of the dwelling, etc. Three of those socioeconomic categories receive up to now progressive discounts, even if a reform is being discussed nowadays to eliminate the discount for Stratum III as of 2019.

	MONTHLY CONSUMPTION LIMIT FOR SOCIAL TARIFF	DISCOUNT
Argentina	<150 kWh	100% for the first 150 kWh
	150kWh< <300 kWh	50%
	Income < 2 Minimum wages, retired and beneficiaries of other social programs with the exception of owning more than one house or a car with less than 10 years	
Bolivia	<70 kWh for grid consumers; <30 kWh for off-grid	25%
Brazil	Free <50kWh if indigenous or quilombeas	
	<30 kWh	65%
	31-100 kWh	40%
	101-220 kWh Families inscribed in *Catastro Federal* with Income pc =< ½ minimum salary or beneficiaries of *Prestação Continuada da Assistencia Social*	10%
Colombia	<200 kWh	*Stratum I*: 50% *Stratum II*: 40% *Stratum III*: 15%
Ecuador	<110 kWh in the sierra <130 kWh in the coast, east and insular regions <120 kWh subsidy to the elder	50%
El Salvador	<100 kWh	86% in average
Guatemala	<50 kWh	fixed tariff 0,08 US$/kWh
Honduras	<300 kWh	14 US$ year approx.
	Other	25%
Jamaica	<100 kWh	62,44%
	<300 kWh	14,16%
Mexico	<75 kWh	72%
	76 - 140 kWh	65%
	<900 kWh in summer	65% or more

Table 9. Social Tariffs per country
Source: Own elaboration based on Canese (2013) and data from Latin-American Utilities and Regulators

2 Affordability

2.1 AFFORDABLE ELECTRICITY

	MONTHLY CONSUMPTION LIMIT FOR SOCIAL TARIFF	DISCOUNT
Nicaragua	<125 kWh	50%
	126 - 150 kWh	40%
Panama	<100 kWh	20%
	<600 kWh	25%
	Other	5%
Paraguay	<100 kWh	75%
	101 - 200 kWh	50%
	201 - 300 kWh	25%
Peru	<100 kWh	50% if rural
		25% if urban
	<100 kWh + subsidized consumption	100% for the first 100 kWh
Dominican Republic	<200 kWh	60,4% in energy + fixed charges
	200 - 300 kWh	37,2% + fixed charges
	300 - 700 kWh	2,2% + fixed charges
	300 kWh	47,2 to 23,7%
Uruguay	<100 kWh	20% in consumption, 80% in fixed charge
	101 - 140 kWh	60%
Venezuela	<300 kWh	

Table 9. Social Tariffs per country (cont.)
Source: Own elaboration based on Canese (2013) and data from Latin-American Utilities and Regulators

Energy efficiency plans appear as an alternative for poor households to increase affordability by reducing electricity consumption. Ecuador and Peru are examples of countries that have implemented Energy Efficiency measures targeted to the poor (see Box 3). Some other countries have implemented Energy Efficiency programs but their results in terms of decreasing electricity consumption or increasing affordability are still to be properly measured.

ENERGY EFFICIENCY PROGRAM	RESULT
ECUADOR	
Program for the Renewal of Inefficient Energy Consumption Equipment	
Since 2012, it encourages replacement of refrigerators with more than 10 years of use.	Resulted in more than 28000 replacements, estimated to have saved around 15,780 MWh per year, equivalent to US$17 million.
Project of Replacement of incandescent light bulbs for saving bulbs	
It began in 2008 with the objective of reducing electricity demand during peak hours.	In 2008, 6 million saving light bulbs were installed, focusing on homes with consumption of less than 150 kWh/month. In 2010, 10 million saving light bulbs were installed in other sectors such as health, education and social service, as well as residential users with consumption of up to 200 kWh/month.
Induction Cooktop Pilot Project	
Since 2010 the program aims to partially replace LPG stoves by electricity induction cooktops.	By 2014, approximately 3,433 induction cooktops were delivered.
PERU	
Replacement of incandescent light bulbs by compact fluorescent light bulbs (CFL)	
Between 2009 and 2010, the program aimed to replace incandescent light bulbs by CFL in homes with consumption of less than 100 Kwh/month.	Just in one year, 1.5 million light bulbs were replaced.
National Energy Plan	
Started in 2014 with the objective of replacing 2.5 million incandescent light bulbs both in private and public buildings together with other EE measures.	Estimated savings of the whole program are US$80 million. Antonio et al. (2020) estimates that as a result of this program an average household saved about 2.18% on the electricity bill for each incandescent light bulb replaces by LED.

