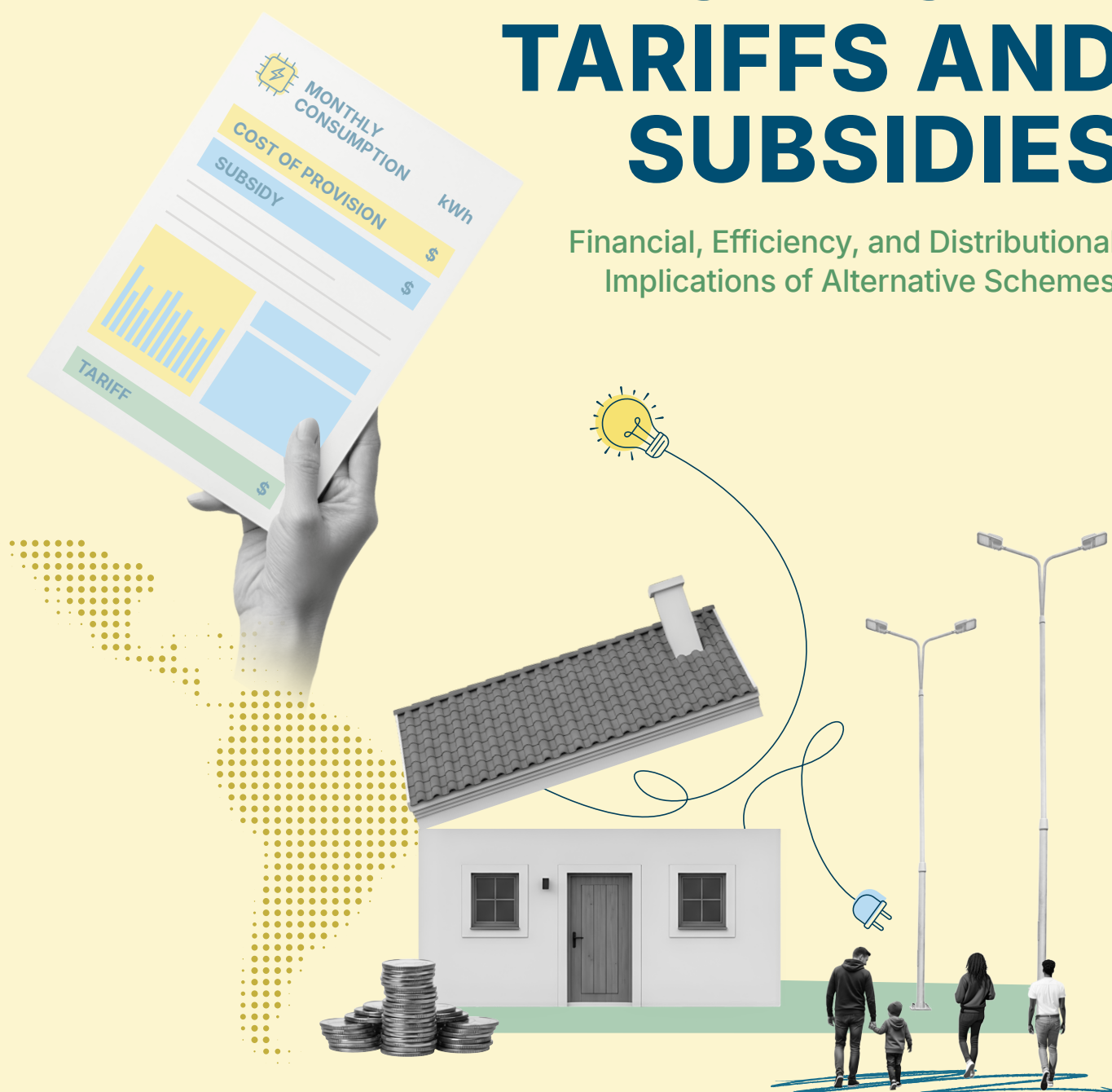


SETTING APPROPRIATE **ELECTRICITY TARIFFS AND SUBSIDIES**

Financial, Efficiency, and Distributional
Implications of Alternative Schemes.



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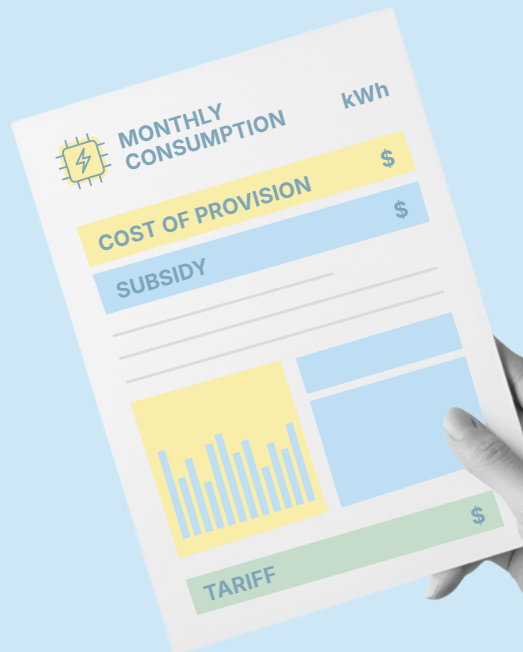
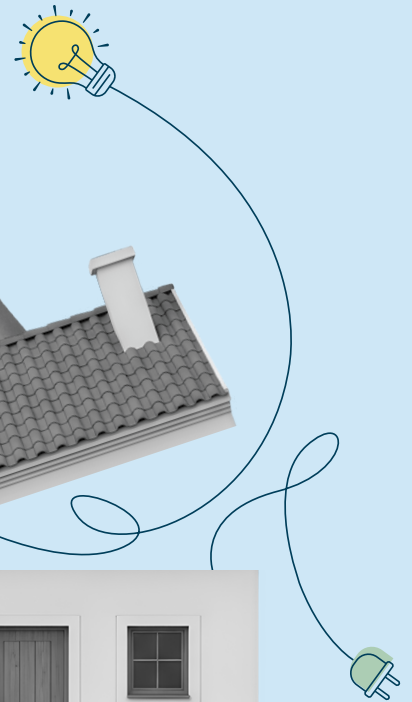
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SETTING APPROPRIATE **ELECTRICITY TARIFFS AND SUBSIDIES**

Financial, Efficiency, and Distributional
Implications of Alternative Schemes.

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Abstract

Electricity tariffs play a central role in ensuring the financial sustainability and efficiency of the entire electricity sector, while well-designed complementary subsidy schemes safeguard the affordability of electricity services. Yet across Latin America and the Caribbean (LAC), tariff schemes frequently fail to recover the full costs of service provision and to reflect their structure, while subsidy mechanisms remain poorly targeted. The result is electricity sectors that do not cover their costs—or, where they do by underinvesting, low-quality service—along with fiscal burdens, distorted price signals, and misallocated subsidies. This report examines alternative tariff and subsidy designs using microsimulations for a sample of LAC countries spanning a broad spectrum of income levels and regulatory frameworks. We develop a unified analytical framework that integrates tariff structure design with subsidy policy. A consumption recovery algorithm uses reported household expenditure and the tariff schedule, data available in most countries, to back out the electricity each income decile consumes and the implicit fixed and variable charges it faces. Because every scheme is expressed as a single fixed charge and a single average variable charge per income group, structures with very different designs become comparable, both across countries and across alternative designs. On that basis we simulate five alternative tariff-subsidy scenarios and find that simple recalibrations of fixed and variable charges can materially enhance cost recovery and improve allocative efficiency through better price signals, while preserving or improving distributional equity, especially when subsidies are well targeted. The comparative analysis further clarifies the nature of each country's difficulties, such as high provision costs, poorly designed tariff structures that fail to recover moderate costs, or mistargeted policy schemes, each having different policy implications.



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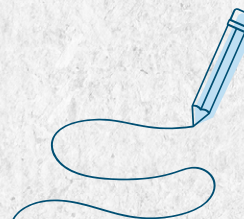


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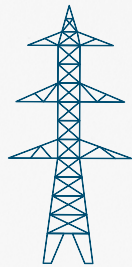
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1.



Introduction



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1. Introduction

Reliable access to electricity is a cornerstone of economic development and social welfare (Dinkelman, 2011; Lee et al., 2020; Reinikka and Svensson, 2002). Yet across Latin America and the Caribbean (LAC), electricity provision faces mounting pressures: aging infrastructure (Cavallo et al., 2020), increasing exposure to extreme weather events (Bagnoli et al., 2025a; Bagnoli et al., 2025b), growing demand from an expanding urban population (Wolfram et al., 2012), changes in temperature patterns (Davis and Gertler, 2015), and the electrification of energy end-uses (Davis and Gertler, 2025; Gertler et al., 2016). Ensuring that electricity systems can withstand and recover from disruptions—whether caused by natural disasters, grid failures, or demand shocks—requires sustained investment in system resilience. This, in turn, depends critically on the ability of the different segments within the electricity sector to recover the full costs of service provision.

In this regard, electricity tariffs—the rates set by regulatory authorities that consumers pay for electricity services—are central. In Latin America and the Caribbean (LAC), electricity rates take various forms, but a common issue across countries is the inability of these rates to expose users to prices that recover the full costs of service provision and accurately reflect the costs of the different associated components (Cavallo et al., 2020). Another shared concern is the affordability of electricity services for low-income households (Jiménez and Yépez-García, 2020) and the related need for electricity subsidy schemes. In light of these considerations, this report examines various electricity tariff and subsidy schemes, using microsimulations to evaluate the effects of alternative designs. The results reveal opportunities to improve cost recovery and efficiency without compromising service affordability.

In [Section 2](#), we begin by outlining aspects of electricity provision that are key to the design of the tariff system, as well as associated challenges. To this end, we explain in detail the cost structure of electricity provision, breaking it down into its generation, transmission, and distribution components. Understanding and identifying these costs is fundamental, as an effective tariff system must recover all expenses incurred in delivering the service. When tariffs fail to cover these costs, states often deploy subsidies to fill the gap, a common practice in the LAC region. We also examine the portions of and differences between fixed and variable costs throughout the production chain—information that is essential for the proper planning of an electricity tariff scheme. In fact, such a scheme should include charges corresponding to both types of costs to reflect the different cost components associated with the service provision. Finally, we formally introduce three essential principles for electricity rate design: cost recovery, cost reflectivity, and affordability (Borenstein 2016; Navajas 2023). The first principle establishes that the tariffs should be sufficiently high to cover the service's total cost, while the second principle requires rates to adequately reflect the different costs associated with the service provision and its variability. The third principle seeks to guarantee that the tariffs allow at least the minimum use of electricity required by a household for adequate development. In the design of a tariff system, these three principles often come into conflict. Accordingly, we review the most frequently discussed price schemes, including *average cost* or *pure volumetric pricing*, *two-part tariffs*, *time-of-use pricing*, and *increasing block pricing*, highlighting the trade-offs among them and considering alternative solutions.

In [Section 3](#), we present the costs, tariff and subsidy structures, and subsidy mechanisms for residential electricity in the main metropolitan areas of four countries, which are a good representation of the diversity of schemes present at the regional level: Argentina for 2017/2018, the Dominican Republic for 2018, Ecuador for 2012/2013, and Uruguay for 2016/2017. We chose these years because they are the ones for which we have access to data on household socioeconomic characteristics, which are fundamental to our purposes in this work. Although the regulatory frameworks from these periods may no longer be in effect, our objective here is not to propose changes to current schemes but to gain insights that can guide the future design of the region's energy tariffs and subsidy policies. For each country, we present the monthly costs of providing electricity services, distinguishing between fixed and variable components. Then, we present, in significant detail and with an array of visualizations, each of the focal countries' tariff schemes and subsidy policies in the respective years. We present these schemes in detail to highlight the complexity that commonly characterizes tariff schemes in the region and discuss the extent to which the tariff and subsidy structures align with the three key principles introduced in [Section 2](#).

In [Section 4](#), we present a framework for policy analysis and reform in which we redefine the tariff and subsidy structures vis-à-vis household income levels using income and electricity expenditure data for a sample of households from each country. For instance, we show the fixed and variable charges paid by each income decile and the extent to which it received consumption subsidies. This approach is crucial for evaluating the effectiveness of subsidy targeting and determining the degree to which the tariff scheme achieves cost recovery. Additionally, presenting tariffs and subsidies as a function of income allows clear and direct comparison of the four countries' different tariff and subsidy structures, despite their inherent diversity. Our unified conceptual framework thus ensures a coherent and consistent analysis, facilitating meaningful cross-country assessment and proving to be a valuable tool. Throughout this section, we also examine the extent to which the tariff and subsidy schemes align with the three fundamental principles for appropriate tariff design.

In [Section 5](#), we evaluate alternative tariff and subsidy structures. Specifically, we assess five alternative scenarios, chosen from among various possibilities to provide diverse perspectives and insights rather than to exhaustively preview reform possibilities. Beyond the specific scenarios analyzed, our aim is to show how our unified conceptual framework allows us to evaluate different tariff and subsidy schemes. The baseline scenario is the one in effect in each country during the year of our analysis. The first alternative scenario simulates the situation in which all households face an *average cost* or *pure volumetric* tariff scheme. The second and third scenarios analyze the situation of a two-part tariff scheme. In the second, all households face a fixed charge equal to the fixed portion of the provision cost and a variable charge equal to the variable portion of the service provision. In the third scenario, the fixed cost is paid through a charge proportional to each household's income. The first three scenarios feature full cost recovery. The fourth and fifth scenarios incorporate *increasing block pricing* for the variable portion of the tariff, which aims to subsidize users who consume less on the basis of the assumption that those who consume less have lower incomes. In the fourth scenario, this subsidy policy is universal, while in the fifth, it is targeted at households with lower incomes. In [Section 6](#), we offer concluding remarks.

This report contributes to the literature by integrating electricity tariff analysis with subsidy policy analysis, two areas commonly examined separately. From a theoretical perspective, there is evidence that electricity tariffs are typically not designed to harmonize the cost recovery, cost reflectivity, and affordability principles and that tariff schemes might move toward higher fixed charges or avoid excessive reliance on increasing block pricing schemes (Borenstein, 2016; Borenstein and Bushnell, 2022; Foster and Witte, 2020; Hennig et al., 2022; Navajas, 2023) in favor of simplified two-part tariffs combined with targeted lump-sum transfers (Burger et al., 2020). However, beyond these discussions, the literature rarely examines the implications of a shift from current schemes to the theory-suggested alternatives (Borenstein et al., 2021). At the same time, substantial research highlights the fiscal (Di Bella et al., 2015) and distributional costs of poorly targeted subsidy systems, offering

compelling evidence that better-targeted subsidies can substantially raise welfare for low-income households (Giuliano et al., 2020; Hancevic et al., 2022; Hernández and Patino-Echeverri, 2022; Pacudan and Hamdan, 2019) and that well-designed progressive subsidy regimes enhance both allocative efficiency and sectoral financial sustainability (Burger et al., 2020; Cahana et al., 2022; Feger and Radulescu, 2018; Hahn and Metcalfe, 2021; Huenteler et al., 2017; Schaffitzel et al., 2020). However, these studies generally analyze the benefits of better targeting instruments within an already-defined tariff system instead of integrating the tariff scheme and subsidy policy design within the same analysis, which we consider necessary since tariffs and subsidies are complements: Any shortfall in cost recovery under a reformed tariff inevitably implies fiscal transfers or intrasectoral cross-subsidies. We advance an integrated analytical approach that reconciles equity, efficiency, and fiscal sustainability in power sector regulation.

The most directly comparable studies applying a unified tariff-subsidy framework in Latin America include Sandoval et al. (2025), Urbiztondo et al. (2020), and McRae and Wolak (2020). Sandoval et al. (2025) analyze Mexican small and medium enterprises and document substantial inefficiencies from misclassification of customers into inappropriate tariff categories. These distortions result in excess charges and misallocated subsidies, as businesses end up in tariff structures that lead them away from their optimal consumption levels. Urbiztondo et al. (2020) argue that climate commitments, equity mandates, and distributed energy integration necessitate tariff structures reflecting network cost causation through optimal fixed-variable charge combinations while maintaining equity via targeted transfers to low-income households. Their analysis of Argentina's Buenos Aires metropolitan area shows that rebalancing distribution charges under independent regulatory governance can simultaneously achieve revenue adequacy, allocative efficiency, and distributional objectives. McRae and Wolak (2020) show that a welfare-maximizing tariff scheme in Colombia would feature marginal cost pricing with fixed cost recovery through lump-sum charges. However, uniform fixed charges create affordability constraints for low-consumption

households. The authors' solution-household-specific fixed charges calibrated to willingness-to-pay estimates—approximates the first-best pricing while maintaining universal access and preserving efficient investment signals for renewable energy adoption.

Building on the preceding literature, this work makes three distinct and complementary contributions to the electricity tariff and subsidy literature. First, we develop a unified analytical framework that explicitly integrates the design of tariff structures with subsidy mechanisms. While previous studies examine these elements separately, we recognize that any tariff reform inevitably affects subsidy requirements and vice versa. Our methodological innovation—implicit in other studies (Borenstein et al., 2021)—is made explicit here through the development of a consumption recovery algorithm. We first back out how much electricity the average household in each income decile consumes, and with it the fixed and variable charges it pays, which can also be done for each percentile or as a continuous function of total household income. This approach allows us to present different tariff structures under the same conceptual framework. Instead of considering different tariff schemes that are highly complex, we reconstruct the tariff structure by income level for each of the countries for which we provide evidence. From there, the same simulations can be performed for all countries, which facilitates comparison of structures and countries. Additionally, neither McRae and Wolak (2020) nor Urbiztondo et al. (2020) integrate the cost of service provision in the analysis.

Other studies that incorporate all the factors within the analysis typically rely on high-granularity (e.g., 30-minute intervals) electricity consumption data and detailed geographic information at the zip code level (Borenstein and Bushnell, 2022; Burger et al., 2020; Hofmann et al., 2025; Levinson and Silva, 2022). However, LAC countries lag behind other regions in smart meter adoption and administrative data systems, leaving regulators with limited information for tariff and subsidy design decisions. Our framework is specifically designed for the data-constrained environments typical of developing economies, requiring only basic information on household consumption, income distribution, and average provision costs.

Second, this report provides a systematic multicountry empirical assessment of how alternative tariff–subsidy combinations perform across efficiency, equity, and fiscal sustainability dimensions. We analyze four LAC countries—Argentina, the Dominican Republic, Ecuador, and Uruguay—spanning a broad spectrum of income levels, rate structure design and subsidy policies. Some rely heavily on block pricing structures, while others employ household classification systems based on observable socioeconomic characteristics to target benefits. In addition, this empirical evidence is valuable in a region for which empirical evidence about household energy behavior remains scarce (Eguiguren-Cosmelli, 2018; Zabaloy and Viego, 2022) and many of the related studies have a more descriptive approach (Jiménez and Yépez-García, 2020; Quishpe et al., 2019; Rosas et al., 2010; Santillan et al., 2020). Our comparative analysis yields two principal insights. Simple recalibrations of fixed and volumetric charges can materially enhance allocative efficiency while preserving or improving distributional equity, even when countries shift away from complex nonlinear pricing schemes toward more transparent structures. This result holds even for settings in LAC with limited smart meter penetration and nascent advanced-pricing infrastructure (Alvarez Alonso et al., 2023; Wolak and Hardman, 2021), where electricity subsidies remain a major fiscal liability (Di Bella et al., 2015). In addition, our comparative perspective reveals whether each country’s power sector challenges arise predominantly from high underlying service provision costs, misaligned tariff–subsidy arrangements, or both factors simultaneously. This differentiation is crucial for policy design: Reforms targeting only one dimension may prove insufficient if the other remains unaddressed.

Third, we develop an operational policy tool for designing viable subsidy reform pathways. The persistent challenge is not merely identifying subsidies or explaining optimal tariff schemes but designing feasible reform pathways. Since early power sector liberalization efforts aimed at full cost recovery, developing country utilities have consistently fallen short because of political constraints and institutional weaknesses (Beylis and Cunha, 2017; Foster and Rana, 2019). While tools such as the International Monetary Fund (IMF) and World Bank’s CPAT electricity module allow policymakers to simulate reform scenarios and trace their welfare impacts across income deciles (Black et al., 2023), they typically rely on general transfers rather than sector-specific tariff design. Our approach addresses this gap by demonstrating how targeted tariff restructuring can help countries advance toward cost recovery while protecting vulnerable households. This includes systematic evaluation of reforms that move from complex block pricing toward more efficient structures and optimization of household targeting mechanisms on the basis of demographic segmentation.

Throughout this work, we make a considerable effort to explain aspects of tariff design that may not be trivial for many, such that our analytical framework and policy tools can be utilized appropriately by policymakers. Our contributions are accessible across diverse institutional contexts: Regulators with basic data on household energy consumption, income distribution, tariff structure, and average provision costs can replicate our approach. Measuring subsidies across the region remains complicated by inconsistent utility reporting, varying accounting standards, and poor data quality, but our framework provides a systematic approach to overcome these limitations while maintaining analytical rigor.



Designing Electricity



Tariff Schemes

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2. Designing Electricity Tariff Schemes

Electricity tariffs are the prices determined by regulatory authorities that consumers pay for electricity service, which should both cover the cost of the electricity itself and ensure that consumers can use electricity reliably, at any time, and without safety risks or interruptions. To meet these conditions, the electricity grid must be robust enough to meet peak-hour demand and resilient enough to deal with challenges such as power outages or extreme weather events. Electricity tariff schemes must thus also account for the costs of building, maintaining, and upgrading this infrastructure.

In this section, we begin by describing the cost structure of electricity provision and its different components, focusing on the differences between fixed and variable costs, which are essential for understanding the challenges of creating effective electricity tariff and subsidy schemes. Next, we discuss three fundamental principles for electricity rate design—cost recovery, cost reflectivity, and affordability—and highlight the trade-offs among them.

2.1. Monthly Costs to be Covered by the Tariff Scheme

Before we discuss optimal tariff design, we first clarify key aspects of the cost structure associated with electricity provision since these are the costs that ultimately must be covered by the tariff system. To this end, we analyze the costs of electricity service provision on a monthly basis.¹ Let us define the total monthly cost of providing the service for a specific geographic area, or a given distribution utility, as TC and express it as follows:

$$TC = TC^G + TC^T + TC^D \quad (1)$$

where TC^G , TC^T and TC^D are the total monthly costs of generation, transmission, and distribution, respectively.²

The total cost of electricity generation, denoted TC^G , can be calculated as:

$$TC^G = F^G + C^G \cdot kWh$$

¹ To understand the cost structure, we need to consider a time dimension, such as daily, monthly, or yearly. We choose monthly frequency because this is the most common billing period for end consumers in most electricity markets.

² In certain markets, retailing is separate from the distribution segment, constituting another independent category. However, in LAC countries, the standard practice is that distribution companies are also responsible for the retailing process.

where F^G represents the monthly fixed cost of electricity generation while $C^G \cdot kWh$ denotes the corresponding variable costs. Fixed costs in electricity generation are generally related to the construction of generation capacity. For example, if an electricity system has five power plants of 300 MW each, the total installed generation capacity is 1,500 MW, meaning the fixed cost of the system is related to the monthly payment to cover the costs of the original investment and its maintenance. Conversely, the variable electricity generation costs are given by C^G , which is the cost at which generators sell a kWh , multiplied by the monthly total consumption in kWh .³

Electricity transmission and distribution costs primarily stem from long-term investments that require extensive land acquisition, substantial upfront infrastructure spending, and periodic maintenance spending. Importantly, however, variable costs are not negligible, and come mainly from electricity losses inherent to its transmission and distribution and from deficient consumption monitoring and measurement infrastructure (Yépez-García and Jiménez Mori, 2024). Inherent losses are associated with the resistance of transmission lines. Therefore, given that the transmission segment is associated with high-voltage transmission lines with lower resistance, losses—and hence the variable cost—in this segment should be lower than those in local distribution systems (Rudnick, 1998). Moreover, we assume in this simple explanation that distributors also handle the retailing process, which incurs additional operational costs relative to the cost of transmission alone.⁴ In any case, the variable cost related to transporting electricity is easier to measure than that arising from its distribution, as the losses are defined as the difference between the amount of electricity that enters the network at the generation point and that delivered to end users.

Having made explicit the fixed and variable costs associated with the transmission and distribution

segments, we can define their total cost, denoted by TC^T and TC^D , as:

$$TC^T = F^T + C^T \cdot kWh$$

and

$$TC^D = F^D + C^D \cdot kWh$$

where F^T and F^D represent the total fixed costs associated with electricity transmission and distribution, respectively. Similarly, C^T and C^D denote the corresponding variable costs.

Once we have an expression for the total cost of electricity generation, transmission, and distribution and how they are divided between fixed and variable costs, we can express the total cost of electricity provision as the sum of a fixed component and a variable one. Defining $F = F^G + F^T + F^D$ and $C = C^G + C^T + C^D$, we can express the monthly cost of electricity provision as:

$$TC = F + C \cdot kWh \quad (2)$$

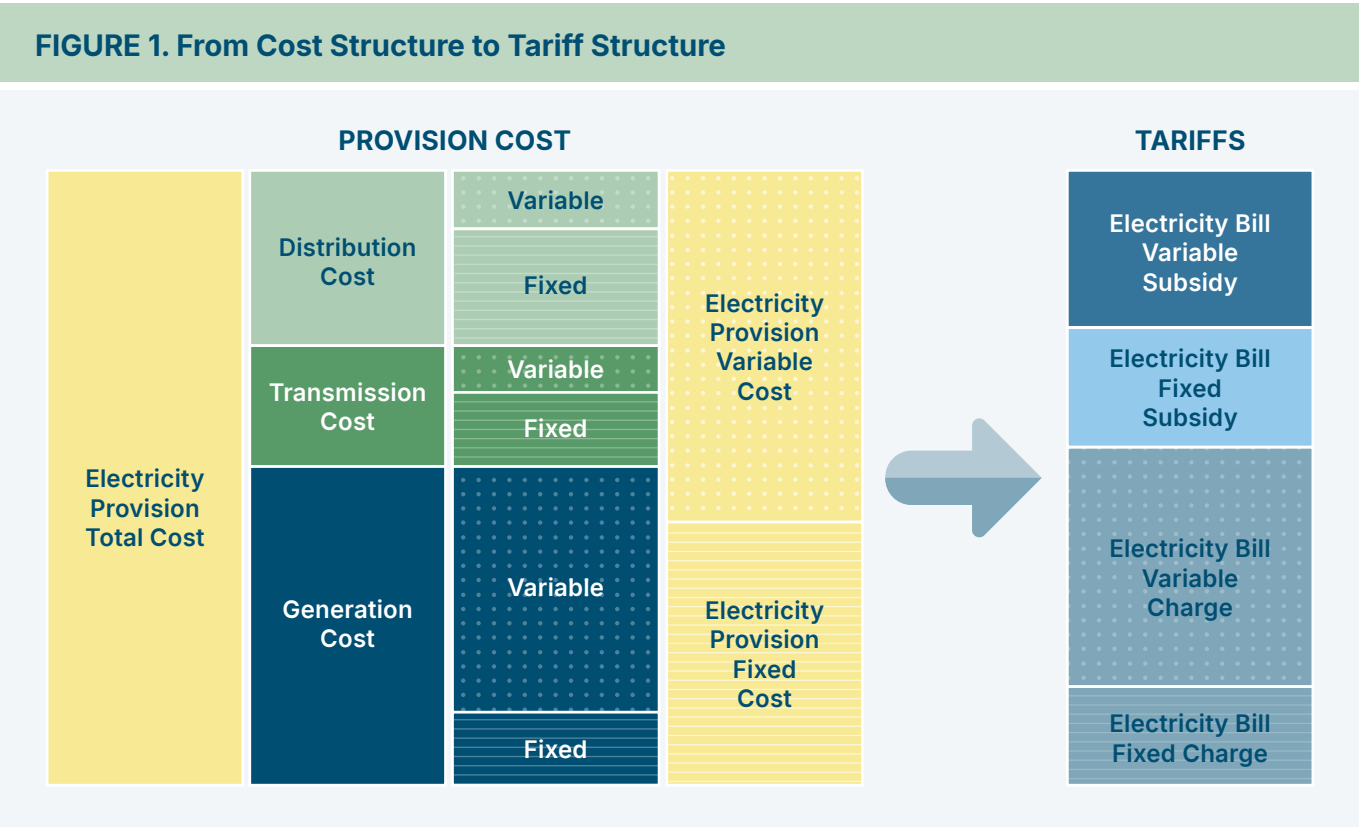
The variable portion of the monthly cost of providing electricity is the simplest component to measure. It consists mainly of the value of generating a unit of electricity, such as a kWh , and the cost of transporting that kWh from the generation point to the final user. To these one qualification must be added: when capacity constrains the system—whether in generation, transmission, or distribution—the cost of serving an additional kWh at peak exceeds the variable cost of the last unit dispatched, since it also reflects the scarcity value of the capacity used. This term is negligible off-peak but can be substantial at peak or under system stress. It is therefore a component of C , and we return to it in [Appendix A](#), where it enters our variable cost estimates as a capacity charge.

3. The variable cost of electricity generation changes second by second and is generally determined by the cost of generating the last unit of electricity entering the system. Therefore, it may seem problematic to speak of a single variable generation cost, as this changes in real time. That said, for explanatory purposes, it is important to consider this cost as constant over a given time period. Additionally, what matters is that we convey that, in a determined time period, month or year, there is an *average variable generation cost*, which is the average cost of generating the last unit of electricity entering the system, not the average cost of generation, which includes the fixed cost associated with the generation portion of the electricity provision. Later, when we explain the *time-of-use* pricing scheme, it will become clear that it might even be advantageous, under certain circumstances, to incorporate this variability in generation costs into the tariffs.

4. In LAC countries, total transmission and distribution losses are around 17% of the total generation, where approximately 80% of the losses occur at the distribution level (Yépez-García and Jiménez Mori, 2024).

The main challenge is assigning a monthly value to the fixed cost of a system with sufficient installed capacity for proper service provision. Although largely incurred up front, the cost of installed capacity must be recovered over the asset’s useful life, so what enters the monthly cost of provision is not the investment itself but its periodic equivalent—capital recovery, maintenance, and the return on capital. Measuring this magnitude correctly is therefore crucial in the design of the tariff structure. Failing to do so would deter firms from investing in or maintaining electrical infrastructure, affecting the quality and security of service provision and ultimately leading the systems to a deficit that—sooner or later—will be covered by subsidies, generally not targeted to those more in need.

Figure 1 depicts the breakdown of the total costs that we just introduced using simple mathematical expressions. The first bar shows the total cost of providing the service, which, so far, we express as a monthly amount (i.e., the left-hand side of [Equation 1](#)). The second bar divides this into the monthly costs of generation, transmission, and distribution (i.e., the right-hand side of [Equation 1](#)). The third bar displays the costs associated with each of these segments, further distinguishing between their fixed and variable components. Finally, the fourth bar once again shows the total cost but splits it into its fixed and variable portions, as expressed on the right-hand side of [Equation 2](#). This is an essential expression of the cost of service provision for tariff design, which should generally include both fixed and variable charges. The last bar of the figure suggests that any cost not covered by the tariff systems must necessarily be met through subsidies, whether explicit or implicit, targeted or universal.



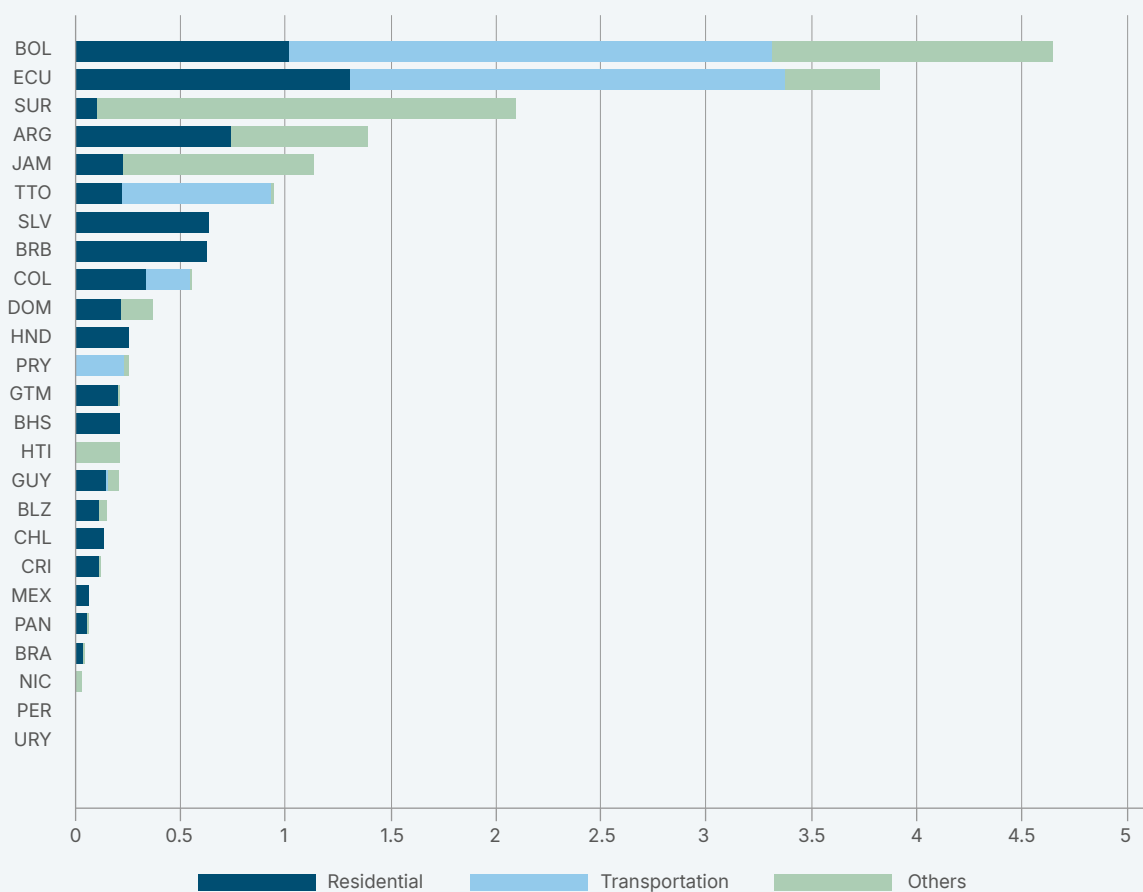
Note: This diagram illustrates how electricity provision costs translate into consumer tariff structures. The figure is divided into two main sections. On the left side, the first bar shows the total cost of service provision. This total cost is broken down into three main components in the second bar: distribution costs (green, top), transmission costs (dark green, middle) and generation costs (dark blue, bottom). The third bar displays the costs associated with each of these segments, further distinguishing between their fixed and variable components. Finally, the fourth bar once again shows the total cost but splits it into its fixed and variable portions. This is an essential expression of the cost of service provision for tariff design, which should generally include both fixed and variable charges.

Source: Authors’ own elaboration.

In the LAC context, energy subsidies are fairly widespread (Banal-Estañol et al., 2017; Izquierdo et al., 2018; Rudnick and Montero, 2002). In 2024, the latest year with available data, the region spent about \$27 billion on subsidies for oil, coal, natural gas, and electricity, about 0.45% of its regional GDP (IMF, 2025). However, the distribution of these subsidies varies significantly across countries. Figure 2 details the components of energy subsidies as a percentage of GDP, differentiating between those directly received by households (residential, the main focus here), primarily oriented towards electricity and gas consumption; those benefiting the transportation sector, mainly

diesel and gasoline; and others, generally targeted at firms.⁵ While this figure highlights the economic significance of energy subsidies by relating them to national GDP, their impact notably extends beyond the mere fiscal cost, with broader economic consequences in terms of efficiency and equity. Given the regional context, any discussion of optimal tariff design must therefore also consider the role of subsidy policies (Banal-Estañol et al., 2017), which is what we do in this report. In the next section, we turn to the principles that the regulator should consider when designing an electricity tariff and subsidy structure.

FIGURE 2. Components of Energy Subsidies as a Percentage of GDP (2024)



Note: The figure shows explicit fossil fuel subsidies as a percentage of GDP, measured by the IMF as the gap between the cost of supplying each fuel and the price its users pay, multiplied by the quantity consumed. For the region as a whole, these subsidies amounted to about \$27 billion in 2024, or 0.45% of regional GDP. Dark blue bars show residential subsidies, light blue bars transportation subsidies, and green bars subsidies to other users. The figures exclude subsidies to fossil fuel producers, such as favorable tax treatment for fossil fuel extraction. They are a snapshot as of 2024, the latest year available; several countries in the region have since undertaken subsidy reforms, so current levels may differ.

Source: Authors' own elaboration based on IMF Fossil Fuel Subsidies Data: 2025 Update.

⁵ In the case of transportation subsidies, both households and firms are beneficiaries. However, they are typically categorized separately.

2.2. From Costs to Tariffs: Three Principles

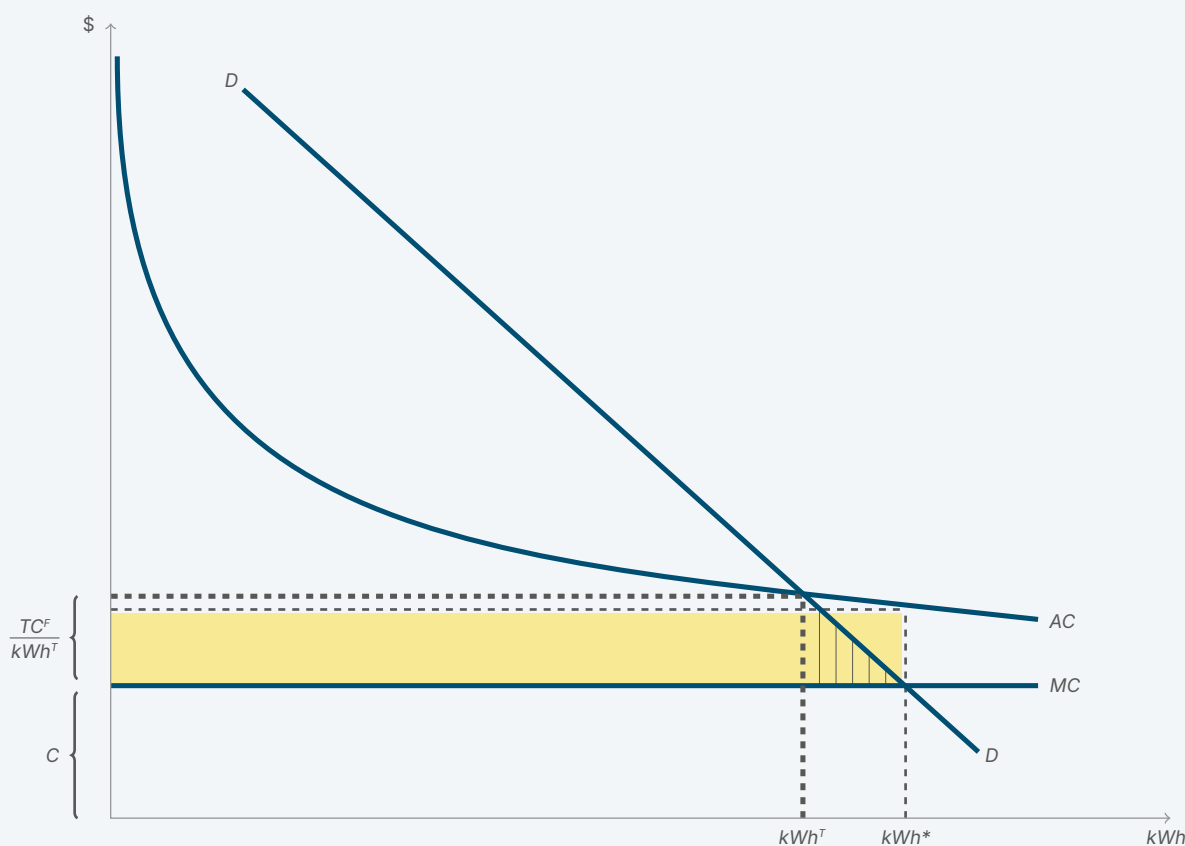
Having now explained the costs that must be covered by the tariff system, and considering that these could partly be covered by subsidies, in this section, we introduce three fundamental principles (Borenstein, 2016; Navajas, 2023) to inform the design

of an electricity tariff structure: cost recovery, cost reflectivity, and affordability.

Cost Recovery

The cost recovery principle states that the total revenue collected by the distribution utility should be sufficient to cover the total cost of providing the service (Huenteler et al., 2017). Figure 3 provides a graphical representation that helps clarify the potential trade-offs that might arise in the design of electricity

FIGURE 3. Variable and Average Cost of Electricity Provision



Note: The horizontal axis represents the quantity, while the vertical axis represents the cost of electricity provision per kWh. The average cost (AC) of electricity provision decreases as the quantity of electricity consumed increases, while the marginal cost (MC) of electricity provision remains constant. The figure depicts an elastic demand for electricity. In a competitive market, the optimal pricing structure would set the price equal to the MC, which is problematic since the AC is higher than the variable cost. Consequently, the distribution utility operates at a loss, and its losses would be equivalent to its total fixed cost, depicted by the yellow area. Finally, if the rate is set equivalent to AC, there will be consumer welfare loss, equivalent to the dashed triangle.

Source: Authors' own elaboration.

tariffs. Quantities are on the horizontal axis, measured in kWh, and the cost of electricity provision per kWh is on the vertical axis. The figure depicts both the average and variable cost of electricity provision.⁶ Electricity distribution is characterized by substantial fixed costs relative to variable costs, resulting in declining average costs over the relevant range of demand. This cost structure gives rise to economies of scale and makes electricity distribution a natural monopoly, providing the economic rationale for price regulation.⁷ The figure also depicts an elastic demand for electricity.

In a competitive market, the optimal pricing structure would set the price per kWh equal to the variable cost of providing the service (Wang et al., 2011). However, if the regulator sets the electricity rate at a level equal to the variable cost of electricity provision, the cost recovery principle will be violated. For instance, as illustrated in [Figure 3](#), if the electricity rate is set at C , the consumption of electricity will be kWh^* . In this case, the total revenues will be $C \cdot kWh^*$. However, the total cost of providing that electricity, including fixed costs and variable costs, will be given by $F + C \cdot kWh^*$. Thus, the distribution utility would incur losses equivalent to its fixed costs, represented by the yellow area in the figure.

Such a situation would, in the long term, force distribution companies to exit the market or require subsidies. To address this issue, regulators could adopt a variety of tariff schemes. However, none are exempt from costs, and most of them include some form of fixed cost variabilization. Fixed cost variabilization tariffs in their simplest form consist of a rate equal to the average cost of service provision, $C + F/kWh^T$, which we call the *average cost or pure volumetric* pricing scheme. In this case, demand would result in consumption of kWh^T , and total revenue, $(C + F/kWh^T) \cdot kWh^T$, would match the total costs, given

by $F + C \cdot kWh^T$. Therefore, the cost recovery principle would be met.

Charging the average cost is equivalent to prorating the fixed charge according to each household's consumption level. The regulator establishes ex ante that the fixed costs the distribution company has to cover during a given month will be prorated according to the electricity consumption of each customer. For example, suppose there are three clients. The first client consumes 100 kWh in a given month, the second one 200 kWh, and the third one 300 kWh. Let us further assume that the variable cost associated with the provision of electricity was €10 per kWh. The first customer must pay \$10, the second \$20, and the third \$30. However, it is necessary to pay for monthly expenses associated with covering the fixed costs. Suppose the total fixed costs are \$42. The *average cost or pure volumetric* pricing scheme establishes that the first customer should pay \$7, the second customer \$14, and the third \$21, such that the final tariff for each customer will be €17 per kWh.

The issue that arises with this kind of tariff is that customers are paying €17 per kWh for the last unit of electricity, which is inefficient because the variable cost of provision associated with an extra kWh is €10 per kWh. That is, the variable charge does not reflect the variable cost of service provision, which violates the cost reflectivity principle.

Cost Reflectivity

The cost reflectivity principle is critical for ensuring that the economic signals sent to consumers and firms are conducive to optimal resource use and service provision, which requires an efficient tariff scheme, where the different tariff charges adequately reflect the various costs of service provision and their different nature (Fabra, 2023). For example, with fully

6. From [Equation 2](#), we have that the average cost of electricity is given by:

$$AC = \frac{F}{kWh} + C$$

which decreases as the quantity of electricity consumed increases, while the variable cost of electricity provision remains constant, and is given by:

$$MC = C$$

7. This is true in the case of a single commodity. However, in a multiproduct setting, a natural monopoly prevails when the cost of production of goods or services is minimized by a single firm supplying all of them (Viscusi et al., 2005).

cost-reflective schemes, fixed charges should correspond to the fixed costs of service provision, while variable charges should reflect the variable costs.

To better understand the costs of a tariff system that is not cost-reflective, let us consider the example of an average tariff. If the electricity price is set above the variable cost of electricity provision, $C + F/kWh^T > C$, there will be no incentive for consumers, at the margin, to increase their consumption, which constitutes a welfare loss equivalent to the dashed triangle in [Figure 3](#).⁸ Moreover, in the context of the energy transition, which requires a shift among consumers from fossil fuels to electricity, charging a price higher than the variable cost of service provision will disincentivize electricity consumption relative to consumption of other fuels. Consumers will then opt, at the margin, for a higher-emission alternative when purchasing a durable good. Considering that consumers can electrify their energy consumption (e.g., by acquiring an electric car instead of an internal combustion one, or electric stoves and water heating systems) therefore helps not only to set the appropriate electricity rate but, consequently, to transition to a lower-carbon economy.

To further understand the cost reflectivity principle, consider the example of the regulator setting the price equal to the total cost of electricity provision evenly distributed among users regardless of their consumption. While this tariff structure satisfies the cost recovery principle, it comes at the expense of cost reflectivity. In such a scenario, economic agents would not receive adequate economic signals to use electricity efficiently. A rate structure that, from a theoretical point of view, satisfies both the cost recovery and cost reflectivity principles is the *two-part tariff* scheme. The first component of this scheme is a fixed charge to each consumer, calculated by taking the total fixed costs divided by the number of consumers, which is independent of the level of consumption and enables the regulator to cover the

total fixed cost. The second component of the tariff scheme is a charge equivalent to the variable cost of electricity provision, allowing an optimal market equilibrium, given by kWh^* in [Figure 3](#).⁹

The problem with the *two-part tariff* scheme is that an excessively high price of the fixed part could discourage lower-income consumers from participating in the market or, if they participate, their monthly bill will be quite expensive, violating the affordability principle. Given that electricity is a basic need, it is incumbent upon regulators to ensure that the process of creating a cost-recovering and cost-reflective rate structure does not result in prohibitively high electricity prices and thus exclude potential consumers. We delve further into the affordability principle in the next section. Importantly, cost reflectivity does not solely imply that fixed and variable costs should be correctly reflected in the tariff structure. This principle also implies that variable charges may account for the constant fluctuation in the cost of service provision throughout the day and therefore that *real-time* or at least *time-of-use* tariff schemes may be appropriate.

Affordability

An optimal tariff scheme should adhere to the principle of affordability, guaranteeing the minimum electricity consumption a household requires for appropriate development. Defining what constitutes affordable electricity is, however, complex, as this can vary significantly based on households' purchasing power and needs (Foster and Witte, 2020; Paiva et al., 2019). For example, despite having substantial electricity consumption needs, a high-income household is unlikely to face affordability issues. Likewise, a low-income household consisting of a single individual whose electricity usage is minimal—because of lifestyle or work hours—may not struggle with affordability even if the user pays a high rate per kilowatt-hour. In contrast, a low-income household that consumes the minimum amount of electricity necessary to ensure its

⁸ We consider this a welfare loss because the variable cost of service provision is lower than the value the consumer assigns that variable unit. Therefore, there would be benefits (at least for some consumers) if the transaction were to occur, and no one would be worse off if it did.

⁹ The tension a two-part tariff resolves—that a single linear price cannot at once give the right marginal signal and recover fixed costs—is a classic pricing problem, and it is not unique to retail tariffs. Wholesale markets face a version of it from another angle: there the instrument is not a tariff but a market price, and the question is whether a uniform, spot market price lets each generating unit cover its own costs (Cramton, 2017; Eguiguren-Cosmelli, 2024; Graf et al., 2021; Reguant, 2014).

optimal development may have difficulty meeting this expense and may consequently forgo consumption of other goods equally necessary to its development. Therefore, even if a household pays only for minimum consumption, it may nevertheless face affordability issues.

In this study, we consider that electricity is affordable if two conditions are met. The first concerns the minimum amount of electricity consumption a household needs; the second involves the percentage of household income represented by electricity consumption. The first measure is very context specific in that a household in the tropics faces different needs from one in a Mediterranean climate. The same is true for a household with school-age children in comparison to one consisting of two working adults (Kavousian et al., 2013; Modi et al., 2006; Moss et al., 2020). For the second measure, a variety of metrics are commonly used. A standard metric is the *10% threshold*: When a household spends more than 10% of its disposable income on energy-related expenses (including electricity, gas, etc.), these costs are considered unaffordable (Boardman, 1991). We must adjust this measure when focusing exclusively on electricity expenditures and excluding other household energy costs. Another widely used metric is the *2M indicator*, which defines affordability on the basis of whether a household spends more on energy than twice the national median share of income spent on energy costs (Schuessler, 2014).¹⁰ In this work, rather than providing a precise formula to determine whether the affordability principle is met, we emphasize the importance of considering these two dimensions of affordability in the design of electricity tariff schemes.

A common tariff scheme used to incorporate the affordability principle is the *increasing block pricing* (IBP) scheme, whereby the regulator defines several

tiers based on electricity consumption levels and the variable charge to the household increases as monthly usage moves from one tier to another (Borenstein, 2016; Foster and Witte, 2020; Puig and Navajas, 2024).¹¹ In [Figure 4](#) Panel (a), an IBP scheme is illustrated with five blocks of 60 kWh, where the variable charge for each block rises with the level of consumption. For the first 60 kWh, a variable charge of ¢4 is applied, for the second 60 kWh ¢7, and so on until the 5th block, which is the last block and includes all consumption greater than 240 kWh, where the variable charge is ¢16. In the context of this figure, it is assumed that everyone pays a fixed charge determined by the tariff schedule to recover the fixed costs of service and that the charges under the IBP structure cover only the variable costs of service.