Box 3. Selection of Energy Efficiency programs in the residential sector
Source: Own elaboration based on Chapter 8 of Jimenez and Yépez-García (2018) and Antonio et al. (2020)

2 Affordability

2.1 AFFORDABLE ELECTRICITY

The numbers cited regarding savings due to energy efficiency measures could be amplified if accompanied with campaigns to promote energy conservation through behavioral change. Box 4 summarizes the behavioral biases related to energy consumption and the best way to tackle those biases according to previous studies that have been performed throughout the world.

BEHAVIORAL BIAS	POSSIBLE INTERVENTIONS TO FOSTER ENERGY CONSERVATION
Framing: drawing different conclusions depending on how information is presented	Use positive framing when referring to self-other: refer to benefits to oneself and others (Loroz, 2007).
Cognitive overload/Satisficing and Bounded rationality: exert efforts to reach a satisfactory outcome instead of the optimal one	Making desired actions easier and quicker using new technologies. Reduce perceived uncertainty by making people try the desired action in a risk-less environment. Information and incentives are more motivating if they come from a trustworthy source (Craig and McCann, 1978).
Status quo and inertia: resisting change or deferring making a decision, even if an alternative behavior yields better outcomes	Set defaults like washing machines in short cycle or house heaters in off during the night. Encourage behavioral change when a life change happens like moving houses.
Sunk cost effect: irrationally fixated on recovering losses already incurred	Frame messages to reduce saliency of costs already incurred in non-efficient equipment. Provide information on future returns on investment in efficient equipment. Cash-back bonuses for upgrading appliances may be more efficient than month to month incentives after appliances have been upgraded.
Present bias, Temporal discounting and spatial discounting: perceive things as less valuable if further away in time or space	Different techniques to both increase the saliency of future pay-offs and making people visualize more vividly their future self can be applied. Consider immediate intrinsic rewards like praise or extrinsic like gifts.
Loss aversion: weighing losses more heavily than equal sized gains more willing to engage in risk behavior if to avoid certain loss than to get an equally size gain	Frame energy-conservation messages in terms of cost and loss avoidance (referring to the household or the present generation) when referring to one-self.
Social norms, comparison and reciprocity: people are influenced by the behavior of others	Compare a household consumption with that of their neighbors focusing on positive norms (Allcott, 2011). Frame energy savings as socially desirable, more so with immediate social groups (Goldstein et al. 2008) and including reinforcement mechanisms (like a smiley) to avoid rebound effects. Make collective achievements more salient, showing that no neighbors are free-riding, for example. This effect is stronger when individual motivation is low (Schultz, 2013). Respond to other people's actions with the same action (Fehr and Gachter, 2000). Andor and Fels (2018) show that social comparison produces between 1.2% and 30% reduction in energy consumption as compared with a control group. A caveat is that larger samples find smaller effects.
Availability heuristics and saliency: likelihood of events are assessed considering the most readily available events in memory	Messages should include examples of actions that are easily available in consumer's memories because they are recent, frequent or because they are emotionally salient like testimonials in the media. Gilbert and Zivin (2014) find a reduction in consumption between 0.6 and 1% of the average daily consumption in the first week after receiving the bill.
Intrinsic motivation: people may respond negatively to extrinsic motivations (like monetary incentives) if the intrinsic motivation is high	In-kind gifts and praise can prove more powerful than sole financial incentives to induce sustained change in behavior.