Panel (a) illustrates two variants of this scheme, one in blue and the other in light blue. The first variant is a memory-based IBP system, represented by the blue line in Panel (a). In this system, if a household consumes within block 4, it pays ¢4 for each unit consumed in block 1, ¢7 for each unit in block 2, ¢10 for each unit in block 3, and ¢13 for each unit in block 4. The blue line in Panel (b) depicts the household's average variable charge for different levels of consumption under a memory-based IBP system. Conversely, in a non-memory-based IBP system, represented by the light blue line in Panel (a), if a household consumes within Block 4, it pays ¢13 for all units consumed. In this case, the average variable charge corresponds to the light blue line in Panel (b). Notice, from Panel (a), that if a household's consumption level shifts from consuming 60 kWh to 61 kWh, the variable charge is much higher than ¢7. In fact, it is ¢187, because the total cost goes from ¢240 to ¢427. We illustrate this enormous change in the variable charge with the light blue points at the top of Panel (a) at each block threshold.¹²

¹⁰. Several measures and metrics have been proposed in the literature to assess electricity and energy affordability. A widely used is the 10% threshold. Other approaches focus on the broader dimensions of energy vulnerability, including access, affordability, and flexibility (Bouzarovski and Petrova, 2015). For a comparative overview of affordability thresholds across developed and developing economies, see Estache et al. (2018).

¹¹. Throughout, we use *variable charge* and *marginal charge* interchangeably: both denote the price applied to the last unit consumed. On the cost side the distinction is immaterial, since we assume a constant variable cost C per kWh, so that the marginal cost of provision equals its average variable cost. On the tariff side it is not: because the schedule is nonlinear, the variable (marginal) charge and the average variable charge generally differ, which is the distinction Panels (a) and (b) draw.

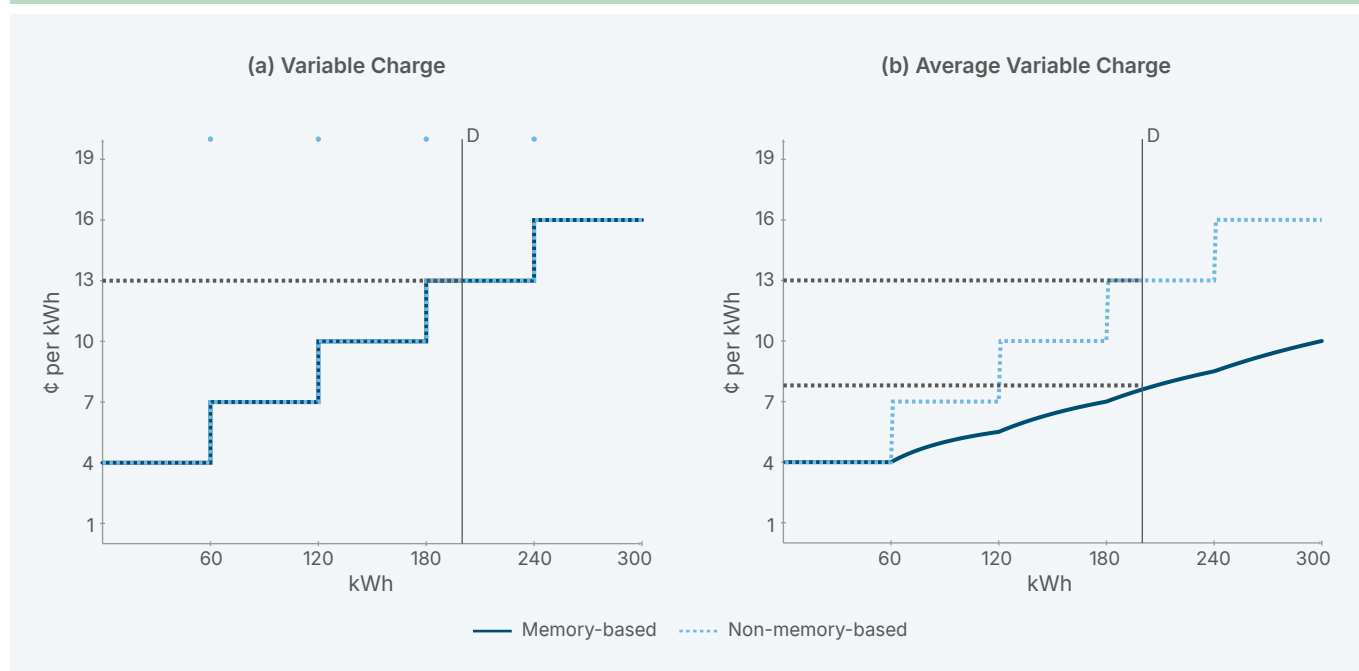
¹². Note that in a true cost recovery comparison, the memory-based system's variable charges (blue line) must eventually exceed the variable charges of the non-memory-based system (light blue line) at upper consumption tiers to generate equivalent total revenue. The current illustration prioritizes conceptual clarity over mathematical precision.

Panel (b) turns to a distinct magnitude. While Panel (a) shows the *variable charge*—the price applied to the marginal (last) unit at each consumption level—Panel (b) shows the *average variable charge*: total variable spending divided by consumption, that is, what the household actually pays per kWh. The two coincide under a flat rate, but under increasing block pricing whether they differ depends on the scheme's memory. Under the memory-based scheme the household pays lower rates on its initial units, so the average variable charge (blue line in Panel (b)) lies below the marginal one at every consumption level beyond the first block. Under the non-memory scheme the reached block's rate applies to all units, so the average (light blue line in Panel (b)) equals that rate throughout the block. Note that the spikes shown by the light blue points in Panel (a) have no counterpart in Panel (b): at a threshold the marginal charge jumps to ₺187, but that jump is spread over all the units the household consumes, so under the non-memory scheme the average variable charge moves only from ₺4 to ₺7. Under both variants, then, the average variable charge is an endogenous

outcome: it depends on how much the household consumes—through both the mix of cheaper units and the block it reaches under a memory-based scheme, and through the block reached alone under a non-memory one.

The IBP tariff scheme presumes a positive correlation between household income and consumption (higher-income households tend to consume more electricity) and aims to make access to the minimum electricity necessary for a household more affordable. Specifically, the goal is to establish a cross-subsidy, whereby wealthier households, which consume more, subsidize poorer households, allowing them to access the minimum consumption needed for their proper development. However, several issues arise with IBP tariff schemes. First, it is not necessarily true that higher-income households always consume more electricity. While there may be a positive correlation, subsidizing the first blocks of electricity consumption may lead to inclusion errors, where households that do not truly need subsidies benefit from the IBP

FIGURE 4. Increasing Block Pricing Schemes



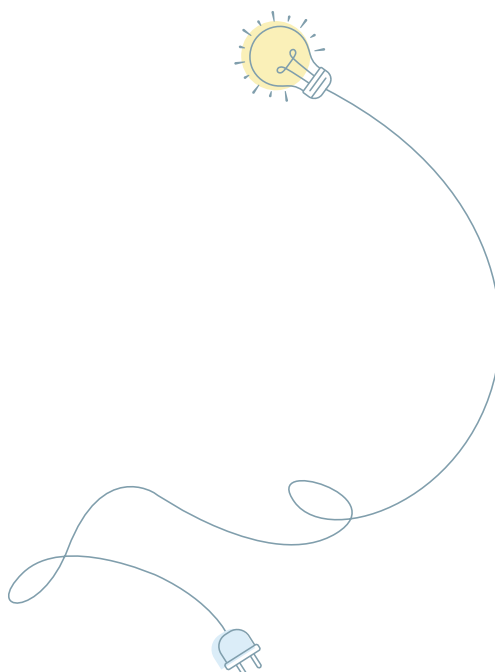
Note: Panel (a) shows the variable charge for the memory-based and non-memory-based pricing schemes, while Panel (b) shows the average variable charge for both of them. The horizontal axis represents the quantity of kWh that each household may consume, while the vertical axis represents the charge per kWh.

Source: Authors' own elaboration.

scheme. Second, even in cases where consumption and income are perfectly correlated, the memory-based IBP scheme still subsidizes those who consume more. Finally, beyond the ability of an IBP scheme to address the affordability principle, it violates the cost-reflectivity principle. This is particularly problematic as it implies that higher rates for electricity usage are charged to those who consume more, potentially discouraging the electrification of energy consumption that is so crucial for the energy transition.

Although implementing IBP schemes to fulfill the affordability principle may not always be advisable,

affordability remains a critical consideration in any tariff and subsidy design. Ideally, affordability of electricity consumption should be achieved through a well-designed subsidy system that does not necessarily rely on either the household consumption level or the variable charge of the electricity tariff structure. Instead, subsidies should specifically target vulnerable populations and ideally focus on the fixed portion of electricity provision costs. However, designing an effective subsidy system is as complex as developing a robust tariff scheme. It involves numerous trade-offs, starting with the challenge of creating an effective policy to accurately identify vulnerable households.



3.



Tariffs and Subsidies in Selected Countries



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3. Tariffs and Subsidies in Selected Countries

We now turn to the costs, tariff structures, and subsidy mechanisms for residential electricity in the main metropolitan areas of four countries: Argentina, the Dominican Republic, Ecuador, and Uruguay. These countries are representative of the variety of schemes existing at the regional level, particularly in large urban areas. Specifically, we explore the cases of Buenos Aires Metropolitan Area, Greater Santo Domingo, the Metropolitan Area of Quito, and Montevideo.

The analyzed regulatory frameworks correspond to specific time periods: December 2017 to November 2018 for Argentina, 2018 for the Dominican Republic, April 2012 to March 2013 for Ecuador, and December 2016 to November 2017 for Uruguay. We chose these periods based on the availability of national household surveys on income and expenditure, which provide essential data, particularly on households' monthly electricity expenses. The regulatory schemes from these periods may no longer be in effect, but this does not impact the study's objectives. Indeed, our goal is not to propose adjustments to current policies but to gain insights that can inform the future design of energy tariffs and subsidy policies in the region.

For each country, we present the monthly costs of electricity service provision, distinguishing between variable and fixed costs, and outline the methodology used to estimate these costs. We then describe the tariff and subsidy structures in place during the selected periods, which are typically defined by

levels of electricity consumption. Finally, we use a simple and transparent approach to analyze each country's structure within a harmonized framework, which is valuable given the considerable variation in the region's cost, tariff, and subsidy systems. This harmonized framework also proves particularly helpful in determining how these tariff systems align with the three key principles discussed above, especially cost recovery and affordability.

3.1. Provision Costs

To analyze the extent to which electricity tariff schemes comply with the principles of cost recovery and cost reflectivity, estimation of not only the cost of providing the service but also its breakdown between variable and fixed costs is essential. [Figure 5](#) provides estimates of the fixed cost per household and the variable cost per kWh for the four metropolitan areas under study.¹³ Fixed costs are the monthly costs of existing infrastructure, which, as explained in Section 2, correspond to the sum of F^G , F^T , and F^D . Variable costs relate to the costs of generation, transmission, and distribution losses, which are represented by the sum of C^G , C^T , and C^D . Specifically, [Figure 5](#) shows that the monthly fixed cost used in this analysis for maintaining the current level of physical infrastructure is \$19.5 per month for Argentina, \$13.4 for the Dominican Republic,

13. In [Appendix A](#), we discuss the pertinence of these estimates in greater detail.

\$11.2 for Ecuador, and \$32 for Uruguay.¹⁴ Meanwhile, the cost associated with the variable portion of the service is ¢11 per kWh for Argentina, ¢18.3 for the Dominican Republic, ¢8 for Ecuador, and ¢9.3 for Uruguay.

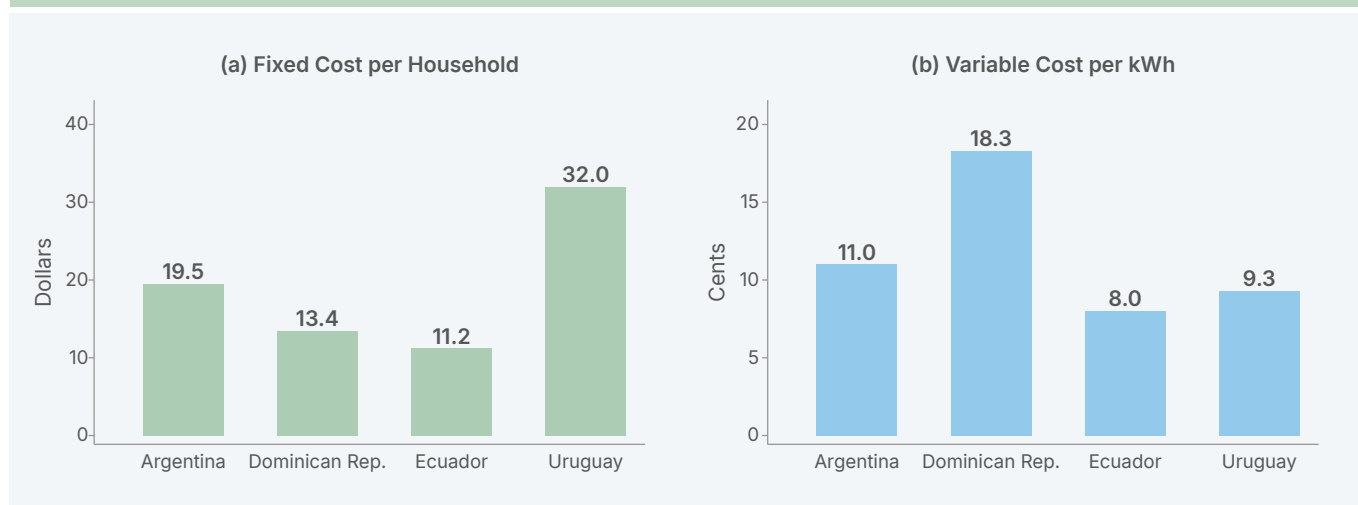
Several factors contribute to the differences in fixed and variable cost estimates across these countries. Fixed costs may vary if a metropolitan area is larger or more densely populated, allowing greater economies of scale or scope and resulting in a lower monthly fixed cost per household. Additionally, differences may arise from the costs associated with construction of the transmission and distribution network, due to both the time required for construction and the land values involved. Finally, the level of resilience with which the network must be constructed can vary by location, as this depends on each country's climate. Variable costs differ primarily because of variations

in the electricity mix and its associated generation costs and loss levels in electricity transmission and distribution in each location.

3.2. Regular Tariff and Subsidy Schemes

In this section, we explain the composition of the tariff structure and subsidies for each of the four countries. We emphasize their differences to highlight what each structure uniquely contributes to the analysis of tariffs and subsidies in the region, which allows us to better capture how different tariff schemes comply or fail to comply with the principles of cost recovery, cost reflectivity, and affordability.

FIGURE 5. Cost of Electricity Provision



Note: The figure depicts the fixed cost per household and the variable cost per kWh for each country that we include in our study. Panel (a) shows that the monthly fixed cost of maintaining the current level of physical infrastructure is \$19.5 per month for Argentina, \$13.4 for the Dominican Republic, \$11.2 for Ecuador, and \$32 for Uruguay. In Panel (b), the cost associated with the variable portion of the service is ¢11 per kWh for Argentina, ¢18.3 for the Dominican Republic, ¢8 for Ecuador, and ¢9.3 for Uruguay.

Source: Authors' own elaboration based on the methodology described in [Appendix A](#).

¹⁴ These fixed costs are conditional on current consumption levels: they measure the monthly cost of the network as currently dimensioned. A sustained change in average consumption would, over the medium term, change the network required to serve it, and hence the fixed cost per household—even if the fixed cost per kWh remains roughly unchanged. The figures should therefore be read as the fixed cost of provision *at observed consumption*, not as a magnitude invariant to it.



ARGENTINA (2017/2018)

As is the case in most countries, the electricity tariff in Argentina has two components, fixed and variable charges, both defined in terms of the electricity that households consume. Table 1 shows the average tariff structure between December 2017 and November 2018. There are nine consumption blocks, each with an associated fixed and variable charge paid monthly by households. For example, a household that consumed 350 kWh of electricity in a given month falls within block 3 and pays a fixed charge of \$3.5 and a variable charge of ¢6.6 per kWh. Therefore, \$26.6 is the total amount the household would pay for electricity before taxes.¹⁵

[Figure 6](#) depicts the information from Table 1. In Panel (a), the blue line shows the fixed charge per household. Then, based on the information provided in [Section 3.1](#), we plot the fixed cost portion of the provision cost per household, depicted by the yellow line. Here, we observe that for consumption levels lower than 450 kWh, the fixed portion of the provision cost is higher than the fixed charge on the regular bill, while for consumption levels above 450 kWh, the fixed charge is higher than the fixed portion of the provision cost. Therefore, households that consume more than 450 kWh in a month, in terms of the fixed cost associated with electricity provision, subsidize

TABLE 1. Regular Electricity Tariff Schemes in Argentina

December 2017 to November 2018

Block	kWh start	kWh end	Fixed (\$)	Variable (¢)
1	0	150	1.2	6.4
2	150	325	2.1	6.4
3	325	400	3.5	6.6
4	400	450	4.1	6.9
5	450	500	6.2	7.2
6	500	600	12.2	7.4
7	600	700	31.4	8.3
8	700	1400	45.5	8.6
9	1400	-	55.7	8.7

Note: This table shows the average of the tariff schedules for the period between December 2017 and November 2018 for the two distribution companies, EDENOR and EDESUR, that cover the Metropolitan Area of Buenos Aires. The schedule above is the regular tariff that households face; discounts to it—whether through a social tariff or other benefits—are described in the text and the [appendix](#) and are incorporated into the analysis.

Source: Authors' own elaboration based on EDENOR and EDESUR information.

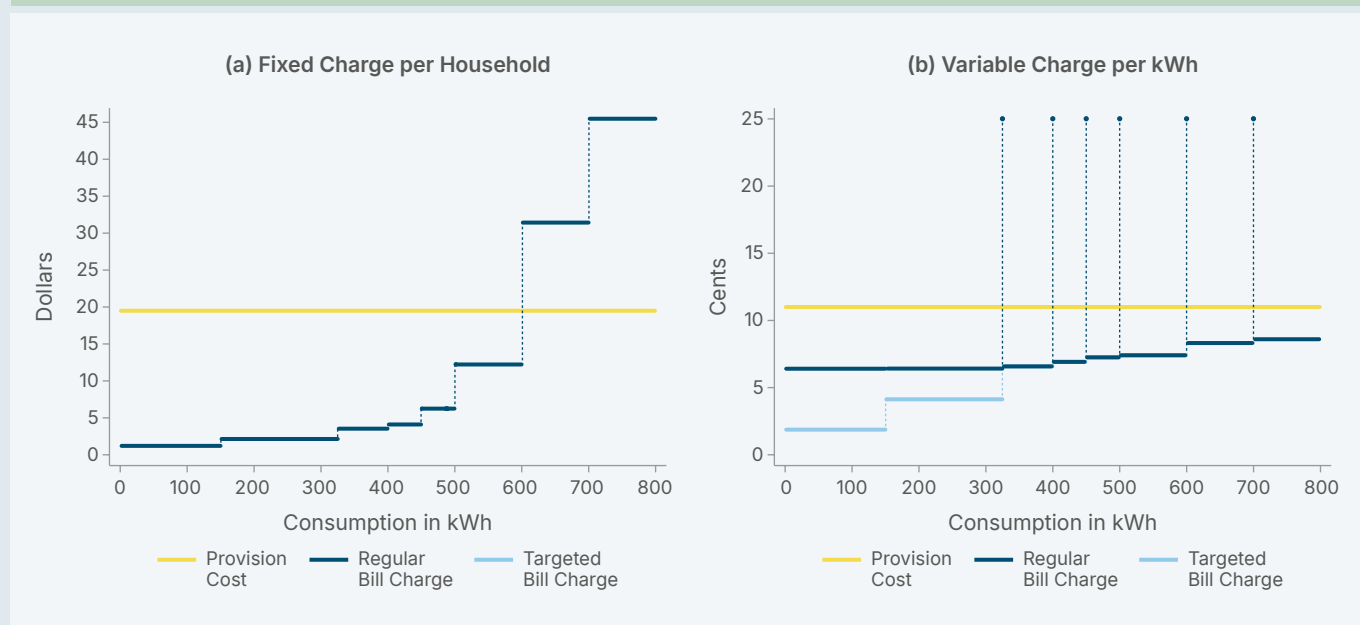
¹⁵ $26.6 = 3.5 + 0.066 \times 350$

the system. Increasing block tariffs in the fixed charge do exist elsewhere in the LAC region, though not across nine blocks or at such high levels. In the case of Argentina, a household consuming between 600 and 700 kWh pays more than \$30 in fixed charges, which is quite high not only by regional standards but also in comparison to the fixed portion of the provision costs, as reflected in Panel (a). Moreover, note that, for graphical reasons, we omit the last consumption block from the figure, which exceeds \$50 in fixed charges (see [Table 1](#)). While it is true that households consuming at these levels are relatively scarce, this particular feature of the Argentine tariff scheme should nonetheless be highlighted.

Panel (b) of Figure 6 shows the regular variable charge in blue and the variable portion of the provision cost, as described in [Section 3.1](#), in yellow. In Argentina, the variable charge increases with the level of

consumption, but the scheme lacks memory. This means that whenever a consumer moves from one block to another, she must pay the variable charge of the new block for her entire consumption. The direct effect is that the variable charge for moving from one block to another is very high. For example, a household consuming 400 kWh per month pays a variable charge of ¢6.6 per kWh, which amounts to \$26.4 per month in variable charges. If that household had consumed 401 kWh in the same month, its variable charge would have increased to ¢6.9 for all units consumed, and it would have paid \$27.669 per month for variable charges. Thus, for that additional kWh, the variable charge would be \$1.269. The blue points at the top of the graph at the threshold of each bracket seek to depict not the exact value of the variable charge but the fact that it is much higher than the variable charges per kWh that households see on the bill they receive from the distribution company.

FIGURE 6. Fixed and Variable Charges by Consumption Level for Argentina



Note: Panel (a) shows the fixed charge per household per month and Panel (b) the variable charge per kWh. The horizontal axis represents the quantity of kWh the household consumes, while the vertical axis represents the charge per unit. Panel (a) shows that for consumption levels lower than 450 kWh, the fixed portion of the provision cost is higher than the fixed charge on the regular bill, while for consumption levels above 450 kWh, the fixed charge is higher than the fixed portion of the provision cost. Panel (b) shows how the variable charge changes with consumption. For all levels of consumption, except when a consumer moves from one block to another (scheme with no memory), the variable charge is lower than the variable cost of provision.

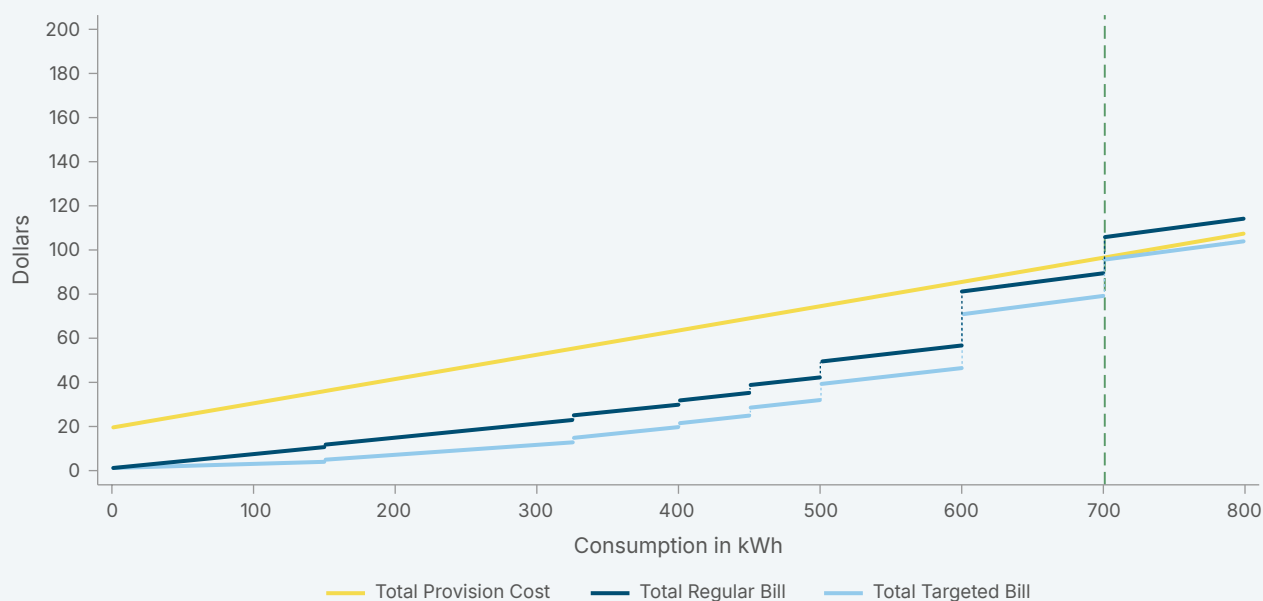
Source: Authors' own elaboration based on EDENOR and EDESUR information.