Box 4. Behavioral Economic Interventions in the Energy Sector
Source: Own elaboration based on Frederiks et al. (2015), Sanin et al. (2019) and references mentioned in the box

Delmas (2013) metanalysis finds that the greater effect on energy saving (13.5%) is observed in programs where the intervention consists of auditing the households and informing them about their energy efficiency, with the effect varying with the behavioral nudge. The effect of this type of interventions is yet to be explored in LAC.

2 Affordability

2.2. SUBSIDIES AND AFFORDABLE CLEAN FUELS

Heterogeneity in terms of fuel subsidies is even stronger than in the case of electricity ranging from an average of more than 9% of GDP to being taxed in many countries.

Fuel subsidy reforms tend to have high political costs since they make a huge difference in the household budget. El Salvador is not only an example in terms of access to new technologies for cooking but also in terms of fuel subsidy reform. The country pursued a general subsidy reform in all infrastructure services (see Caruso et al. 2015) that reduced the threshold for Social Tariffs in Electricity to 100 kWh and imposed a series of changes in the LPG subsidy that successfully replaced a price subsidy with a transfer, depending on household income (see Box 5). This measure achieved political acceptability using an important informational campaign: in January 2011 a representative opinion survey found 70% of the population against the reform whereas just a year later 68% where in favor.

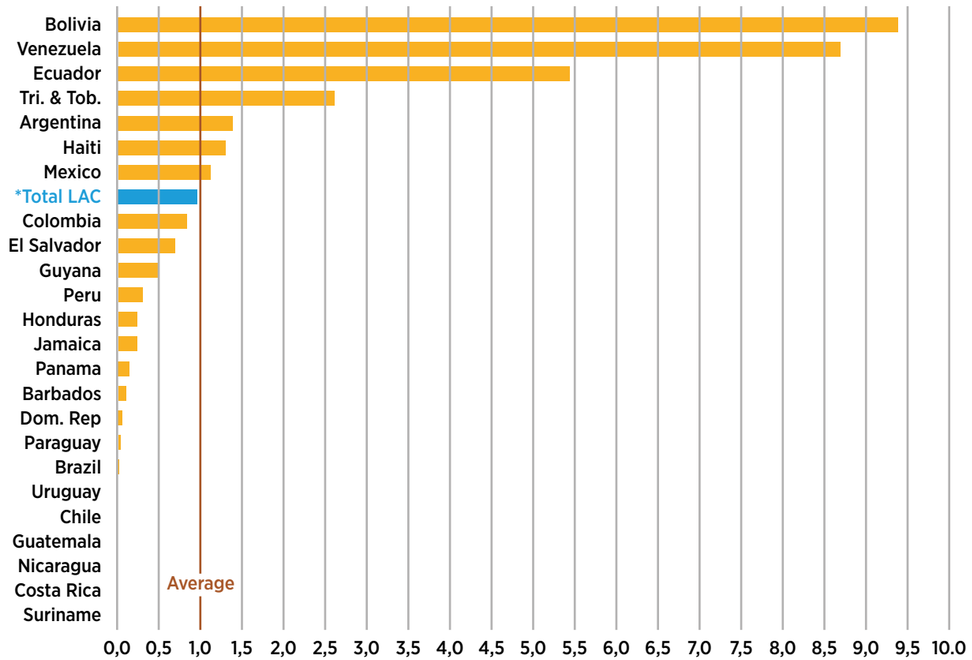


Figure 9. Fuel subsidies as a percentage of GDP, 2008-2014 average
Source: Own elaboration using data from Marchan et al. (2017)

PROGRAM	RESULTS
EL SALVADOR	
Between 2004 and 2011 all LPG consumers could profit from a price ceiling that represented a US$8 subsidy per cylinder of 25 pounds (11 kg), without limit in the number of cylinders that could be bought per household.	The cost from such subsidy was 0.3% of GDP in 2004.
2011's reform	
In April 2011 the subsidy was removed and substituted with a direct transfer of US$8.5 per month (the difference between the old price for a 25-pound cylinder of US$5.10 and the new price US$13.60) in cash or in the electricity bill for households consuming less than 200 Kwh. Households without electricity where also eligible.	Since 47% of households in the bottom 40% of the income distribution did not use gas for cooking, the reform was pro-poor.
2013's reform	In 2013 cost remained at around 0.6% of GDP.
In 2013 the system switched to the usage of mobile technologies. Vendors of subsidized LPG received a phone in which they receive mobile transfers upon beneficiary provision of ID and the entry of a PIN. The price for beneficiaries is fixed but the subsidy paid to vendors varies with market price of LPG.	High income households no longer benefit from the subsidy but 40% of the beneficiaries are middle income households.
The consolidation of the monitoring program and the use of the Solidarity Card was achieved in 2014.	Inclusion error diminished but further efforts are needed to target the subsidy to the poor: 26% of the population is now left outside of the subsidy as compared to 6% in 2011.

Box 5: Subsidies' reform for LPG in El Salvador
Source: Own elaboration with data from IDB, 2010, World Bank, 2014, Calvo-Gonzalez et al., 2015, Di Bella et al., 2015, Beneke et al. 2015 and Toft et al. 2016

3

Quality and the quest for efficiency

Highlights

a) In average, LAC´s electricity losses are twice the world average and the amount of losses have not decreased significantly in the last 10 years.

b) The number and duration of electricity interruptions are higher than other region´s averages (excluding Sub-Saharan Africa) and have not decreased significantly in the last 4 years.

Successful policies have tackled both problems using enforceable performance-based regulation.

2 Quality and the quest for efficiency

3.1. QUALITY IN ELECTRICITY SERVICES

Reliability is increasingly important: just a few hours without electricity could mean rotten food and hours of lost work. On average, LAC had 6.26 non-programmed interruptions in 2017 (see Figure 10). The average duration of those interruptions is of 12.8 hours. While most of the other regions have improved in terms of these two quality indicators, LAC only experienced a very thin improvement in terms of the number of interruptions and no improvement in terms of duration of those interruptions. This stagnant trend in terms of quality indicators is particularly worrisome when comparing LAC with other developing regions who have made very important progress in the same period of analysis, as it is the case of South Asia.