During the period under study, there was a social tariff in place for vulnerable groups in Argentina.¹⁶ The social tariff waived the full energy component of the variable charge—which is only part of the total variable charge—on the first 150 kWh, and half of it on consumption between 150 kWh and 300 kWh. The discount had memory: a household consuming 350 kWh would receive the full energy discount on the first 150 kWh, the half discount on consumption between 150 kWh and 300 kWh, and the regular tariff on the remaining 50 kWh. This is why there are no light blue outlier dots in Panel (b) of [Figure 6](#). Finally, for the social tariff, the fixed charge is the same as the regular tariff, which is why there is no light blue line in Panel (a), as it is covered by the blue one.

Figure 7 displays the total expenditure and total cost of service provision for different consumption levels. Since the monthly fixed cost of service provision was

\$19.5 per customer and the variable cost was \$11 per kWh, the yellow line, which indicates the total cost of service provision for each consumption level, has an intercept of 19.5 and a slope of 0.11. The blue line, in turn, represents the total expenditure per household given the regular tariff structure. We observe a discrete jump at 150 kWh due to the increase in the fixed charge and the variable charge past this threshold. We observe the same again at 325 kWh, 400 kWh, and so on. At any threshold, the intercept and the slope of the line change. Finally, a household paying the regular charges that consumes to the right of the green dashed line begins to subsidize the system, which is a common feature of IBP schemes beyond a certain consumption level. However, as we will see in the next section, few households in Argentina consume above this threshold, and the large majority of users pay less than the cost of service provision.

FIGURE 7. Monthly Bill by Consumption Level for Argentina



Note: The horizontal axis shows the consumption in kWh, while the vertical axis shows the USD that each household pays. The yellow line represents the cost of service provision by level of consumption, the blue line represents the total expenditure per household given the regular tariff structure, and the light blue line represents the total expenditure for a household that is a beneficiary of the social tariff. The green vertical line indicates the cutoff point (consumption level) where the tariff scheme starts to be cost-recovering.

Source: Authors' own elaboration based on EDENOR and EDESUR information.

¹⁶ To be considered vulnerable, households need to meet specific requirements established by the government; see [Appendix B](#) for more information about the Social Tariff scheme.



DOMINICAN REPUBLIC (2018)

The electricity tariff in the Dominican Republic has two components: the fixed one, paid monthly, and the variable charge, which changes with consumption. Table 2 shows the tariff structure for the period between January 2018 and December 2018. There are five consumption blocks, each with an associated fixed and variable charge that households pay monthly. As for Argentina, the variable charge increases with consumption. However, in addition to differing in the number of blocks, the Dominican Republic tariff scheme does not always have memory. In Argentina, each block variable charge applies to all electricity consumed, meaning it lacks memory. In the Dominican Republic, however, a household consuming 250 kWh in a given month falls into block 3 and pays a fixed charge of \$2.80, plus ¢9 for the first 200 kWh and ¢14.1 for the remaining 50 kWh, equaling a monthly expense before taxes of \$27.85.¹⁷ Notably, however, if a household consumes more than 700 kWh, the tariff scheme loses memory, meaning the household pays a

variable charge of ¢22.4 for all electricity consumed, not just for the excess above that threshold.

Figure 8 depicts the information from Table 2. The blue line in Panel (a) shows the fixed charge per household. Then, based on the information provided in Section 3.1, we plot the fixed cost portion of the provision cost per household, depicted by the yellow line. Here, we observe that, at all consumption levels, the fixed portion of the provision cost is higher than the fixed charge on the regular bill. This aligns with the fact that, in the region, most tariff schemes have fixed charges lower than the actual fixed costs. In countries with cost-recovering schemes, this difference between fixed costs and fixed charges ends up being charged in the variable component, a practice known as *variabilization of the fixed cost*. Note, however, that this is not a conclusion we can draw with certainty at this stage, as it is also possible that the variable charges do not even cover the variable costs. In that

TABLE 2. Regular Electricity Tariff Schemes in the Dominican Republic

January 2018 to December 2018

Block	kWh start	kWh end	Fixed (\$)	Variable (¢)
1	0	100	0.8	9.0
2	100	200	2.8	9.0
3	200	300	2.8	14.1
4	300	700	2.8	21.9
5	700	-	2.8	22.4

Note: This table shows the average of the tariff schedules for the period between January 2018 and December 2018 for the two distribution companies, EDESUR and EDEESTE, that cover the Metropolitan Area of Santo Domingo. The schedule above is the regular tariff that households face; discounts to it—whether through a social tariff or other benefits—are described in the text and the appendix and are incorporated into the analysis.

Source: Authors' own elaboration based on EDESUR and EDEESTE information.

¹⁷ $27.85 = 2.8 + 0.09 \times 200 + 0.141 \times (250 - 200)$.

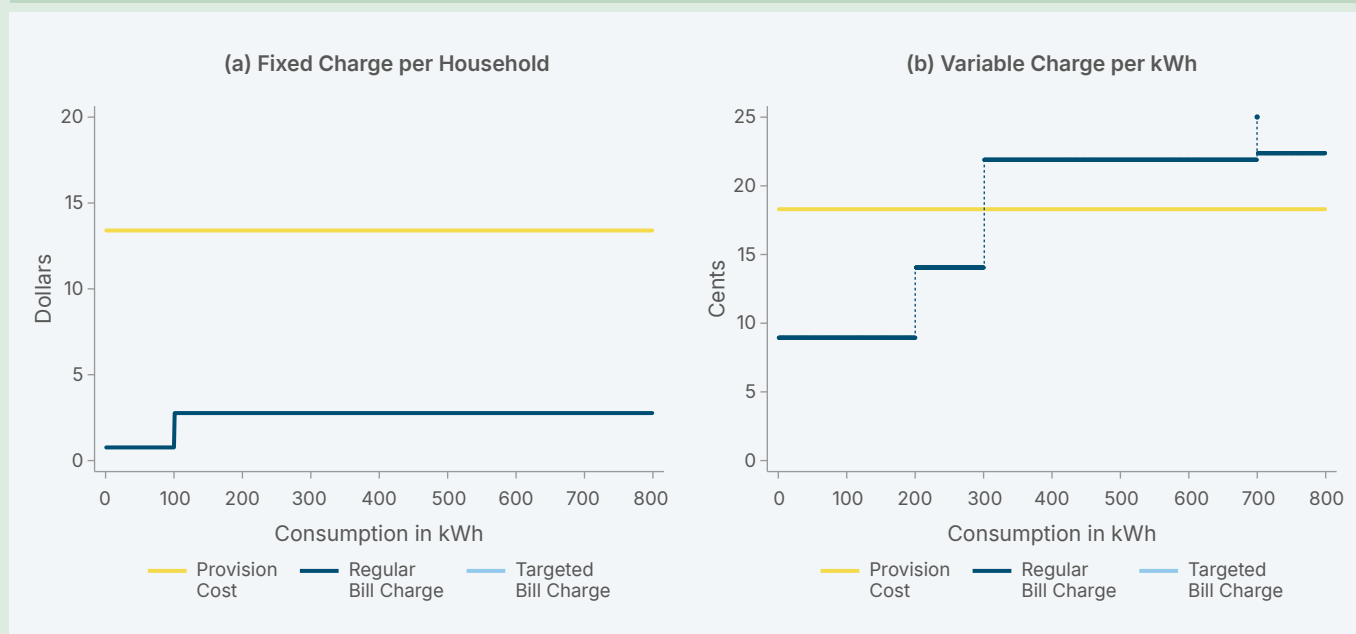
case, we would not be observing variabilization of fixed costs, but rather a subsidy covering both the fixed costs and part of the variable ones.

Panel (b) of Figure 8 shows the regular variable charge in blue and the variable portion of the provision cost, as described in [Section 3.1](#), in yellow. Unlike in Argentina, the Dominican scheme retains memory throughout, and loses it only at the 700 kWh threshold. At this point, the variable charge is represented by the blue dot at the top of the graph. The gap between the dot and the blue line is not as large as it is for Argentina because the variable charge for the last block is much higher here. However, the objective of depicting the dot is illustrative: to explicitly show how the variable charge increases significantly when consumption exceeds 700 kWh.

The presence of a variable charge that increases with consumption may be due to cross-subsidies from higher-consumption households to lower-consumption

households to cover the total variable cost of provision. Alternatively, it could result from allocating fixed costs as variable charges, where consumers with higher consumption are transferred a more significant share of the fixed costs. However, since the variable charge does not fully cover the variable costs of service provision for consumption below 300 kWh, this portion must be subsidized, either directly or through a cross-subsidy. If the lines do not intersect and the yellow line consistently remains below the blue line, this would indicate no cross-subsidy between households to cover the variable portion of the service costs, and the variable charge would fully cover these costs at all consumption levels. In such a scenario, the increase in regular bill charges with consumption could be attributed to the allocation of fixed costs as variable charges. The analysis thus offers two key takeaways. First, IBP could reflect a subsidy for the variable portion of the service provision costs for lower consumption levels.

FIGURE 8. Fixed and Variable Charges by Consumption Level for the Dominican Republic



Note: Panel (a) shows the fixed charge per household per month and Panel (b) the variable charge per kWh. The horizontal axis represents the quantity of kWh the household consumes, while the vertical axis represents the charge per unit. Panel (a) shows that the provision cost is higher than the fixed charge on the regular bill for all levels of consumption. Panel (b) shows how the variable charge changes with consumption. For consumption levels below 300 kWh, the variable charge is lower than the variable cost of provision.

Source: Authors' own elaboration based on EDESUR and EDEESTE information.

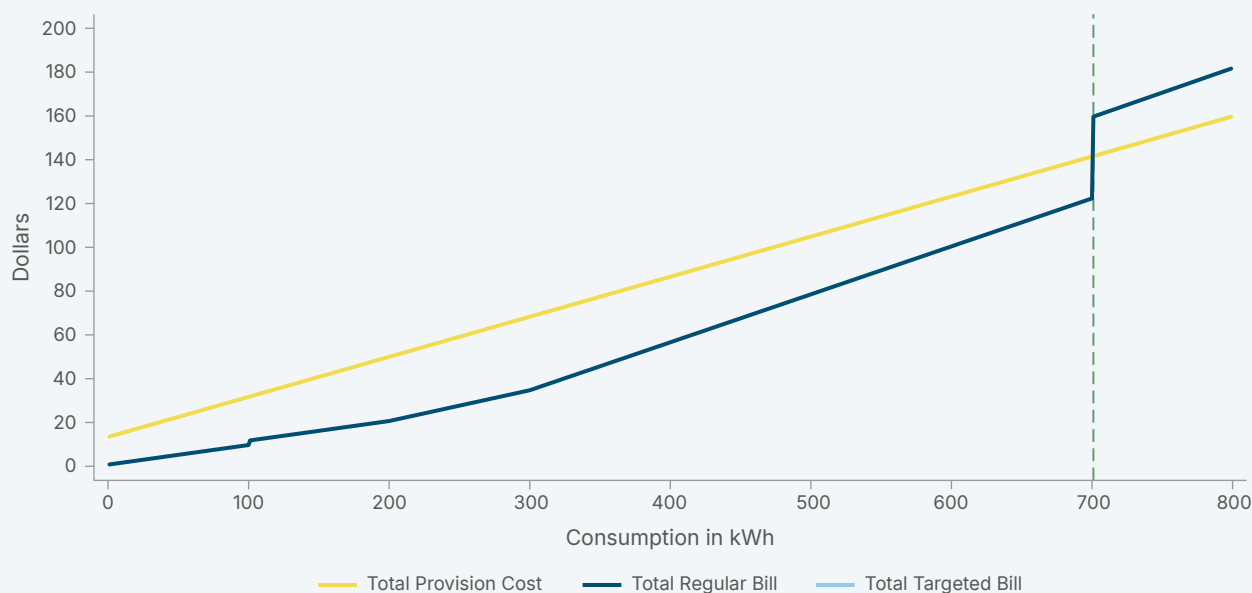
Alternatively, even if the variable cost is fully covered by the variable charge at all consumption levels, the IBP scheme could represent the allocation of fixed costs where higher consumption levels pay not in proportion to their share of total consumption but in a more-than-proportional manner.

Note that, in contrast to their counterparts for the Argentinian case, Panels (a) and (b) do not show the light blue line with a targeted tariff incorporated in the rate structure. In the Dominican Republic, there is a targeted policy for vulnerable groups, but it is not implemented through the tariff structure. It finances up to 100 kWh and is assigned by the central government to households previously identified through a targeting instrument.¹⁸ Although targeted mechanisms can always be improved, in many circumstances, it is good practice for the subsidy not to be a discount on

the regular tariff and to cover only a limited amount of consumption to encourage rational use of the resource.

Figure 9 shows the total expenditure for different consumption levels and the total cost of providing the service. Since the fixed cost of providing the service is \$13.4 per customer and the variable cost is \$18.3 per kWh, the yellow line, which indicates total cost recovery for each consumption level, has an intercept of 13.4 and a slope of 0.183. The blue line represents the total expenditure per household given the regular tariff structure. We observe a discrete jump at 100 kWh, due to the increase in the fixed charge per household past this threshold. Then, at the 200 and 300 kWh thresholds, we observe changes only in the slope of the line, explained by the fact that changes in the variable charge apply only to additional units.

FIGURE 9. Monthly Bill by Consumption Level for the Dominican Republic



Note: The horizontal axis shows the consumption in kWh, while the vertical axis shows what each household pays. The yellow line represents the total cost of service provision per level of consumption, and the blue line represents the total expenditure per household given the regular tariff structure. The green vertical line indicates the cutoff point (consumption level) where the tariff scheme starts to be cost-recovering. There is not a light blue line representing the total expenditure for a household that is a beneficiary of the social tariff (Total Targeted Bill) because there is no social tariff through the tariff structure.

Source: Authors' own elaboration based on EDESUR and EDEESTE information.

¹⁸ [Appendix B](#) describes this mechanism in detail, together with the way we incorporate it into the analysis.

So far, the scheme behaves like a memory-based system. There is, however, a large discrete jump at 700 kWh because beyond this threshold, the system loses memory and all units consumed are charged at the new variable rate, not just the excess above 700 kWh. Finally, note that households that consume to the right of the green dashed line begin to subsidize

the system, which is the idea behind IBP schemes. However, as we will see in the next section, very few households in the Dominican Republic consume above this threshold, and the large majority of users pay a fixed and variable charge lower than the cost of service provision.





ECUADOR (2012/2013)

The two components, fixed and variable, of the tariff structure in Ecuador for the year 2012 are presented in Table 3. We see that there are fourteen blocks of consumption and each has an associated variable charge. The fixed charge is the same for all of them. The IBP structure for the variable charge in Ecuador, however, is different from that in Argentina and the Dominican Republic. For example, in Ecuador, a household that consumes 170 kWh would fall into

block 4. It should pay a fixed amount of \$1.414 per month, ¢7.1 for the first 50 kWh consumed, ¢7.3 for the second and the third 50 kWh consumed (i.e., for the consumption between 50 kWh and 150 kWh), and ¢8 for the last 20 kWh of consumption (i.e., between 150 kWh and 170 kWh).¹⁹ Therefore, the total amount of electricity, before taxes, that the household pays is \$13.86.²⁰ In contrast, in the case of Argentina, if a household is, for example, in block 4, it pays the

TABLE 3. Regular Electricity Tariff Schemes in Ecuador

April 2012 to March 2013

Block	kWh start	kWh end	Fixed (\$)	Variable (¢)
1	0	50	1.414	7.1
2	50	100	1.414	7.3
3	100	150	1.414	7.3
4	150	200	1.414	8.0
5	200	250	1.414	8.7
6	250	300	1.414	8.9
7	300	350	1.414	8.9
8	350	500	1.414	8.9
9	500	700	1.414	11.9
10	700	1000	1.414	13.5
11	1000	1500	1.414	16.1
12	1500	2500	1.414	26.5
13	2500	3500	1.414	42.6
14	3500	17500	1.414	67.1

Note: This table is based on the available information for April 2012 to March 2013 for the distribution company, EEQ, that covers the Metropolitan Area of Quito. The values here represent the average over twelve months. The schedule above is the regular tariff that households face; discounts to it—whether through a social tariff or other benefits—are described in the text and the appendix and are incorporated into the analysis.

Source: Authors' own elaboration based on EEQ information.

¹⁹ The values between the 2nd and 3rd blocks are the same. However, there are fourteen blocks by regulation regardless of the fact that two or more blocks may have the same values.

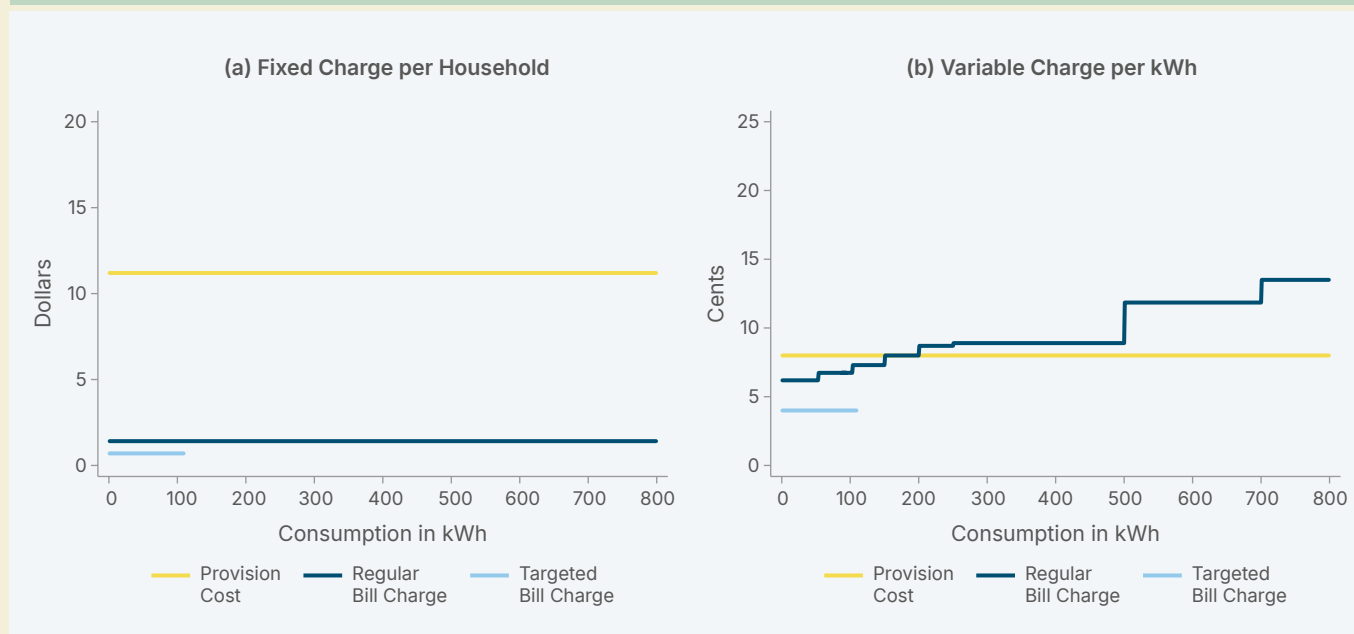
²⁰ $13.86 = 1.414 + 0.071 \times 50 + 0.073 \times (150 - 50) + 0.080 \times (170 - 150)$.

same variable charge for all the units consumed. The Dominican Republic is similar to Ecuador, but recall that its scheme loses memory for consumption greater than 700 kWh.

Figure 10 depicts the information from [Table 3](#). The blue line in Panel (a) shows how the fixed charges change with the amount of consumption, while in Panel (b), we see how the variable charges change with the consumption level. Given that Ecuador's system has memory, in contrast to Argentina's and the Dominican Republic's, no blue dots appear at the top of Panel (b). The light blue lines depict the charge that, according to regulation, targeted groups of the population pay. In the case of Ecuador, these are households that consumed at or below 110 kWh per month, which is why, on the horizontal axis, the light blue line goes from 0 to 110. In contrast to the Argentinian and Dominican schemes, this targeting policy is based entirely on consumption level.²¹ The actual cost of both the fixed and variable portions of the provision costs is depicted by the yellow lines in both graphs.

[Figure 11](#) shows the total expenditure for different consumption levels and the total cost of service provision. Since the monthly fixed cost of service provision is \$11.2 per customer and the variable cost is ¢8 per kWh, the yellow line, which indicates total cost recovery for each consumption level, has an intercept of 11.2 and a slope of 0.08. The blue line represents the total expenditure per household given the regular tariff structure, where we observe only changes in the slope of the line because changes in the variable charge apply only to additional units. The blue line crosses the yellow line at the consumption level marked by the green dashed line—about 585 kWh—so households consuming below this level pay less than the cost of provision, while those above it begin to cover and, at higher consumption, subsidize the system. As we will see in the next section, however, the large majority of households in Ecuador consume well below this threshold.

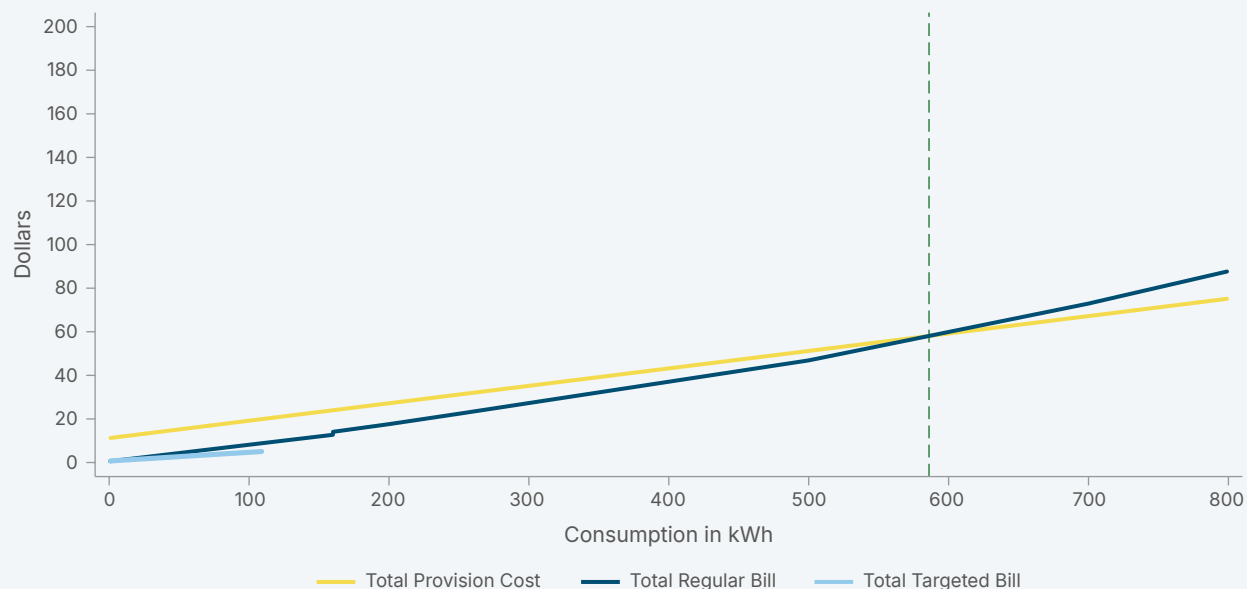
FIGURE 10. Fixed and Variable Charges by Consumption Level for Ecuador



Note: Panel (a) shows the fixed charge per household per month and Panel (b) the variable charge per kWh. The horizontal axis represents the quantity of kWh the household consumes, while the vertical axis represents the charge per unit. Panel (a) shows that the provision cost is higher than the fixed charge on the regular bill for all levels of consumption. Panel (b) shows how the variable charge changes with consumption. For consumption levels above 200 kWh, the variable charge is higher than the variable cost of provision.

Source: Authors' own elaboration based on EEQ information.

21. Appendix B describes Ecuador's targeted schemes—its social tariff and the cross-subsidy—in detail, including their names and targeting, together with the way we incorporate them into the analysis.

FIGURE 11. Monthly Bill by Consumption Level for Ecuador

Note: The horizontal axis shows the consumption in kWh, while the vertical axis shows what each household pays. The yellow line represents the cost of service provision per level of consumption, the blue line represents the total expenditure per household given the regular tariff structure, and the light blue line represents the total expenditure for a household that is a beneficiary of the social tariff. The green vertical line indicates the cutoff point (consumption level) where the tariff scheme starts to be cost-recovering.

Source: Authors' own elaboration based on EEQ information.