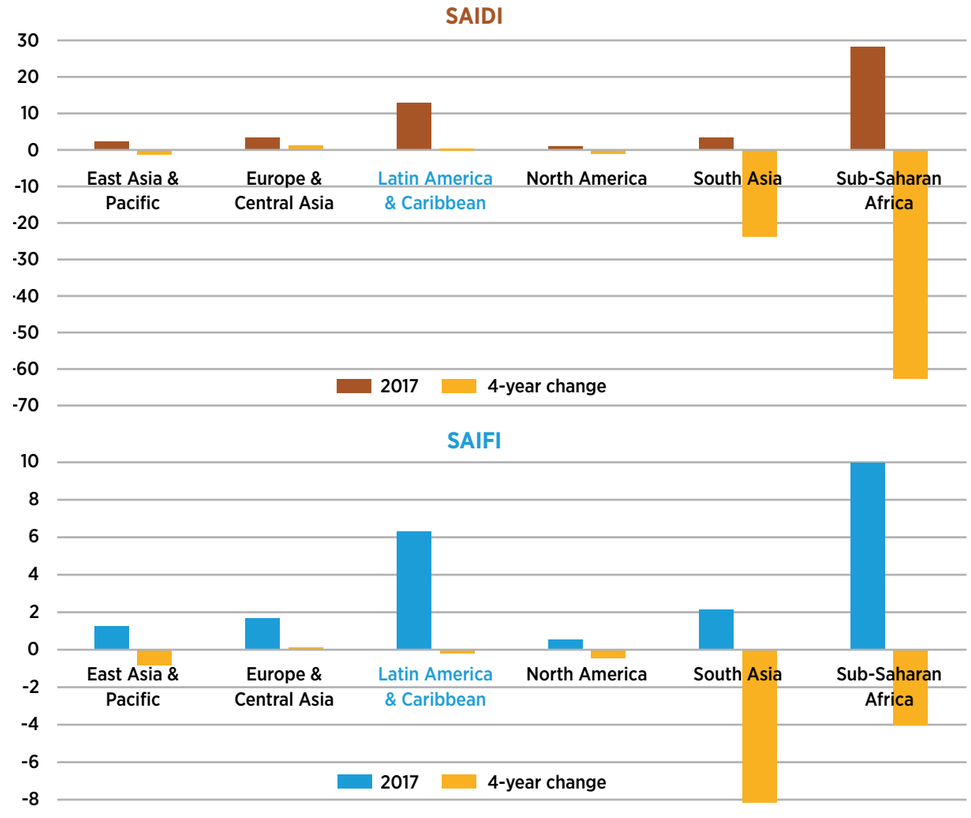


Figure 10. SAIDI: average duration of interruptions in hours per year; SAIFI: average frequency of interruptions per year (2017)
4-year change calculated in absolute terms since 2013

Source: Own elaboration using data from The World Bank (2018) keeping countries with data for all years in the period considered

The overall average hides strong differences among countries. Only Peru and Ecuador have made great progress in both indicators due to enforceable performance-based regulation, having still room for improvement.