URUGUAY (2016/2017)

In contrast to the schemes of the other three countries we have analyzed, the electricity tariff in Uruguay has three components: a classical fixed charge, a contracted-power fixed charge and a variable charge. The contracted-power charge is paid monthly. Table 4 shows the average tariff structure between December 2016 and November 2017. There are three consumption blocks with the same fixed charge for any level of consumption of \$10.4, \$6.4 for the classical fixed charge concept plus \$4 for the power fixed charge.²² The variable charge increases with the block number. The variable charge is ¢16 per kWh for the first 100 kWh and ¢21 per kWh for the electricity consumed between 100 kWh and 600 kWh. Finally, for consumption levels greater than 600 kWh, the variable charge is ¢26 per kWh. For example, a household that consumed 260 kWh would fall into block 2. It should pay a fixed amount of \$10.4 per month, ¢16 for the first 100 kWh and ¢21 for the second 160 kWh consumed. Therefore, the total amount, before taxes, that the household pays for electricity is \$60.²³

Figure 12 depicts the information from Table 4. The blue line in Panel (a) shows the monthly fixed charge, which does not change with the consumption level, while the yellow line represents the fixed cost portion of the provision cost per household. At all consumption levels, the fixed portion of the provision cost is higher than the fixed charge on the regular bill. Panel (b) shows how the variable charge changes with the consumption level, illustrating that the variable charge increases with household consumption. In Uruguay, during the period analyzed, there was a social tariff applied to all households consuming 230 kWh or less monthly, which is depicted by the light blue line in Panel (b).²⁴ The targeted bill charge line shows that there is no variable charge for consumption below 100 kWh, a charge of approximately ¢21 for consumption between 100 and 140 kWh, an increase to approximately ¢39 per kWh for consumption between 140 and 230 kWh, and finally a reduction to ¢26 per kWh for consumption above 230 kWh. The objective of this tariff is to facilitate consumption of the first

TABLE 4. Regular Electricity Tariff Schemes in Uruguay

December 2016 to November 2017

Block	kWh start	kWh end	Fixed (\$)	Variable (¢)
1	0	100	10.4	16
2	100	600	10.4	21
3	600	-	10.4	26

Note: This table is based on the available information for December 2016 to November 2017 for the National Administration of Power Plants and Electric Transmissions (UTE). The values here represent the average over twelve months. The schedule above is the regular tariff that households face; discounts to it—whether through a social tariff or other benefits—are described in the text and the appendix and are incorporated into the analysis.

Source: Authors' own elaboration based on UTE information.

²² The power fixed charge can change every month depending on the power contracted by the household, which we have assumed is 2 kW per month for all households.

²³ $60 = 10.4 + 0.16 \times 100 + 0.21 \times (260 - 100)$.

²⁴ [Appendix B](#) describes Uruguay's targeted scheme, together with the way we incorporate it into the analysis.

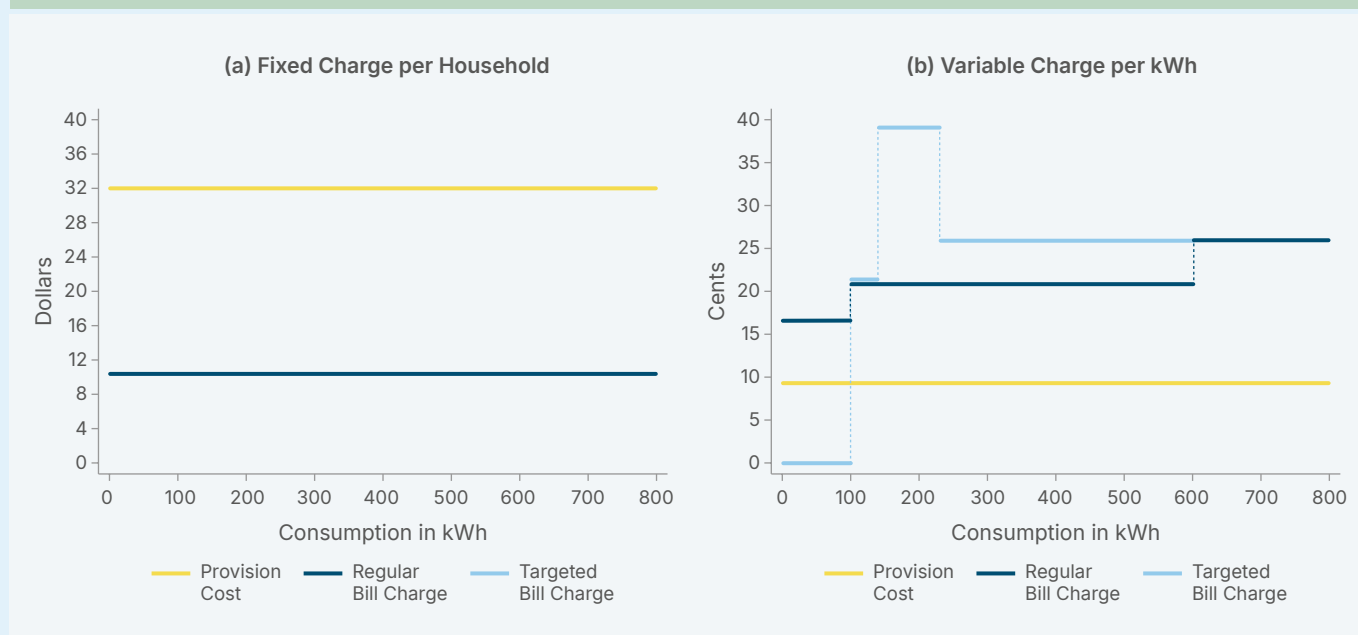
consumed units, but as consumption moves away from 100 kWh, it becomes strongly disincentivized. In contrast to the policies of Argentina, Ecuador, and the Dominican Republic, this targeting policy achieves cost recovery in most consumption brackets, with the exception of the first 100 kWh for the targeted tariff.

Figure 13 shows the total expenditure for different consumption levels and the total cost of service provision. Given that the monthly fixed cost of service provision was \$32 per customer and the variable cost is ¢9.3 per kWh, the yellow line—which indicates total cost recovery for each consumption level—has an intercept of 32 and a slope of 0.093. The blue line represents the total expenditure per household under the regular tariff structure. This line displays two barely perceptible changes in slope, corresponding to the thresholds at 100 and 600 kWh. These changes occur because the variable charge applies only to additional units beyond each threshold.

The total targeted bill represents an alternative tariff structure with slope changes that reflect different

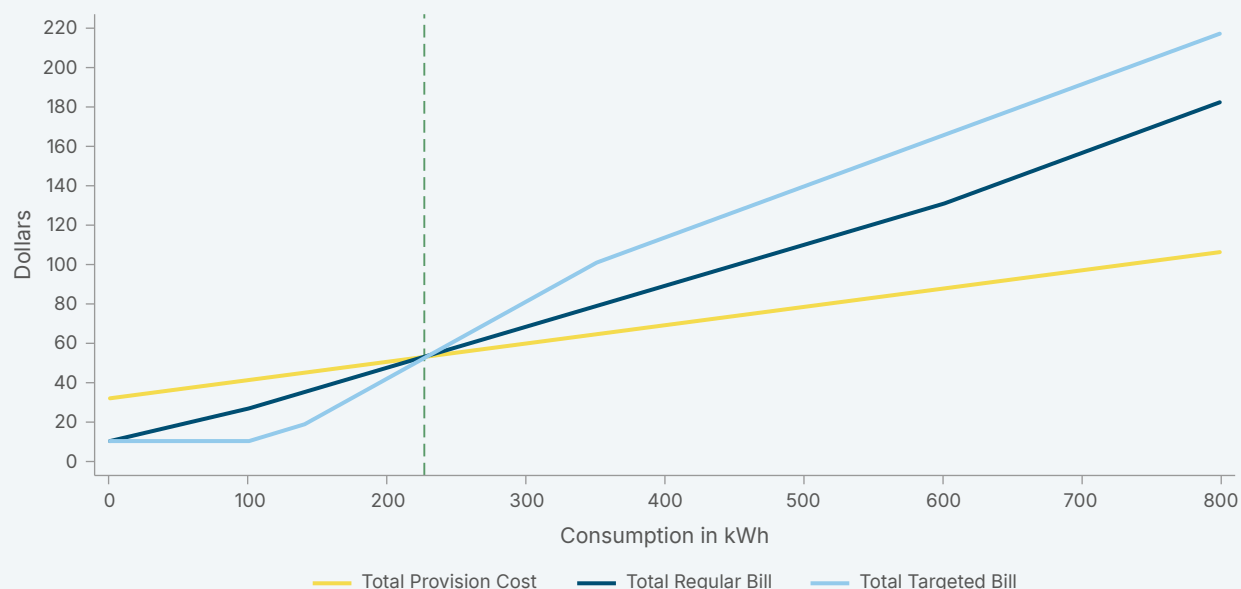
variable charges applied at various consumption thresholds. Initially, the slope is flat, indicating zero variable charge for the first 100 kWh consumed. As consumption increases, the slope becomes progressively steeper, signaling higher variable charges for additional units. Each change in slope corresponds to a shift in the tariff bracket, demonstrating how the regulation adjusts the price per kWh based on the household's total monthly usage. This structure provides targeted support for households at lower consumption levels while gradually increasing costs for higher usage. The dashed green vertical line indicates the threshold at which the regular tariff scheme achieves cost recovery. Households with consumption levels beyond this threshold begin to pay more than the cost of provision, effectively subsidizing the system. As we will see in the next section, this structure results in higher-income households in Uruguay cross-subsidizing lower-income households, since those with higher consumption—who tend to have higher incomes—pay proportionally more to help fund the reduced tariffs available to low-consumption, low-income households.

FIGURE 12. Fixed and Variable Charges by Consumption Level for Uruguay



Note: Panel (a) shows the fixed charge per household per month, while Panel (b) shows the variable charge per kWh. The horizontal axis represents the quantity of kWh the household consumes, and the vertical axis represents the charge per unit. Panel (a) demonstrates that the provision cost is higher than the fixed charge on the regular bill for all consumption levels. Panel (b) shows that for all consumption levels, the variable charge is higher than the variable cost of provision, except for the first 100 kWh, for which there is a subsidy.

Source: Authors' own elaboration based on UTE information.

FIGURE 13. Monthly Bill by Consumption Level for Uruguay

Note: The horizontal axis shows the consumption in kWh, while the vertical axis shows how much each household pays. The yellow line represents the cost of service provision per level of consumption, the blue line represents the total expenditure per household given the regular tariff structure, and the light blue line represents the total expenditure for a household that is a beneficiary of the social tariff. The green vertical line indicates the cutoff point (consumption level) where the tariff scheme starts to be cost-recovering.

Source: Authors' own elaboration based on UTE information.

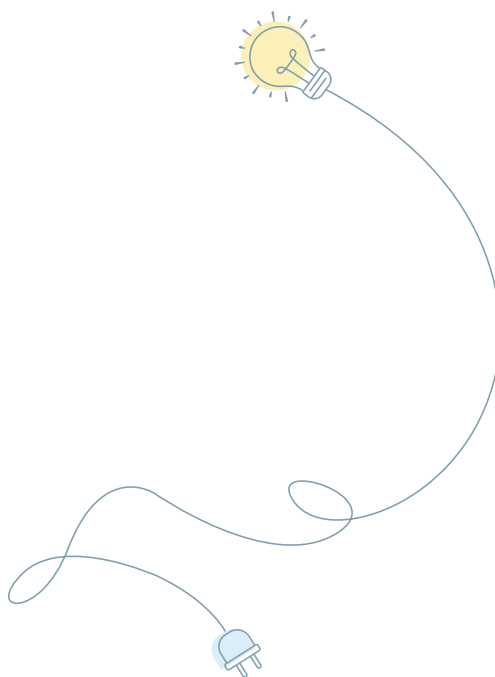
3.3. Tariff and Subsidy Schemes in Light of the Three Principles

Thus far we have described the tariff structure of each of the four countries, without emphasizing how the tariffs' design aligns with the three principles we explained in [Section 2](#). Now, we consider the various tariff and subsidy schemes in light of two of the three principles for appropriate tariff system design: cost recovery and cost reflectivity. We cannot assess the third principle, affordability, as the tariff structures themselves do not provide sufficient insight into this aspect of the electricity service. Indeed, without information on household income, general expenses, and consumption levels, it is impossible to determine whether the service imposes a significant financial burden on households in the countries under study or whether households can afford the minimum amount of consumption necessary for their proper development.

Figures [7](#), [9](#), [11](#) and [13](#) suggest that the cost-recovery principle will be met if the total subsidies received by consumers on the left side of the dashed green line

(i.e., where the blue and yellow lines cross) balance the additional amounts paid by those on the right side. However, to confirm this, we would need detailed data on household consumption. The farther to the right the distribution's mass, the higher is the likelihood that the tariff system achieves cost recovery. The same figures show that the principle of cost reflectivity is not met. In most cases, the fixed charge is significantly lower than the actual fixed cost of service provision, and the variable charge does not align with the variable cost of provision. For low consumption levels, the charge is below the cost, whereas for high consumption, it exceeds the cost. Additionally, none of the schemes incorporate hourly or seasonal adjustments that would better reflect the real-time cost of service provision. In any case, cost reflectivity is difficult to analyze in its full dimension by observing data at an annual level.

In the next section, we incorporate into the analysis household income and consumption data from the four metropolitan areas, which allows us to draw more accurate conclusions about the systems' cost recovery and affordability—something the tariff structures alone did not permit.





4.

A Framework for Policy



Analysis and Reform

[← Back to Contents](#)

4. A Framework for Policy Analysis and Reform

In what follows, we use household income and expenditure data from national surveys to reframe the tariff and subsidy structures based on household income levels, as opposed to consumption levels. Our unified conceptual framework enables coherent analysis and comparison of tariff systems across countries while also serving as a valuable tool for assessing the accuracy of subsidy targeting and the welfare impacts of alternative policies.²⁵

4.1. Framework

This section describes how the tariff structures and related subsidy policies are redefined and expressed as a function of household income instead of consumption. The critical variable for redefining the tariff structure as a function of income instead of consumption is a measure of the quantity consumed per income level, which is not generally available.

To obtain this measure, we analyze household-reported data on electricity expenditure from income and expenditure surveys. With these expenditure data segmented by income level, we then apply the specific tariff and subsidy structures of each country

to calculate the consumed quantities (Alberini et al., 2022; Hancevic and López-Aguilar, 2019). This allows us to determine the fixed and variable charges applicable at each income level.

In any tariff structure, there is a defined relationship between quantity and price, typically consisting of a fixed charge (A) and an average variable charge (p), so the monthly expenditure per household is given by:

$$E = A + p \cdot kWh$$

In this equation, E represents the total monthly expenditure, A is the fixed charge that remains constant regardless of consumption and is generally applied monthly, p is the average variable charge per unit of consumption (e.g., \$/kWh), and kWh is the amount of electricity consumed. However, in some cases, the monthly fixed charge depends on the consumption level in the respective month, and generally, the average variable charge changes with the level of consumption. Thus, technically, we have $A = A(kWh)$ and $p = p(kWh)$, both functions strictly increasing in kWh . Therefore, the right way to express the previous equation is:

$$E = A(kWh) + p(kWh) \cdot kWh$$

²⁵ In each country, the sample is restricted to the metropolitan area that matches the tariff structure: Gran Buenos Aires, Greater Santo Domingo, the Quito metropolitan area, and Montevideo. This keeps household consumption and income geographically consistent with the tariff structures we have already introduced. Accordingly, our results should be read as representative of these large urban centers rather than of each country as a whole, and extending the analysis nationwide—where tariffs and provision costs vary across regions—is a natural next step.

In each survey, we observe E for each income level, and based on the tariff and subsidy schedule in effect at the time of the survey, we have the functional form of $A(kWh)$ and $p(kWh)$. Then, recovering kWh is straightforward. First, we define the number of income levels for which we want to have data. Using the income and expenses surveys, we rank households by *equivalized* income and take the average income of each income decile.²⁶ The 10 measures of income level are given by:

$$I^1, I^2, \dots, I^{10}$$

with $I^1 < I^2 < \dots < I^{10}$. We then take the average expenditure per income decile in electricity, with the deciles given by:

$$E^1, E^2, \dots, E^{10}$$

Then, we recover consumption for each decile of income by looking at the specific kWh^i for $i \in 1, 2, \dots, 10$ that satisfy the following equation:

$$E^i = A(kWh^i) + p(kWh^i) \cdot kWh^i$$

Then, based on the recovered consumption for each income level, we can examine the tariff structure and observe the fixed charge, variable charge, and average variable charge corresponding to that consumption level.²⁷ This is what we start by presenting for each country below.



26. Equivalized income divides household income by an equivalence scale $s = (a + \theta n)^\alpha$, where a is the number of adults, n the number of children, $\theta \in (0, 1)$ the consumption weight of a child relative to an adult, and $\alpha \in (0, 1)$ a parameter capturing economies of scale within the household. Its two extremes—*per-capita* income ($\theta = 1$, $\alpha = 1$, so $s = a + n$) and total income ($\alpha = 0$, so $s = 1$)—each have advantages and drawbacks. Per-capita income orders households by the resources available to each member, but it ignores the economies of scale a household enjoys: a woman living alone on \$300 is ranked as richer, in per-capita terms, than a couple with two children earning \$800 in total (\$200 per member), yet she bears the household's fixed costs—housing, lighting, the electricity fixed charge—on her own and may in fact face greater difficulty affording necessities. Total income, at the other extreme, hides household composition: a single earner supporting nine dependents is treated the same as a two-person household with the same total income, though the ten-person household is far worse off per person. The square-root scale $s = (a + n)^{1/2}$ (the case $\theta = 1$, $\alpha = 1/2$) sits between these two, crediting economies of scale while still adjusting for household size. The choice of scale is ultimately a matter of judgment; we adopt this transparent, commonly used one. See (Buhmann et al., 1988) and (Deaton and Zaidi, 2002) for a discussion of equivalence scales.

27. We characterize each decile through its representative (average-income, average-expenditure) household, which is what allows us to express tariffs and subsidies as a function of income. This abstracts from the within-decile dispersion of tariff levels: under nonlinear schedules, households at different consumption levels within a decile face different charges. The omitted dimension is itself relevant for equity, since a tariff whose charges do not vary with consumption—such as a simple two-part tariff—avoids this dispersion altogether. The framework can be applied at finer income granularities (percentiles, or a continuous function of income), which would narrow but not eliminate the dispersion.

4.2. Schemes Under the Harmonized Framework

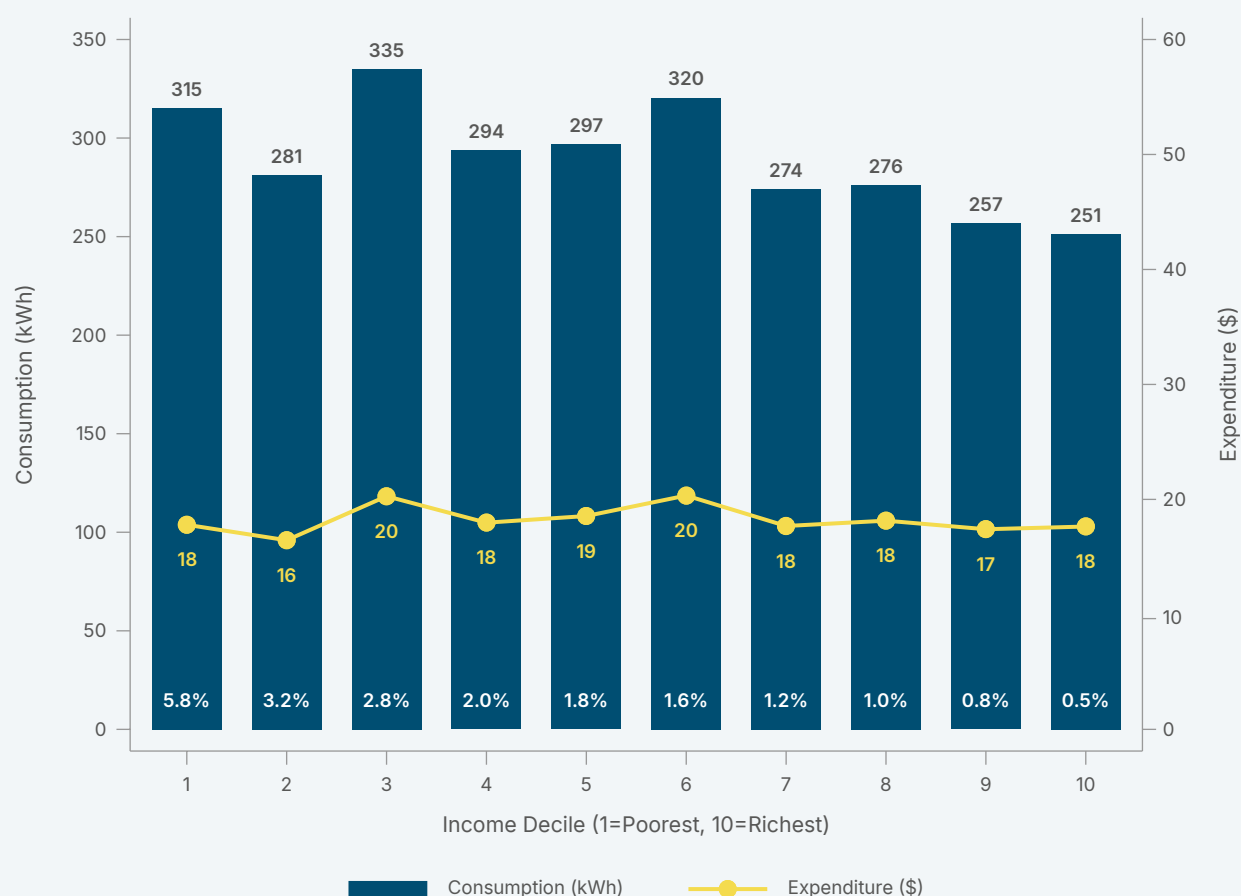


ARGENTINA (2017/2018)

Using household electricity expenditure data from Argentina's 2018 National Household Income and Expenditure Survey (ENGHo), along with the tariff

scheme described in [Section 3.2](#), we calculate the average electricity consumption in kWh for each income decile, as shown in Figure 14. The consumption

FIGURE 14. Monthly Consumption Level by Decile in Argentina



Note: The horizontal axis represents income deciles. The unit of measurement on the left vertical axis is kWh and on the right vertical axis is USD. The figure shows electricity consumption (blue bars, measured in kWh) and monthly expenditure (yellow line with dots, measured in USD) across income deciles. The percentages at the bottom of each bar represent the proportion of household income spent on electricity.
Source: Authors' own elaboration based on EDENOR and EDESUR information and ENGHo 2018.

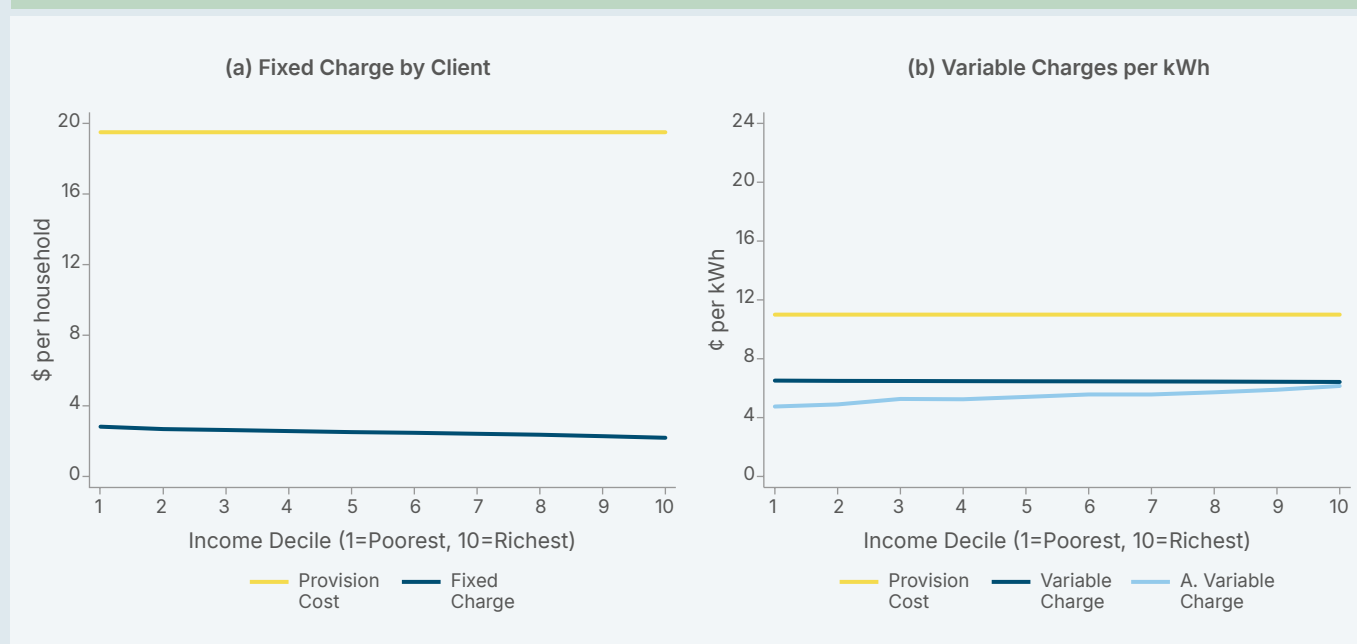
for the first income decile is 315 kWh per month, while for the tenth decile, it is 251 kWh. Overall, we observe that consumption does not vary sharply along the income distribution, but the gradient is negative—which, as we will see when examining other countries, is a unique characteristic of Argentina.