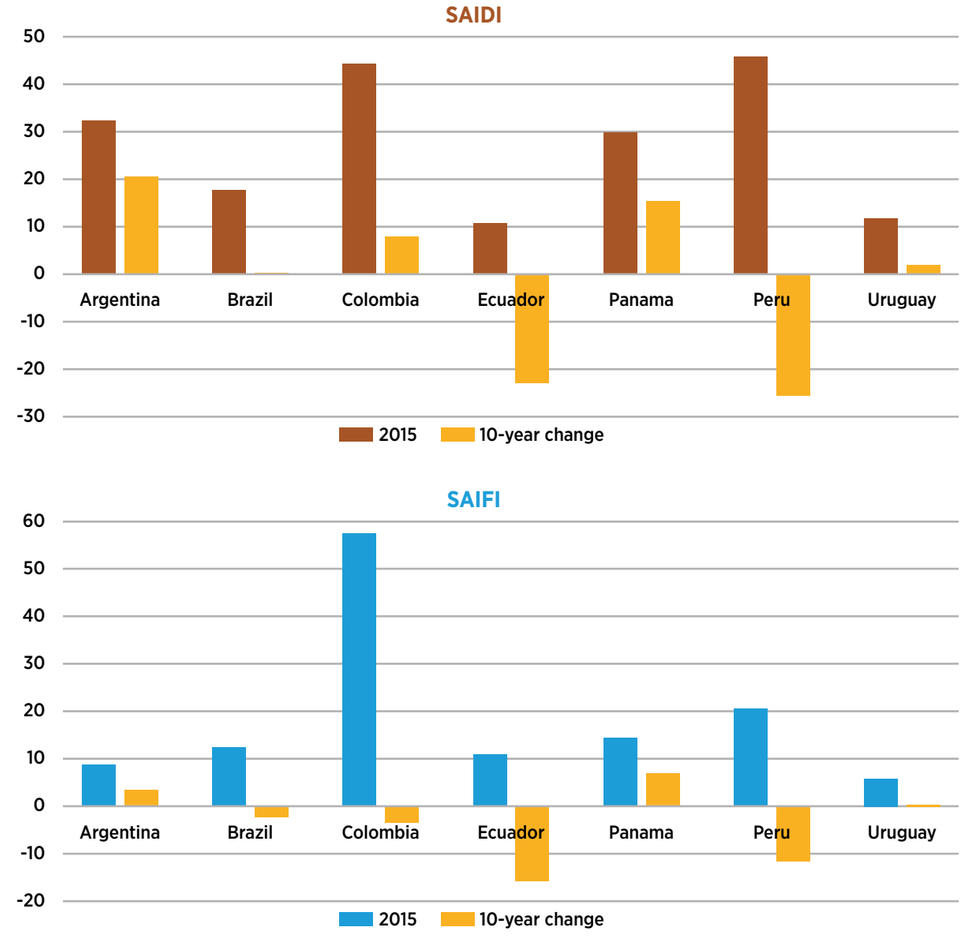


Figure 11. SAIDI: average duration of interruptions in hours per year;
SAIFI: average frequency of interruptions per year for selected countries, average across utilities (2016)
10-year change calculated in absolute terms since 2005

Source: Own elaboration using CIER (2016) where the average per country is calculated as a weighted average with available data of distribution companies

2 Quality and the quest for efficiency

3.1. QUALITY IN ELECTRICITY SERVICES

Most of the progress has been the result of specific policies that charge the distribution companies in case of non-compliance with the predetermined limit in terms of interruptions.

POLICY	RESULTS
ECUADOR	
The 8th Article of the *Reglamento Sustitutivo del Reglamento de Suministro del Servicio de Electricidad* (1999), defines as "Quality of Technical Service" the frequency and duration of interruptions. The distribution companies are responsible to compile the SAIDI and SAIFI data. In the case of non-compliance with the regulatory limits, the distribution company is fined by the regulatory agency. The company is also responsible to conduct a survey among its customers about the quality of its services.	The duration of interruption decreased 67.6 % (1360 minutes) from 2011 to 2015, while the frequency of interruption dropped 59% in the same period, from 26 to 11 times per year. The average time of each interruption were 20.4% shorter in 2015 as compared to 2011. On average, in 2015 each consumer experienced 1 hour of interruption on average.
PERU	
As of 2004 a specific procedure to control the inspection of electric meters entered into force. In April 2004 the regulator OSINERGMIN made it compulsory for distributing firms to report SAIDI and SAIFI (Resolution OSINERG 074-2004-OS/CD). As of 2009 detailed quality standards where established by the regulator (OSINERGMIN 686-2008-OS/CD). Those standards consider both technical aspects (like SAIDI and SAIFI) and commercial aspects (like customer service). The non-compliance with the regulatory limits in terms of quantity and duration of interruptions per type of consumer (high, medium and low voltage) obliged the companies to pay a compensation to customers.	Total benefits at the end of 2015 of this program where US$104 million as compared to US$17.21 million of monitoring costs. The amount of malfunctioning meters was 12.5% in 2003 and decreased to only 3.3% in the second semester of 2015. SAIDI and SAIFI significantly decreased in the last 10 years: 25 hours/year less in terms of duration of interruptions and the number of interruptions decreased of one third.

Box 7: Electricity quality regulation in Ecuador and Peru
Source: Own elaboration based on Country Regulators and Vasquez-Cordano et al. (2016)

These countries have accompanied this quality regulation with regulation to tackle electricity losses. Total losses in LAC were 15.62% of total generation in 2014, well above the world average of 8.25% for that same year, and has not significantly improved during the last ten years (see Figure 12). According to Jimenez et al. (2014) losses could represent US$27 millions a year in the region. Policies tackling this issue have made an important difference. This is the case because as efficiency increases, quality increases while decreasing costs. The most salient case is the one of Ecuador with the greatest diminution in losses since 2007 for a country where there is competition in the retail market.[5]