Figure 15 illustrates the tariff and subsidy structure, now expressed as a function of household income rather than consumption. Panels (a) and (b) are analogous to those in [Figure 6](#). The blue lines represent the fixed and variable charges by income decile and the yellow lines the fixed and marginal portions of the provision cost. For all the deciles, the *average* fixed charge remains between \$2 and \$3 per household. These are decile-level representative values: because the household survey does not identify which households receive the social tariff, each decile's charge is computed as a weighted average of the full-tariff and social-tariff regimes, weighted by the decile's social-tariff coverage, so the plotted charge lies between the discrete block values of [Table 1](#) rather than at any single one. The downward trend in the blue line reflects the fact that higher-income deciles consume less

and that, under the Argentine schedule, the fixed charge rises with the consumption block. Panel (b) shows the analogous average variable charge, which stays essentially flat—between ¢6.4 and ¢6.6 per kWh across the income distribution—because most consumption falls in the first two blocks, both priced at ¢6.4, with only a minority reaching the ¢6.6 block and above.

The light blue line shows the average variable charge, which already incorporates the social tariff. Given that, according to our estimates 52% of households in the first decile are subject to the social tariff, we find that the average variable charge paid by households in decile 1 is substantially lower than the variable charge, which is not the case for decile 10, in which only 6% of households pay the social tariff. Obtaining the average variable charge is fundamental because it can differ greatly from the variable charge corresponding to a given consumption level, as it incorporates the effect of social policy and the memory or memorylessness of the IBP system. The *average* variable charge is what the household ultimately pays *per kWh consumed*, while the variable charge is what the household

FIGURE 15. Fixed and Variable Charges by Income Decile for Argentina



Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis in both panels is USD. Panel (a) shows the fixed charge (blue line) compared to the provision cost (yellow line) across income deciles. The provision cost remains constant at approximately \$19.5 per household, while the fixed charge consumers pay is lower for all income levels. Panel (b) displays the marginal charge (solid blue line) and average variable charge (light blue line) compared to the provision cost (yellow line) across income deciles.

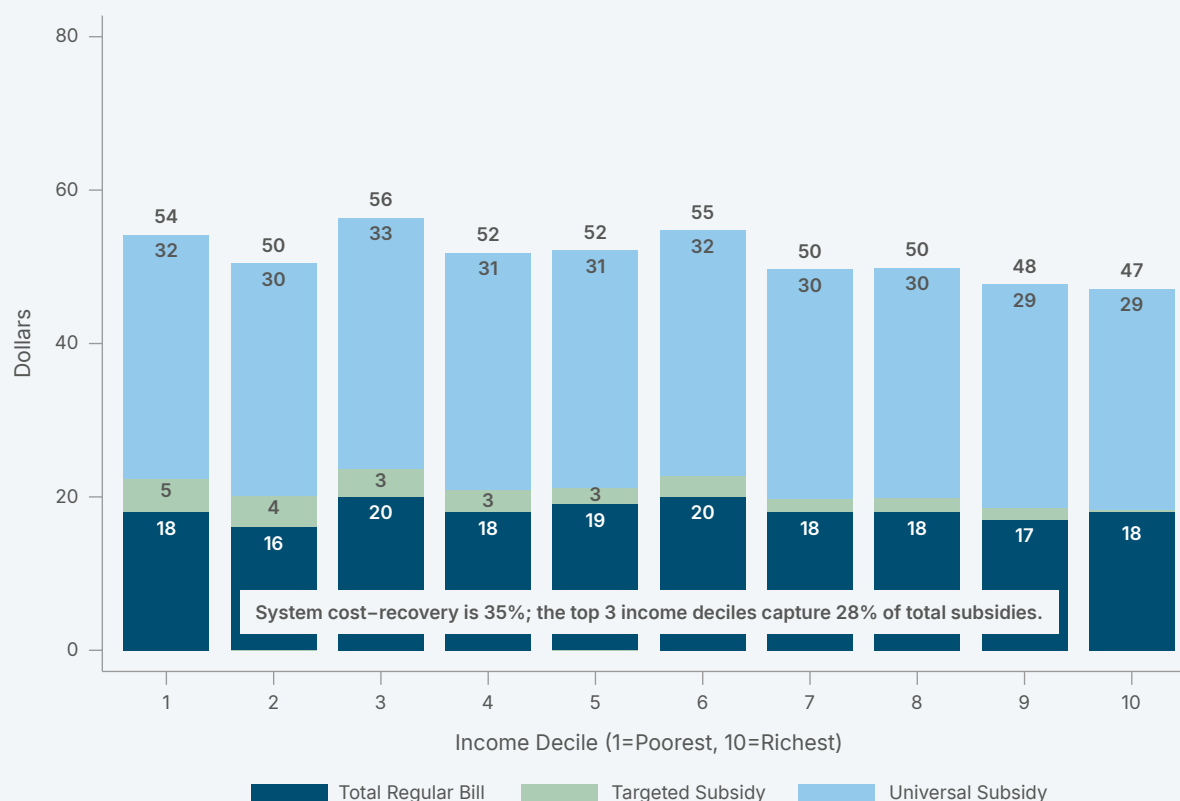
Source: Authors' own elaboration based on EDENOR and EDESUR information and ENGHo 2018.

pays for the *last consumed unit*. The advantage of presenting the tariff structure in this way is that each decile is summarized by a single fixed charge and a single average variable charge, rather than by a schedule that varies with consumption. This is what makes tariff structures with very different block designs directly comparable across countries and will allow us to simulate alternative schemes within a common framework.

Using the tariff structure based on household income levels, we calculate the effective subsidy for the average household in each decile. Figure 16 illustrates the breakdown of tariffs and subsidies by decile. The height of each bar represents the total cost of providing the electricity consumed by the average household in each decile. In Argentina, the total cost per decile of

service provision is similar across all deciles, which is explained by the fact that consumption levels do not vary significantly with income. The blue portion of each bar indicates total household expenditure by income level, representing the part of the provision cost covered out-of-pocket by households. Out-of-pocket payments are broadly similar across deciles, even though lower-income households consume somewhat more. This is explained by the social tariff, captured by the green portion of each bar: since coverage is higher among low-income households, the share of the provision cost covered by this targeted subsidy is larger at the bottom of the income distribution. The light blue portion shows the universal subsidy, which covers the remaining share of the provision cost and stays fairly constant across income levels.

FIGURE 16. Tariff and Subsidy Decomposition by Decile for Argentina



Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis is USD. Each bar is divided into three segments representing the total regular bill (blue), targeted subsidy (green), and universal subsidy (light blue). The total height of each bar represents the total cost of electricity provision for each decile's consumption, while the blue bar height represents the total payment that households make out of pocket.

Source: Authors' own elaboration based on EDENOR and EDESUR information and ENGHo 2018.



DOMINICAN REPUBLIC (2018)

Using household electricity expenditures reported in the 2018 National Household Income and Expenditure Survey (ENIGH), along with the regular tariff schemes described in [Section 3.2](#), we estimate the average electricity consumption in kWh for each income decile in the Dominican Republic, as shown in Figure 17. Average consumption for the first income decile is 139

kWh per month, while for the tenth decile, it is 340 kWh. Overall, we observe that the first three deciles consume approximately the same amount, with a gradual increase in consumption from the third to the ninth deciles. Finally, the tenth decile's consumption level stands as an outlier.

FIGURE 17. Monthly Consumption Level by Decile for the Dominican Republic



Note: The horizontal axis represents income deciles. The unit of measurement on the left vertical axis is kWh and on the right vertical axis is USD. The figure shows electricity consumption (blue bars, measured in kWh) and monthly expenditure (yellow line with dots, measured in USD) across income deciles. The percentages at the bottom of each bar represent the proportion of household income spent on electricity.
Source: Authors' own elaboration based on EDESUR and EDEESTE information and ENIGH 2018.

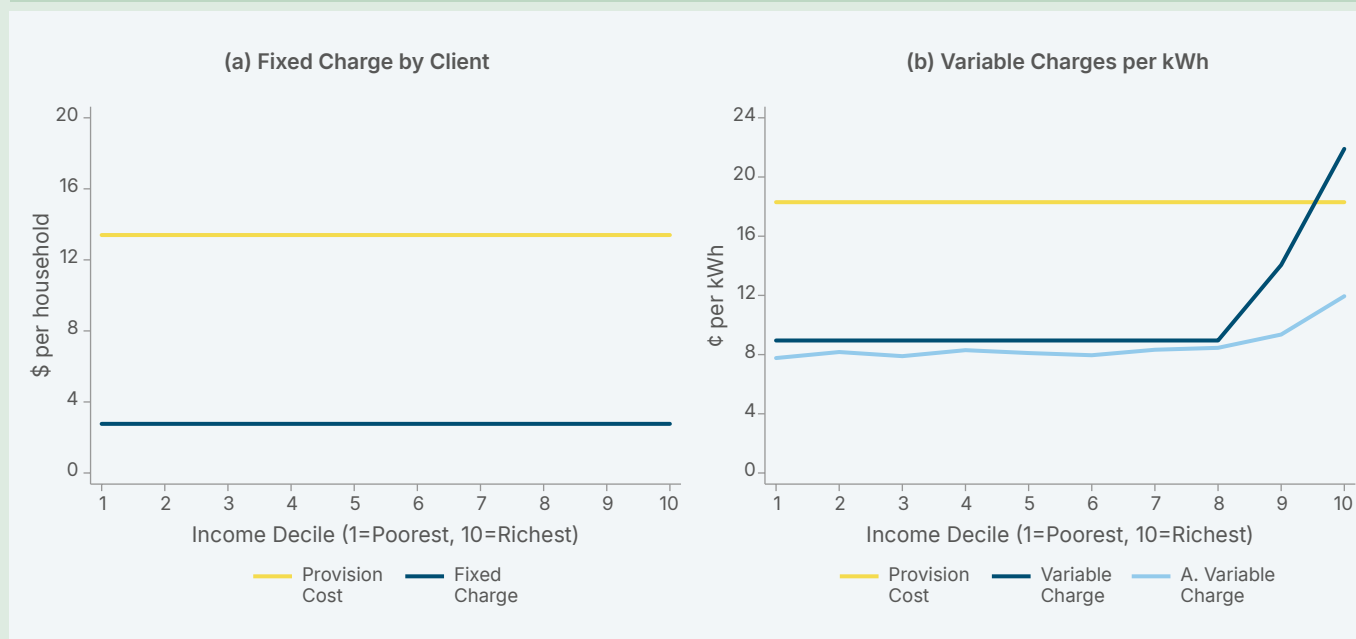
Figure 18 shows the tariff and subsidies structure no longer as a function of household consumption but instead as a function of its income. Panels (a) and (b) are analogous to those shown in [Figure 8](#). The blue lines represent the fixed and variable charges by income decile, the light blue line the average variable charge, and the yellow lines the fixed and marginal portions of the provision cost.

To construct the fixed and variable charges by income level, we simply take the average consumption associated with each decile from [Figure 17](#) and retrieve the fixed and variable charges associated with each of these consumption levels in the tariff structure. Since the average consumption for all deciles exceeds 100 kWh per month, the fixed charges are the same for everyone, amounting to \$2.8. Then, given that consumption for the first eight deciles is between 100 kWh and 200 kWh, the variable charge is ¢9 per kWh. The variable charge for the ninth decile, with its consumption between 200 kWh and 300 kWh, is ¢14.1

per kWh, while the variable charge for the tenth decile is ¢21.9 per kWh since its consumption is above 300 kWh but below 700 kWh.

In summary, the tariff structure faced by the vast majority of the Dominican population (i.e., households from the first to the eighth decile) is the same. Moreover, in contrast to what happens in Argentina (see [Figure 14](#)), in the Dominican Republic, the 10th decile consumes considerably more than the other deciles, which is why it pays a significantly higher marginal charge per kWh. Finally, unlike Argentina, Ecuador, and Uruguay, the Dominican Republic does not incorporate subsidies within its tariff structure or through the distribution company. Instead, support for vulnerable households is provided through a targeted policy administered directly by the central government—a transfer (*Bono Luz*) that covers roughly the first 100 kWh of monthly consumption for eligible low-income households.

FIGURE 18. Fixed and Variable Charges by Income Decile in the Dominican Republic



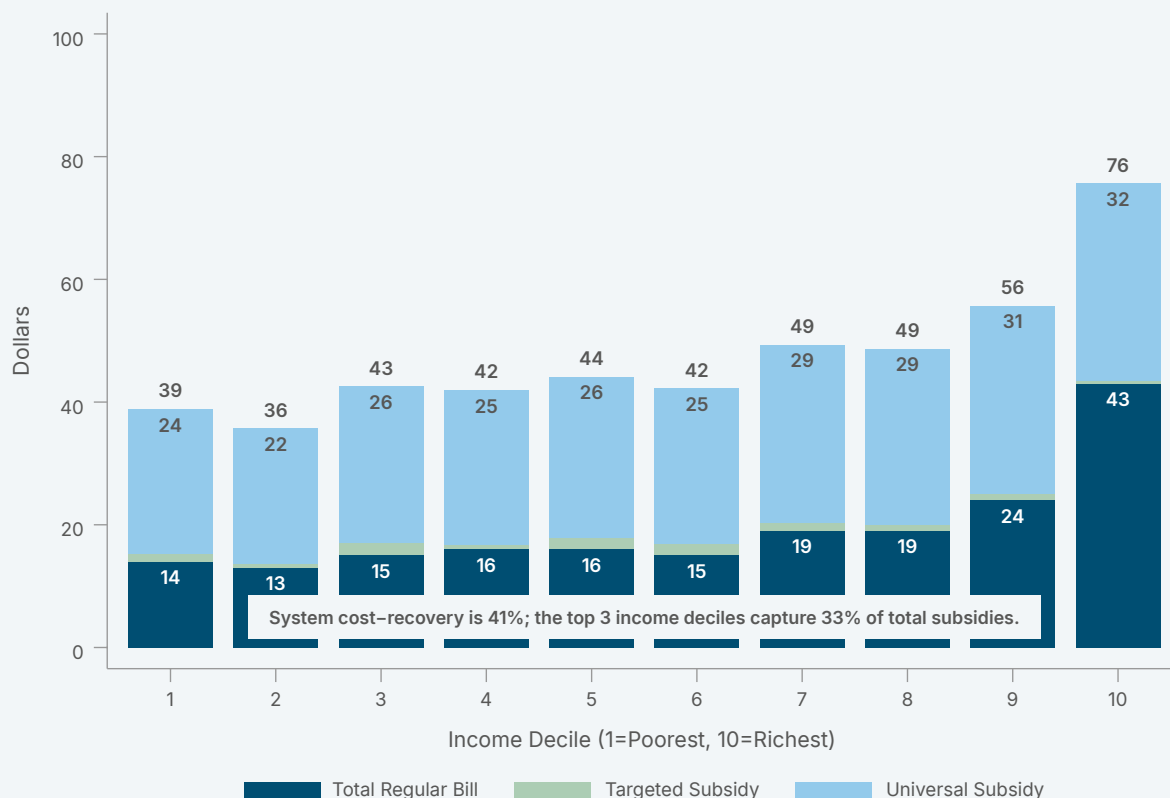
Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis in both panels is USD. Panel (a) shows the fixed charge (blue line) compared to the provision cost (yellow line) across income deciles. The provision cost remains constant at approximately \$13.4 per household, while the fixed charge consumers pay is lower for all income levels. Panel (b) displays the marginal charge (solid blue line) and average variable charge (light blue line) compared to the provision cost (yellow line) across income deciles.

Source: Authors' own elaboration based on EDESUR and EDEESTE information and ENIGH 2018.

Using the tariff structure based on household income levels, we calculate the effective subsidy for the average household in each decile. Figure 19 shows the breakdown of tariffs and subsidies by decile. The height of each bar represents the total cost of providing the electricity consumed by the average household in each decile. Although the consumption of Dominican households in the 9th decile is similar to that of households in the same decile in Argentina, the provision cost is much higher in the Dominican Republic. The blue portion of each bar indicates total household expenditure by income level, representing

the part of the provision cost covered out-of-pocket by households. The green portion, which is not labeled because of its small size, represents the portion of the total cost covered by the targeted subsidy. In the Dominican Republic, this subsidy is modest and concentrated in the first nine deciles. The light blue portion represents the universal subsidy, which covers the rest of the provision cost. Since higher-income households consume more, they receive a larger total amount of this subsidy (i.e., the light blue portion increases with income).

FIGURE 19. Tariff and Subsidy Decomposition by Decile for the Dominican Republic



Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis is USD. Each bar is divided into three segments representing the total regular bill (blue), targeted subsidy (green), and universal subsidy (light blue). The total height of each bar represents the total cost of electricity provision for each decile's consumption, while the blue bar height represents the total payment that households make out of pocket.

Source: Authors' own elaboration based on EDESUR and EDEESTE information and ENIGH 2018.

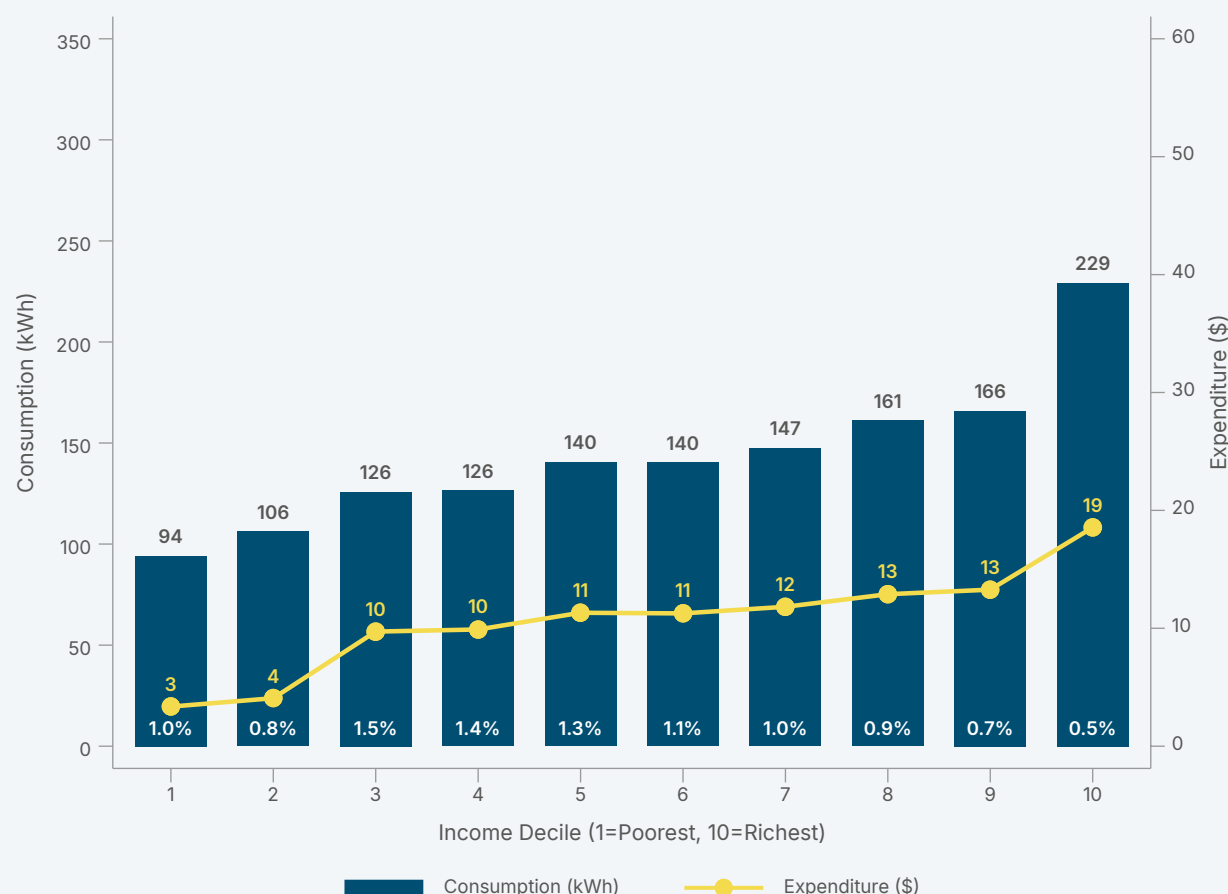


ECUADOR (2012/2013)

Using the 2012 National Survey of Income and Expenditures of Urban and Rural Households (ENIGHUR), along with the regular tariff schemes described in [Section 3.2](#), we estimate the average electricity consumption in kWh for each income decile in Ecuador, as shown in Figure 20. The consumption for the 1st income decile is 94 kWh per month, while for the 10th decile, it is 229 kWh. Overall, we observe that the distribution is much more similar

to the Dominican Republic's than to Argentina's. A slight difference is that consumption increases with income in a more monotonic way in Ecuador than in the Dominican Republic. However, despite the similarities, a significant difference from the Dominican case lies in the total expenditure on electricity, which in Ecuador is significantly lower not only in absolute terms but also relative to income. While a household in the lowest decile in Ecuador allocates 1.0% of its

FIGURE 20. Monthly Consumption Level by Decile for Ecuador



Note: The horizontal axis represents income deciles. The unit of measurement on the left vertical axis is kWh and on the right vertical is USD. The figure shows electricity consumption (blue bars, measured in kWh) and monthly expenditure (yellow line with dots, measured in USD) across income deciles. The percentages at the bottom of each bar represent the proportion of household income spent on electricity.
Source: Authors' own elaboration based on EEQ information and ENIGHUR 2012.

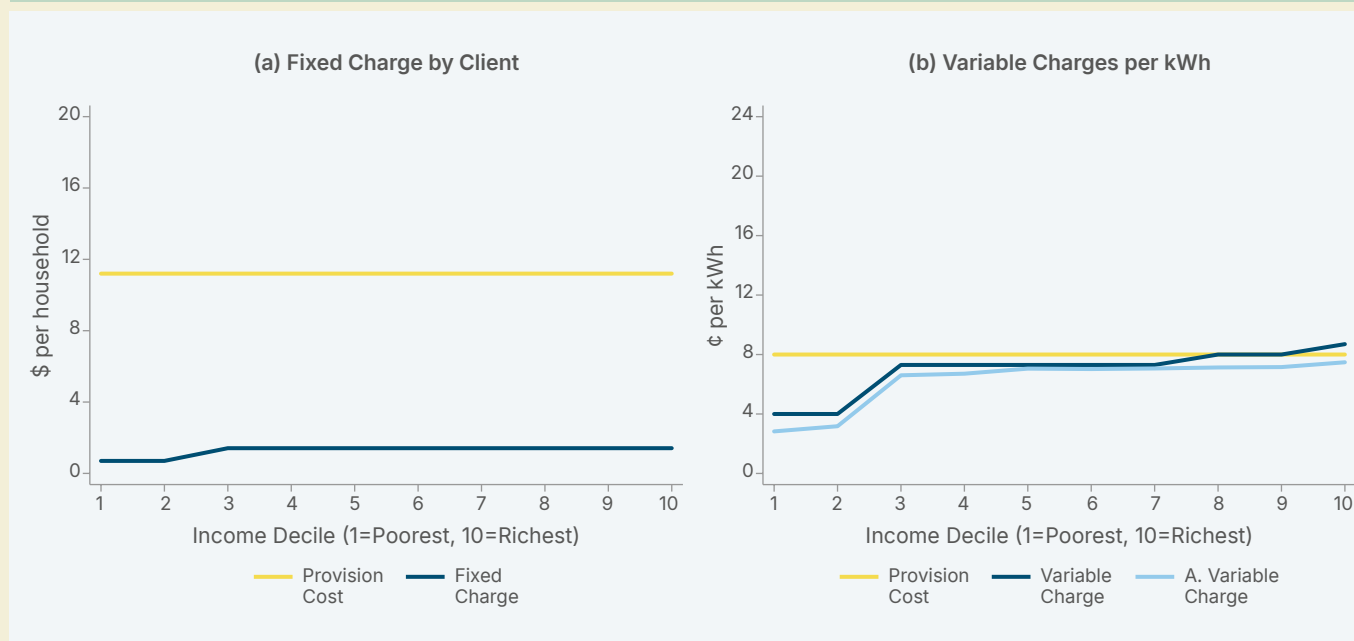
income to electricity consumption, its counterpart in the Dominican Republic allocates 8.5%. For the highest income decile, the same numbers are 0.5% and 1.2%, respectively. This pattern is mainly explained by the fact that tariffs are significantly higher in the Dominican Republic than in Ecuador.

Figure 21 shows the tariff and subsidy structure for each decile. Panels (a) and (b) are analogous to Figures 10a and 10b but show the fixed and variable charges no longer as a function of household consumption but as a function of household income. The blue lines depict fixed and variable charges by income decile, while the yellow lines depict the fixed and variable portions of the provision cost.