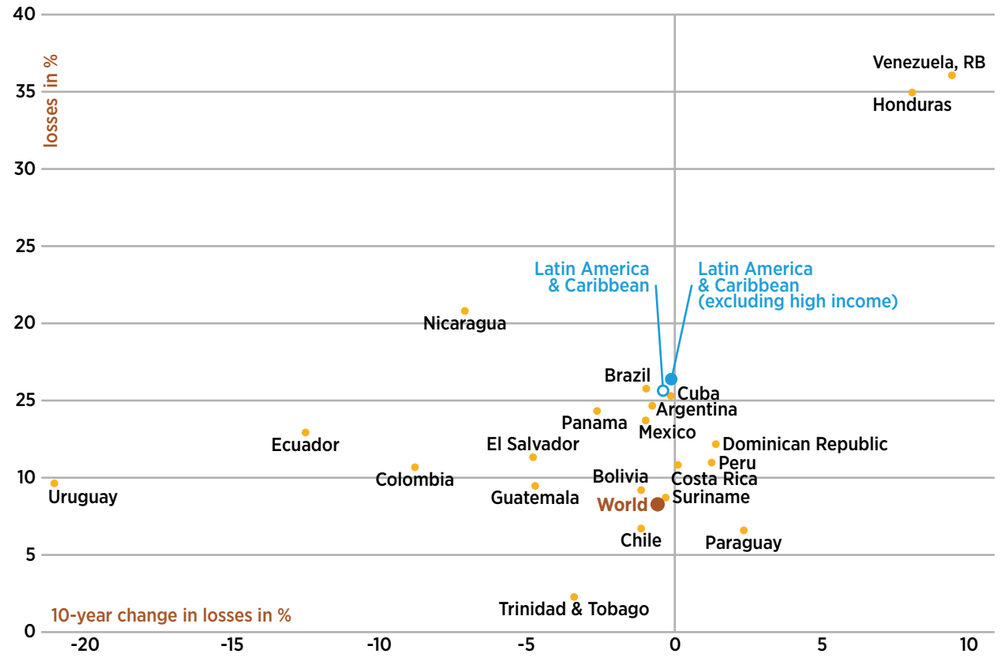


Figure 12. Losses in 2014 and change in losses 2004-2014, both as a percentage of total generation
Source: Own calculations based on The World Bank Database (2018)

5 Uruguay also appears as a great performer in terms of losses reduction, but the case is less interesting since the company is a state company vertically integrated, being responsible for transmission and distribution through the country. The Uruguayan plan included free electric installation inside the house, important financing options and forgiving previous abusive connection.

2 Quality and the quest for efficiency

3.1. QUALITY IN ELECTRICITY SERVICES

The regulation that made this progress possible in Ecuador included an integrated plan for new equipment to manage the network as well as specific penalties for theft, including incarceration. In 2006 PLANREP was approved with the specific purpose to reduce non-technical losses. During the first years of its implementation, meters were systematically changed to improve control of theft and remote metering. As from 2011 judiciary penalties for electricity theft and abolition of land squatting where implemented and meters where placed outside of the home to improve frequency and facilitate inspection. Non-technical losses decreased from almost 13% in 2006 to only 4% in 7 years and has not increased since (see Figure 13).