In Ecuador, specifically in Quito, a fixed charge of \$1.4 applies to households consuming more than 110 kWh, while those at or below this threshold pay \$0.70 under the social tariff. Unlike Argentina's social tariff, this scheme has no carry-over: the reduced rate is not a discount on an initial block available to every household, but a threshold benefit that reaches

only households whose total consumption stays at or below 110 kWh, applying to their entire bill. The first two deciles (about 94 and 106 kWh) fall below the threshold and pay the reduced \$0.70 fixed charge and a flat \$4.0 per kWh, whereas deciles 3–10 (above 110 kWh) pay the \$1.4 fixed charge and the regular tiered variable schedule: \$7.3 for deciles 3–7 (about 126–147 kWh), \$8.0 for deciles 8–9 (about 161–166 kWh), and \$8.7 for decile 10 (about 229 kWh). Because this social tariff has no carry-over, both the marginal and the average variable charge jump upward between deciles 2 and 3, as households cross the 110 kWh threshold. Ecuador's tiered structure has memory, so the marginal variable charge exceeds the average variable charge—which is why the solid blue line in Panel (b) sits above the light blue line—and in the top deciles the marginal charge reaches and even exceeds the variable cost of provision. Even so, the fixed charge lies far below the fixed cost of provision at every income level, and the average variable charge stays below the variable cost throughout, so the system fails to achieve cost recovery at any decile.

FIGURE 21. Fixed and Variable Charges by Income Decile in Ecuador



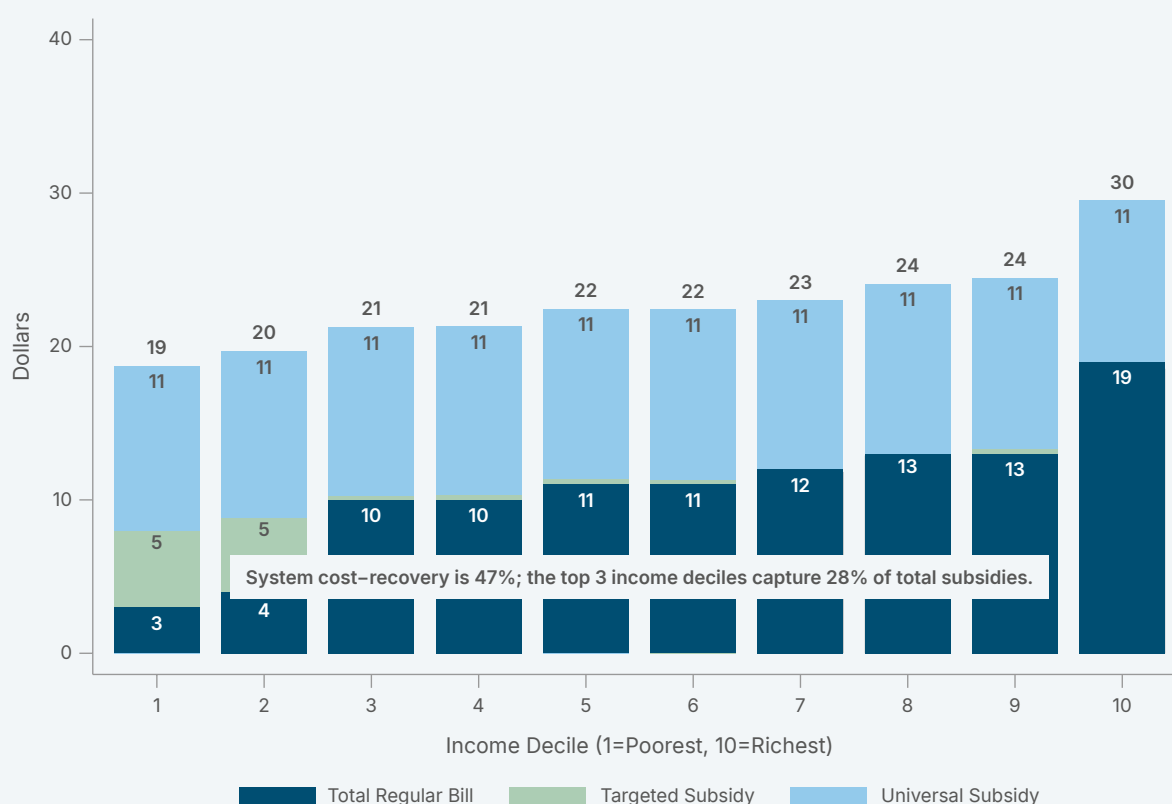
Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis in both panels is USD. Panel (a) shows the fixed charge (blue line) compared to the provision cost (yellow line) across income deciles. The provision cost remains constant at approximately \$11.2 per household, while the fixed charge consumers pay is lower for all income levels. Panel (b) displays the marginal charge (solid blue line) and average variable charge (light blue line) compared to the provision cost (yellow line) across income deciles.

Source: Authors' own elaboration based on EEQ information and ENIGHUR 2012.

Figure 22 illustrates how electricity costs and subsidies are distributed among different income groups in Ecuador. Each bar's total height represents the full cost of electricity provision for an average household in that decile. The blue segments show what households actually pay out-of-pocket. The green portion is the targeted subsidy, which in Ecuador is substantial and concentrated in the two lowest deciles: households consuming at or below 110 kWh receive the social tariff, cutting the out-of-pocket bill of the first two deciles to a few dollars. This green mass is driven mainly by the social tariff rather than by the cross-subsidy, which is nonetheless present—it reaches households consuming below 130 kWh, so deciles 3

and 4 keep a small green sliver (well under a dollar)—but it vanishes from the fifth decile onward. This is a central difference from the Dominican Republic, whose small targeted subsidy is spread fairly evenly across deciles. It should be stressed, however, that this social tariff targets households by their *consumption*, not their income: it reaches low-consumption households, which in Ecuador tend to be low-income, so that here the consumption threshold operates as a broadly progressive rule. This alignment is not guaranteed elsewhere—in countries such as Argentina, where the income–consumption relationship is flat or even negative, the same consumption-based criterion would fail to concentrate the subsidy on the poor.

FIGURE 22. Tariff and Subsidy Decomposition by Decile for Ecuador



Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis is USD. Each bar is divided into three segments representing the total regular bill (blue), targeted subsidy (green), and universal subsidy (light blue). The total height of each bar represents the total cost of electricity provision for each decile's consumption, while the blue bar height represents the total payment that households make out of pocket.

Source: Authors' own elaboration based on EEQ information and ENIGHUR 2012.

The light blue portion is the universal subsidy, which—measured against the regular tariff—stays roughly constant across deciles (about \$11), reflecting the below-cost pricing every household enjoys regardless of targeting. This near-constant level arises because the universal subsidy is dominated by the unrecovered *fixed* cost of provision: every household pays a fixed charge (\$1.4) far below the true fixed cost (\$11.2), so all receive about \$9.8 of fixed-cost subsidy regardless of how much they consume. On the variable side, the tariff is block pricing *with memory*, so the subsidy accrues on the initial blocks that every household consumes—where the per-kWh charge sits below cost—while the additional kWh consumed by higher-income households fall in the upper blocks, which are priced close to (and, in the top decile, above) the

marginal cost of provision. A household consuming 229 kWh therefore pays almost the full cost on each kWh beyond those a mid-consumption household uses, so its extra consumption adds nearly as much to its bill as to the provision cost; the variable gap thus stays small (about \$1) and flat, and together with the fixed-cost gap it makes up the \$11 that recurs across deciles. Out-of-pocket spending is therefore very low at the bottom and rises with income. On average the subsidy coverage is slightly higher in the Dominican Republic, whose cost-recovery is 41% versus 47% in Ecuador, but the two countries differ most in the total cost of service provision, which is higher in the Dominican Republic owing to its high variable cost, so out-of-pocket expenditure is much higher there.





URUGUAY (2016/2017)

Using household electricity expenditure data from the 2016/2017 National Household Income and Expenditure Survey (ENGIH), together with the regular tariff schemes described in [Section 3.2](#), we calculate the average electricity consumption in kWh for each income decile in Uruguay, as shown in Figure 23. The average electricity consumption for the first income decile is 196 kWh per month, while for the tenth

decile it rises to 313 kWh per month. This indicates a gradient in electricity consumption across income deciles: Consumption increases from the 1st to the 3rd decile, remains relatively stable between the 3rd and 7th deciles, and then rises considerably from the 8th to the 10th deciles. An increasing trend in consumption with income is also observed in countries such as the Dominican Republic and Ecuador. However, in

FIGURE 23. Monthly Consumption Level by Decile for Uruguay



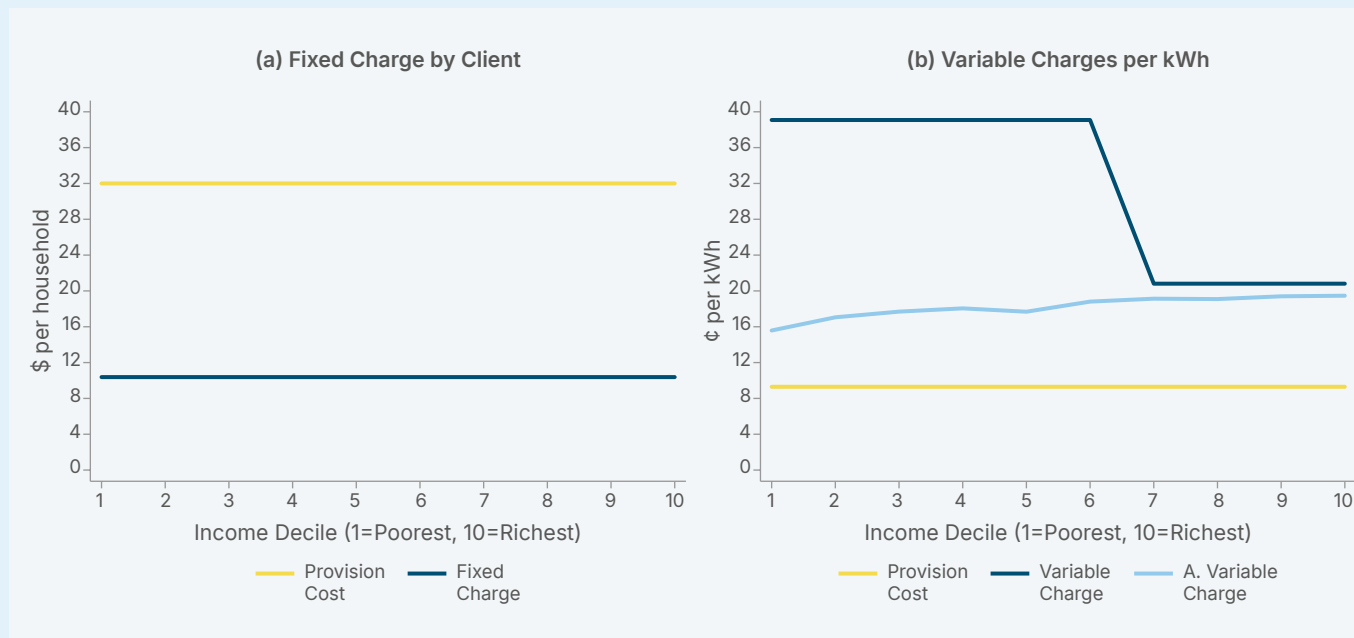
Note: The horizontal axis represents income deciles. The unit of measurement on the left vertical axis is kWh and on the right vertical axis is USD. The figure shows electricity consumption (blue bars, measured in kWh) and monthly expenditure (yellow line with dots, measured in USD) across income deciles. The percentages at the bottom of each bar represent the proportion of household income spent on electricity.
Source: Authors' own elaboration based on UTE information and ENGIH 2016.

Uruguay, the consumption of the highest income decile represents more of a continuation of the upward trend observed through the previous deciles, instead of being an outlier.

Figure 24 illustrates the tariff and subsidy structure expressed as a function of household income by decile in Uruguay. Panels (a) and (b) show fixed and variable charges, respectively. In both panels, blue lines represent the fixed and variable charges by income decile, while yellow lines represent the fixed and variable portions of the provision cost. In Panel (a), we observe that the provision cost (yellow line at approximately \$32) is consistently higher than the fixed charge (blue line at \$10.4) across all income deciles. This indicates that the fixed portion of the tariff does not fully recover the fixed provision costs for any income group. In Panel (b), we see that the variable provision cost (yellow line) is lower than the variable charge for all deciles.

Since the first five deciles are billed according to the social tariff described in [Section 3.2](#), as they consume 230 kWh or less monthly, the variable charge for them is \$39 per kWh while the average variable charge starts at \$16 for the first decile and stabilizes around \$20 per kWh. The tariff scheme is the regular one for households belonging to the 6th decile and above, in which case the variable charge is \$21 per kWh, while the average variable charge is lower (light blue line), which is explained by the fact that, for the first 100 kWh, households pay \$16 per kWh. The figure reveals a feature in the pricing structure that we do not see among the other three countries. The system fails to recover costs in the fixed component (Panel (a)) but overcharges in the variable component (Panel (b)), so the surplus from the variable charges helps offset the deficit from the fixed charges.

FIGURE 24. Fixed and Variable Charges by Income Decile in Uruguay



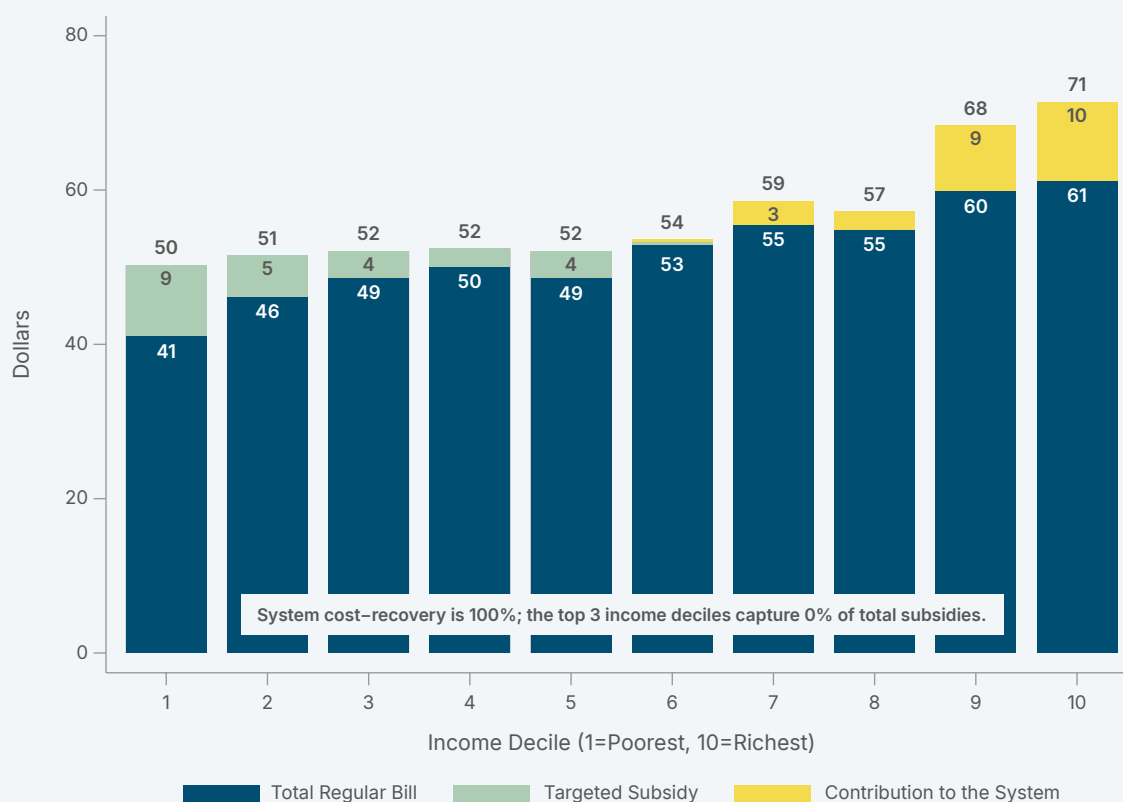
Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis in both panels is USD. Panel (a) shows the fixed charge (blue line) compared to the provision cost (yellow line) across income deciles. The provision cost remains constant at approximately \$32 per household, while the fixed charge consumers pay is lower for all income levels. Panel (b) displays the marginal charge (solid blue line) and average variable charge (light blue line) compared to the provision cost (yellow line) across income deciles.

Source: Authors' own elaboration based on UTE information and ENGIH 2016.

Using the tariff structure based on household income levels, we calculate the effective subsidy for the average household in each decile. Figure 25 shows the breakdown of tariffs and subsidies by decile. The total height of each bar represents the total cost of service provision for each consumption level, where the sum of the blue bar (total regular bill) and the yellow bar (contribution to the system) represents what households actually pay out-of-pocket while the light blue and green portions represent different subsidy components. The universal subsidy is equivalent to the subsidy that the household would have received if there

were no social tariff. This subsidy is activated basically by the fact that the variable charge is increasing with consumption, so if a household consumes less, it simply pays less per kWh consumed. The targeted subsidy is the one that exists due to the fact that there is a social tariff. In both cases, the subsidy comes from the system's contribution to cover the fixed cost of service provision that is not covered by the variable charge since, for all consumption levels, the variable charge is higher than the variable cost of service provision.

FIGURE 25. Tariff and Subsidy Decomposition by Decile for Uruguay



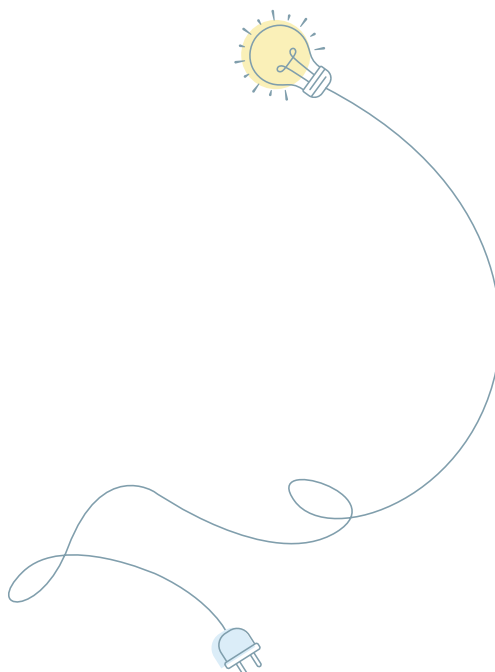
Note: The horizontal axis represents income deciles, and the unit of measurement on the left vertical axis is USD. Each bar is divided into four segments representing the total regular bill (blue), targeted subsidy (green), universal subsidy (light blue), and contribution to the system (yellow). The total height of each bar represents the total cost of electricity provision for each decile's consumption, while the blue bar height represents the total payment that households make out of pocket.

Source: Authors' own elaboration based on UTE information and ENGIH 2016.

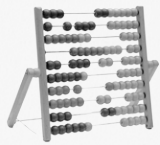
4.3. The Three Principles under the Harmonized Framework

Above, we presented the tariff and subsidy structures for four metropolitan areas in four LAC countries, analyzed by income decile. Unlike in [Section 3](#), where we could draw only limited conclusions about how these arrangements align with the three fundamental principles for electricity rates and subsidy design,

here, we were able to go further. We assessed how each country's system performs regarding cost-recovery, cost-reflectivity, and affordability objectives. This deeper analysis was possible because we incorporated consumption and income data alongside tariff structures and service provision costs. Additionally, all the tariff structures were presented within a unified analytical framework. This approach enhances comprehension, enables meaningful cross-country comparisons, and facilitates the simulation of alternative structures in a straightforward manner—a task we pursue in the next section.



5.



Evaluating Alternative Tariff and



Subsidy Schemes

[← Back to Contents](#)

5. Evaluating Alternative Tariff and Subsidy Schemes

Electricity pricing is a complex challenge balancing multiple objectives: cost recovery, cost reflectivity, and affordability. In this section, we analyze five alternative regimes that represent a spectrum of approaches to managing fixed costs, variable charges, and subsidies. These scenarios are instrumental for highlighting the trade-offs among the three competing principles. We start by presenting the five alternative tariff and subsidy schemes; then, we explain how we calculate the effects of changes in tariff and subsidy schemes on consumption and expenditure. Next, we describe the results of each scenario for the respective countries under study, and finally, we summarize the general findings that emerge from our analysis.

5.1. Alternative Tariff and Subsidy Schemes

The five alternative pricing schemes are described in [Table 5](#), and their corresponding fixed and variable charges are summarized in [Table 6](#). Cases 1 to 3 implement different cost-recovery approaches, varying in how fixed costs are allocated among households, while cases 4 to 5 aim to incorporate explicit subsidy mechanisms through two-tier pricing structures.

Case 1, which we call the *pure volumetric* tariff scenario (equivalent to average-cost pricing), is a

cost-recovery tariff scheme with no fixed charge, where all fixed costs are allocated based on household consumption. For example, if the total fixed cost of electricity provision is F , the variable cost is C per kWh, and total consumption equals Q , the pure volumetric charge is $p^1 = F/Q + C$. The logic behind a pure volumetric tariff scheme is twofold: equity and fairness. The equity argument is that fixed costs should be allocated to those who consume the most, presuming higher consumption correlates with higher income, thus redistributing expenses away from lower-income households. In terms of fairness, consumers who use the network more should pay proportionally more. The problem with pure volumetric tariff schemes is that the marginal charge for the last consumed unit ($p^1 = F/Q + C$) exceeds the variable cost of providing it (C), making the tariff cost-reflective only on average but distorting consumption decisions at the margin.

Case 2, a two-part reflective tariff scenario, is a tariff scheme that reflects the cost structure of service provision. It has a fixed charge equal to a fixed cost per household and a variable charge equal to the variable cost. If there are n households, the fixed charge equals F/n , and the variable and average variable charge is equal to C . Case 2 does not consider the tariff system's outcomes but simply ensures that the established charges recover costs and reflect their nature, whether fixed or variable. Case 3 seeks to incorporate some equity consideration in the distribution of fixed cost. Therefore, they are allocated proportionally based on each household's income relative to the aggregate

income across all households. Thus, assuming that the income of household $i \in 1, \dots, n$ is given by y_i , the fixed charge will be given by $F \cdot y_i / \sum_{j=1}^n y_j$. In both cases, the variable and the average variable charge per kWh, denoted as p^2 and p^3 , respectively, is C . Case 2 represents a fully cost-recovering system without cross-subsidies, while Case 3 adheres to the cost recovery principle but incorporates cross-subsidies where higher-income households bear a greater portion of the fixed costs. However, in both systems, the variable component of the tariff structure remains cost-reflective.²⁸

Cases 4 and 5, which we call the *IBP* and *Targeted IBP* tariff schemes, introduce IBP tariffs in consumption. Theoretically, the most efficient approach is to subsidize the fixed cost of service provision or even give households an unconditional cash transfer (to

compensate their electricity expenses) while charging them the marginal cost of electricity provision C as economic theory indicates that charging less than the cost of producing a good distorts the economy. However, our aim is not merely to limit the share of income households devote to electricity but to ensure they can consume the electricity necessary for their development. We therefore define an essential block of $\bar{q} = 100$ kWh per month and set an affordability threshold of 2.5% of household income for the bill on that block. Both the size of the block and the threshold are arbitrary: nothing in the framework depends on them, and other values could be used. What matters is the mechanism they illustrate—that the variable charge on an essential block can be lowered to protect basic consumption—rather than the particular level at which the block is set or priced. Also, the 10% benchmark from Section 2 refers to *total* household energy and is

TABLE 5. Five Alternative Tariff and Subsidy Schemes

Cases	Description	Tariff Scheme	Fiscal Subsidy
Case 1	No fixed charge; total fixed costs are recovered through a volumetric mark-up over the variable cost, equal to total fixed cost divided by total consumption.	Pure volumetric	No
Case 2	Fixed charge equal to fixed cost per household, and variable charge equal to variable cost.	Two-part cost-reflective	No
Case 3	Fixed charge equal to total fixed cost prorated according to household income with variable charge equal to variable cost.	Two-part income-based fixed charge	No
Case 4	Fixed charge equal to total fixed cost prorated according to household income with memory IBP in the variable charge.	IBP	Yes
Case 5	Fixed charge equal to total fixed cost prorated according to household income, with targeted memory IBP in the variable charge.	Targeted IBP	Yes

Note: IBP = increasing block pricing.

Source: Authors' own elaboration.

²⁸ We have treated an equal fixed charge per household as the no-cross-subsidy benchmark, implicitly assuming that the fixed cost attributable to each household within a metropolitan area is the same. That assumption is itself debatable: the infrastructure required to serve a household depends on the instant capacity it could demand, and that capacity varies with the level of consumption, or at least with its peaks. On that criterion, a fixed charge differentiated by required capacity would track cost causality more closely than a uniform one, but we do not pursue that variant here.

drawn largely from evidence on developed economies; for developing ones a lower figure is more appropriate (Estache et al., 2018), and lower still once electricity alone is considered, since it accounts for only part of household energy spending, which is why we set the threshold well below that benchmark. Our social policy does *not* cap electricity at 2.5% of *total* consumption: it applies only to the essential block, which we calibrate so that a first-decile household spends no more than 2.5% of its income on that block, without ever pricing it above the variable cost C .²⁹ Consumption beyond q is charged at C .