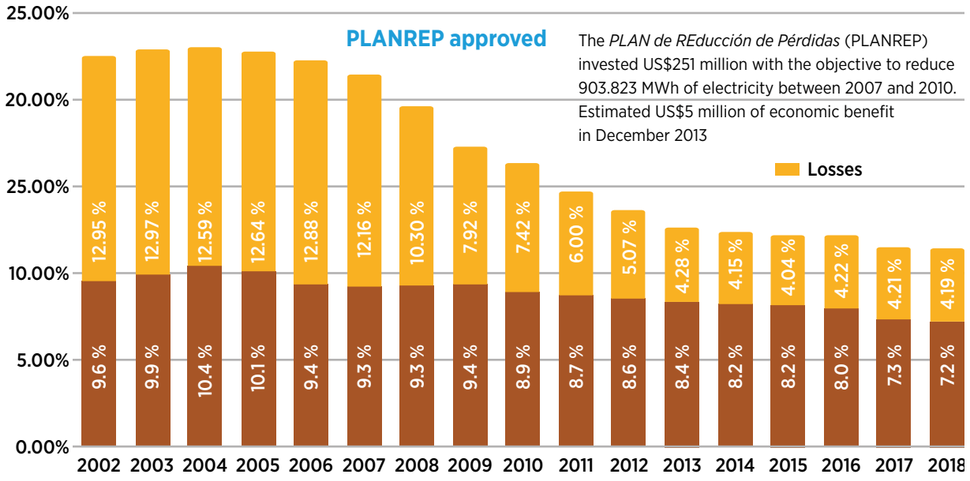


Figure 13: Total losses as a percentage of generation in Ecuador
Source: Own elaboration based on CELEC EP (2019) and Subsecretaria de Distribución y Comercialización del Ministerio de Energía y Recursos naturales no Renovables (MERNNR)

Finally, we could mention that many times the improvement of quality is not accompanied by the improvement in the perception of quality. Stronger efforts are needed to communicate on this type of indicators as well as on getting feedback from the consumer´s needs. An interesting example of the promotion of this is the Consumer Satisfaction Index from ANEEL in Brasil regarding the distributed energy companies. Visibility of the utilities ranking has per se increased both quality of service (incentive for utilities) and quality perception. Additionally, as countries develop standards, quality of service will increase, increasing pressure on governments in this direction.

3 Quality and the quest for efficiency

3.2. CLEAN FUEL QUALITY

Quality standards regarding different type of fuels are established in most countries and are usually enforced by inspection. Such standards usually specify levels of odor in the case of gas to ensure safety of its household usage. The way this regulation applies is similar to the one applied to different components in the case of gasoline. As an example, Peru has established a series of quality standards as of 2002 regarding octane in gasoline and sulfur in diesel that resulted in US$ 117.4 millions of net benefits (see Figure 14).

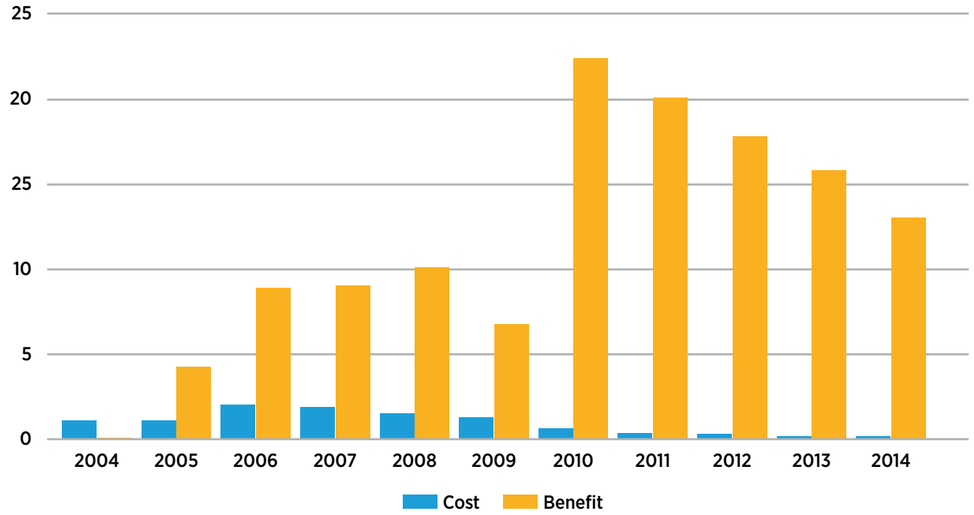


Figure 14: Economic impact of gasoline and diesel quality control in Peru in US$ millions of 2014
Source: Own elaboration based on Vasquez et al. (2017) and Tamayo et al. (2015)

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