Because the essential block is priced below the marginal cost C , Cases 4 and 5 generate a revenue shortfall. We assume this shortfall is met by an explicit fiscal subsidy, not by raising the fixed or variable charges of other users. Consequently, unlike Cases 1–3, these two schemes do not achieve full cost recovery, and the remaining gap is exactly the fiscal cost of the policy. In both scenarios (Cases 4 and 5), the fixed cost is distributed according to household income, as in Case 3. The difference between the two cases is that, in Case 4, the IBP is applied to all households while, in Case 5, it is applied only to a group of households that are beneficiaries of social policies, which we call B , with $B \subseteq 1, \dots, n$.³⁰

[Table 6](#) summarizes the fixed charge, the variable charge, and the resulting average variable charge under each of the five cases. The average variable charge is exogenous only in Cases 2 and 3, where it equals C for every household. In Cases 1, 4 and 5 it depends on how much the household consumes—on total consumption in Case 1, and on where consumption falls relative to the essential block $\bar{q}$ in Cases 4 and 5—so the charges reported for those cases are outcomes of the simulation rather than parameters set *ex ante*. The aggregate fixed cost also differs across scenarios, which is why the fixed charges in the table carry a scenario superscript F^i : in the simulations the total fixed cost is scaled to each scenario's consumption, $F^i = (F/Q) Q^i$, so that the fixed cost per kWh is held at its baseline value. This is not an innocuous normalization, but neither is it arbitrary. Keeping F constant would treat the size and cost of the network as independent of the level of consumption it has to serve, so that average cost would rise mechanically whenever a tariff reduces consumption. Holding F/Q constant instead reflects how capacity adjusts in practice: a tariff that lowers consumption does not call for existing assets to be retired, but for the expansion that would otherwise be required—as incomes rise and as end uses are electrified—to be deferred, and in the interim allows the same installed capacity to serve existing demand at higher quality.

29. Formally, taking first-decile income Y^1 and the (income-prorated) fixed charge F^1 it pays under the reformed scheme, we set the subsidized variable price to $c = \min(\frac{0.025Y^1 - F^1}{100}, C)$, so the total bill on the first 100 kWh (fixed plus variable) equals 2.5% of income. Where the affordability-implied price exceeds C (as in Uruguay), no subsidy is needed and $c = C$.

30. Case 5 assumes the existence of a targeting mechanism capable of identifying the beneficiary set B . Such a mechanism is not available in every setting, and where it exists it typically carries non-trivial inclusion and exclusion errors. Here we simply posit some form of income-based targeting; the purpose is to illustrate the effect of restricting the subsidy to lower-income households, not to model any particular targeting instrument. In the simulations the share of each decile that belongs to B declines with income—the entire first decile, then 90%, 80% and so on in ten-percentage-point steps down to 40% of the seventh decile, with none of the top three—so that the subsidized first-block price applies to that share of each decile and the marginal cost C to the rest.

TABLE 6. Fixed and Variable Charges Across the Five Cases

Case	Fixed charge	Variable charge	Average variable charge
Case 1	0	$\frac{F^1}{Q^1} + C$	$\frac{F^1}{Q^1} + C$
Case 2	$\frac{F^2}{n}$	C	C
Case 3	$F^3 \frac{y_i}{\sum_j y_j}$	C	C
Case 4	$F^4 \frac{y_i}{\sum_j y_j}$	$\begin{cases} c & q_i \leq \bar{q} \\ C & q_i > \bar{q} \end{cases}$	$\frac{c \min(q_i, \bar{q}) + C \max(0, q_i - \bar{q})}{q_i}$
Case 5	$F^5 \frac{y_i}{\sum_j y_j}$	$\begin{cases} c & q_i \leq \bar{q} \text{ and } i \in B \\ C & \text{otherwise} \end{cases}$	$\begin{cases} \frac{c \min(q_i, \bar{q}) + C \max(0, q_i - \bar{q})}{q_i} & i \in B \\ C & i \notin B \end{cases}$

Note: F^j is the total fixed cost of service provision in scenario j , with $F^j = (F/Q) Q^j$, where F and Q are baseline fixed cost and consumption and Q^j is total consumption in scenario j ; hence $F^j/Q^j = F/Q$ for all j . C is the marginal cost per kWh, n the number of households, y_i and q_i the income and consumption of household i , $\bar{q}$ the essential consumption block, $c < C$ the subsidized price on that block, and B the set of targeted beneficiaries.

Source: Authors' own elaboration.

5.2. Effects on Consumption and Expenditure

Our first step consists of calculating the effect of the alternative tariff schemes on consumption. We assume that consumers respond to the average variable charge for electricity consumption and that regardless of the fixed charge amount, households do not disconnect from the grid. To measure the effect on consumption, we start from an equilibrium situation, where the average household electricity consumption in the baseline scenario, q^b , for a given average variable charge, p^b —and given the values

of the closest substitute, which we consider to be gas (p_g), and income, I —is given by the following expression:

$$q^b = D(p^b, p_g, I)$$

where $D(\cdot)$ is the demand function for electricity.

For each of the five cases, we analyze what would happen if there were a change in the average variable charge.³¹ To do this, we differentiate q^b with respect to p^b . Then, we accommodate terms to get to the following expression for the change in quantity:³²

$$\frac{\partial q^b}{\partial p^b} = \eta \cdot \frac{p^j - p^b}{p^b}$$

31. The discussion in the literature on whether households respond to the variable or to the average price (including the fixed cost in their consumption behavior) is still ongoing. For the purpose of this work, we assume that households react to the average variable charge, but the analysis can be done on the basics of either assumption. It is not the objective of this work to determine whether households respond to the marginal or average price, which may also vary with the context.

32. $\frac{\partial q}{\partial p^b} = \frac{\partial D}{\partial p^b} = \frac{\partial D}{\partial p^b} \frac{p^j}{q} \frac{q}{p^b} = \eta \cdot \frac{q}{p^b} \Rightarrow \frac{\partial q}{\partial p^b} = \eta \cdot \frac{\partial p^b}{\partial p^b} = \eta \cdot \frac{p^j - p^b}{p^b}$

where p^j could be the average variable charge in any of the alternative scenarios and η is the electricity price elasticity. From the expression, we obtain that the higher is the elasticity in absolute value, the more households react to price changes, and thus the higher is the change in q^b . In addition, the higher the change in the percentage change in the average variable charge, the higher the relative change in quantities. Understanding the effect of these two variables is essential for designing any tariff and subsidy structure. Finally, we obtain the new quantity of electricity consumed for the five different pricing schemes, which is equal to the original amount plus the change in it:

$$q^j = q^b \cdot \left(1 + \eta \cdot \frac{p^j - p^b}{p^b}\right)$$

where q^j and p^j is the consumption and the average variable charge for $j \in (1, 2, 3, 4, 5)$ of the alternative scenarios. Then, given the new quantities, we can directly calculate the expenditure for each alternative case.

5.3. Results by Country

In this section, we present the main results for each country across the five alternative scenarios. Through a series of figures, we provide a comprehensive analysis of how different electricity tariff and subsidy structures affect consumers across the income spectrum and the system's cost recovery and overall efficiency. For the analysis, we consider an elasticity to the average variable charge of 0.15 (in absolute value).³³ As a reference point, the baseline tariff and subsidy scheme recovers 35% of total provision cost in Argentina, 41% in the Dominican Republic, 47% in Ecuador, and 100% in Uruguay. This is why, except in Uruguay, the reformed schemes (Cases 1–5) generally require higher fixed and variable charges than the baseline.



33. We assume a constant own-price elasticity of 0.15 (in absolute value) and no response to the fixed charge (households do not disconnect). This value is consistent with—and conservative relative to—the available evidence on residential electricity price elasticity for the medium term (Blázquez et al. 2013; Alberini et al. 2011; Labandeira et al. 2017; Zabaloy and Viego 2022). Robust household-level estimates for the region remain scarce—a gap we highlight among our concluding priorities—and the true elasticity likely varies with income and with access to substitutes.



ARGENTINA (2017/2018)

[Figure 26](#) illustrates how fixed and average variable electricity charges vary between income deciles in Argentina under the different pricing regimes and their effects on consumption. Panel (a) shows the fixed charges. For Case 1 (light green squares with dotted line), the charge ranges between roughly \$11.5 and \$14.5 across income deciles, without a clear gradient in income: a household in the 10th decile pays approximately \$12 per month, compared with \$12.5 in the 1st decile. Prorating fixed costs by consumption produces a charge with no rising income gradient—if anything a marginally declining one—because consumption in Argentina does not increase with income: in the base case it falls with income (though not monotonically), while under Case 1 it is essentially flat across deciles. Importantly, Case 1 does not actually apply a fixed charge (it is \$0), which is why we use a dotted line instead of a solid one to emphasize that this charge is not fixed in practice, as the fixed costs are distributed among households through the pure volumetric structure. In Case 2 (light blue diamonds with solid line), the charge remains constant at \$16.5 per household across all income deciles, reflecting a uniform approach in which all households bear identical fixed costs regardless of their consumption. This is below the \$19.5 of the baseline reported earlier because, as explained above, the total fixed cost is scaled to each scenario's consumption: the cost-reflective variable charge in Case 2 reduces consumption relative to the baseline, and with the fixed cost per kWh held constant, a lower Q^2 implies a lower total fixed cost to be shared across households. In contrast, Case 3 (green triangles with solid line) displays a steep progressive curve where the charges are distributed based on income, with households in the wealthiest (10th) decile paying approximately \$45 monthly while the poorest households (1st decile) pay approximately \$4. Cases 4 and 5 follow the same income-based

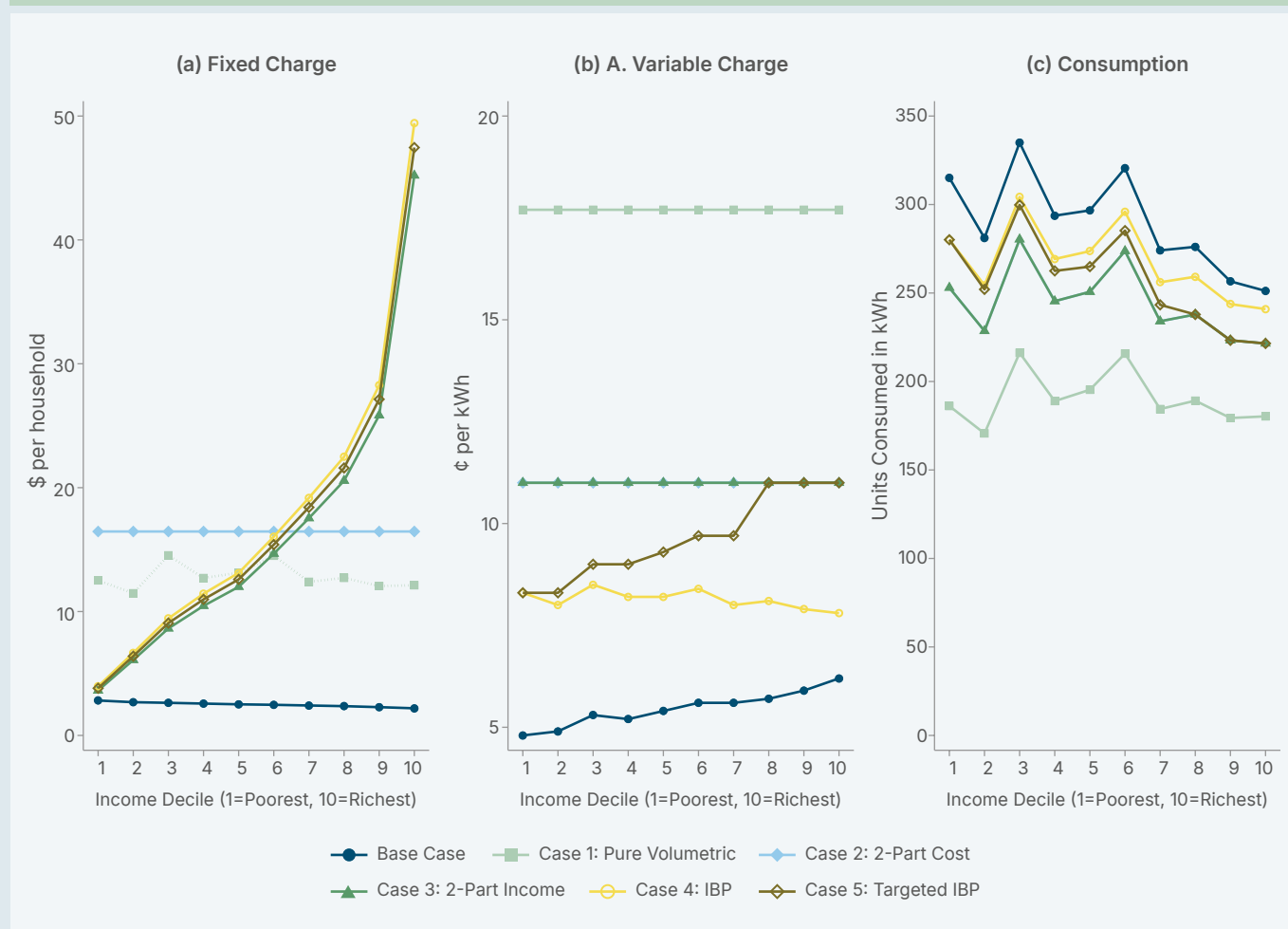
distribution rule as Case 3, so their lines have the same shape; they lie slightly above Case 3 because the essential-block subsidy sustains higher consumption and therefore a larger total fixed cost to prorate.

Panel (b) of [Figure 26](#) depicts, for all the cases, the average variable charges (p_j^v for $j \in (B, 1, 2, 3, 4, 5)$) across income deciles. Case 1 (light green squares) shows a constant rate across all income deciles (about ¢17.7 per kWh) at a significantly higher level than the actual variable cost of electricity provision, which is ¢11 per kWh. This happens because the fixed charge is incorporated into the variable rate, meaning each consumed unit covers the fixed costs. Cases 2 and 3 (light blue diamonds and green triangles) maintain a constant charge of ¢11 per kWh, reflecting the actual variable cost of electricity provision. Case 5 (brown diamonds) displays an upward-sloping average variable charge curve across income deciles, whereas Case 4 (yellow circles) stays roughly flat at about ¢8 per kWh. Under Case 4, the first 100 kWh are sold at a subsidized rate below cost, so a household's average rate depends on how large a share of its consumption falls within that subsidized block; because consumption in Argentina barely varies with income, that share—and hence the average rate—is similar across deciles. The slope in Case 5 is more pronounced because the subsidized rate on the first 100 kWh is subject to income-based eligibility criteria: as household income rises, a smaller proportion of households qualify for the subsidized rate, creating a steeper progression across income deciles. Finally, notice that Cases 2 and 3 have charges exogenous to household behavior while Cases 1, 4, and 5 introduce a degree of endogeneity because the final average variable charge depends on consumption levels in these three cases. Therefore, the values displayed for these latter cases should not be interpreted as fixed, predetermined amounts.

Panel (c) of Figure 26 shows the monthly electricity consumption in kWh across income deciles for the six pricing and subsidy schemes. As we already saw in [Figure 14](#), the Base Case (blue line with circles) shows consistently high consumption that declines with income, from around 315 kWh for the poorest decile to around 250 kWh for the wealthiest—a pattern that differs from the typical increasing consumption trend of most countries in the region. In contrast, we observe a significant decrease in consumption across all of the alternative pricing schemes, which is explained mainly by the fact that the average variable charge in Argentina in the Base Case is considerably low compared to the average variable charges in the alternative cases. Therefore, any effort to align prices

closer to the actual variable cost of service provision results in substantial consumption changes, since the proportional increase from the base scenario average variable charge ($(p^j - p^b)/p^b$ for $j \in (1, 2, 3, 4, 5)$) is considerable. Case 1 (Pure Volumetric, light green squares) shows the lowest overall consumption levels, roughly 170–215 kWh across deciles, with no monotonic variation by income. This is perfectly logical since households respond to the average variable charge and Case 1 has the highest average variable charge. Meanwhile, Case 4 shows the highest consumption levels, which is understandable because, under this scenario, there is a universal subsidy for the first 100 kWh consumed, resulting in a lower average variable charge.

FIGURE 26. Charges and Consumption by Income Decile in Argentina



Note: The figure illustrates how fixed and average variable electricity charges vary across income deciles in Argentina under the different pricing regimes and their effects on consumption. Panel (a) shows the fixed charge per household by income decile, Panel (b) the cents paid per kWh by each income decile, and Panel (c) the total consumption by decile for each tariff and subsidy scheme. The change in consumption is higher for lower income deciles than for higher income deciles because the change in the average variable charge for lower income deciles is higher.

Source: Authors' own elaboration based on the five simulated scenarios.

Finally, Figure 27 presents the results of the different price schemes for expenditures. Panel (a) shows total spending on electricity across income deciles for the different pricing scenarios. The Base Case (blue circles) shows the lowest overall expenditure, around \$16–20 across deciles, with little variation by income. Cases 1–5 all result in significantly higher expenditures across all income groups than the Base Case. Case 5 (Targeted IBP, brown diamonds) and Case 3 (Two-Part Income-Based, green triangles) show the highest expenditures for the wealthiest households, who spend nearly \$70. Case 2 (Two-Part Cost-Reflective, light blue diamonds) shows the highest expenditure for the poorest households, which reflects its regressive nature. The right panel displays electricity expenditure as a percentage of income across deciles. All the cases show a declining percentage as income increases, reflecting that electricity is a basic need whose consumption rises less than proportionally with

income, so that lower-income households devote a larger share of their budget to it. The Base Case (blue circles) shows the lowest percentage of income spent on electricity across all deciles. Case 2 (light blue diamonds) imposes the highest burden on the poorest households at approximately 14% of income, while all the alternatives converge to similar percentages for the wealthiest households, suggesting that moving toward a more progressive tariff and subsidy scheme does not create affordability problems for higher-income households, especially those in the 10th decile. The cost recovery box in the right panel indicates the cost recovery percentage of the system. The Base Case has a cost recovery level of 35% (i.e. a fiscal cost of 65%), while Cases 1, 2, and 3 have a 100% cost recovery level, indicating full cost recovery. Cases 4 and 5 have moderate fiscal costs of 16.1% and 8.2% respectively, which is expected because of the explicit subsidies in these cases.

FIGURE 27. Expenditure Across Income Deciles in Argentina



Note: The figures show how expenditures vary across income deciles under different pricing schemes in Argentina. Panel (a) shows monthly spending on electricity across income deciles, while Panel (b) shows monthly spending as a percentage of monthly income.
Source: Authors' own elaboration based on the five simulated scenarios.



DOMINICAN REPUBLIC (2018)

[Figure 28](#) depicts the distribution of electricity charges across income segments in the Dominican Republic under various pricing structures. Panel (a) reveals that Case 1 (light green squares with dotted line) demonstrates a more moderate income-based progression, where charges increase from approximately \$7 for the poorest households to \$20 for the wealthiest. This approach effectively redistributes the fixed costs toward higher-income consumers by adjusting the charges according to consumption patterns. Note that this line has a steeper slope than the one observed for Argentina because the highest decile consumes notably more than the lowest decile in the Dominican Republic compared to Argentina. Case 2 (light blue diamonds) shows a flat fixed charge of \$11 for all households regardless of economic status. In contrast, Case 3 (green triangles), Case 4 (yellow circles) and Case 5 (brown diamonds) implement a more progressive pricing scheme for the fixed charge that scales with household income—the most affluent segment (10th decile) bears charges of approximately \$43 monthly under Case 3, while the lowest-income households (1st decile) pay a fixed charge of \$2. Cases 4 and 5 lie slightly above Case 3 for the same reason as in Argentina—their essential-block subsidy sustains higher consumption and hence a larger total fixed cost to prorate—reaching about \$52 and \$48, respectively, at the top decile.

Panel (b) reveals that Cases 2 and 3 maintain constant variable charges of ¢18 per kWh, while Case 1 has a higher but flat rate of approximately ¢25 per kWh. This is because for each unit consumed, households are paying a portion of the fixed costs. Cases 4 and 5 show increasing variable charges as income rises, with Case 5 displaying a particularly steep curve, which is expected given that, on average, the higher the income decile, the lower is the subsidy level. In fact, deciles 8, 9, and 10 receive no subsidies at all.

In addition, the average variable charges start from a much lower point than we observe in the Base Case because our proposed social policy considers establishing an average variable charge equivalent to the one that ensures a household consuming 100 kWh spends no more than 2.5% of its income on electricity. As the cost of providing electricity in the Dominican Republic is very high, our social policy for lower-income households implies a significant decrease in the average variable charge they pay. Another reason why Cases 4 and 5 show steeper slopes than those observed for Argentina is that low-income households in the Dominican Republic consume much less than their counterparts in Argentina. Therefore, at the poorest deciles the subsidized first block keeps their average variable charge low, so their consumption tracks the Base Case rather than falling sharply as it does under the cost-recovery Cases 1–3, as shown in Panel (c).

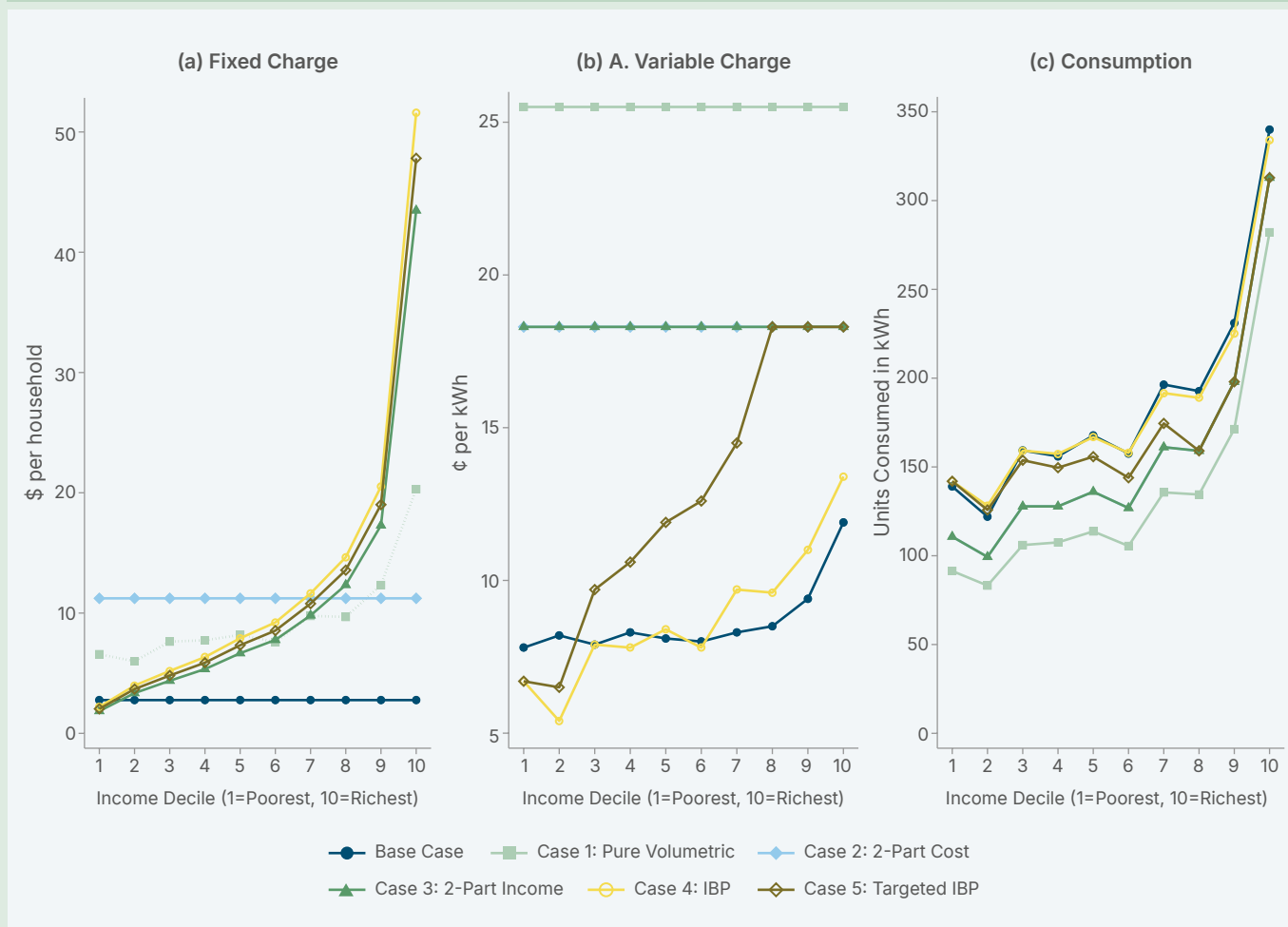
As shown in [Figure 17](#), consumption patterns in the Dominican Republic (Panel (c)) show a much clearer positive correlation between income and electricity usage than do those in Argentina in the Base Case. In addition, all the pricing cases demonstrate a pronounced increase in consumption as household income rises, with a dramatic spike for the wealthiest (10th) decile. Case 4 (IBP) shows the highest overall consumption levels for all income levels, reaching approximately 335 kWh for the wealthiest households. Case 1 (Pure Volumetric, or average cost) consistently shows the lowest consumption across all income groups, starting at approximately 90 kWh for the poorest households and rising to around 280 kWh for the richest. Cases 2, 3, and 5 have consumption patterns between those of Cases 1 and 4, with Case 5 tracking higher than Cases 2 and 3, particularly for lower income deciles, because the variable charge is subsidized for lower-income households.

The expenditure patterns show a more monotonic relationship between expenditure and income deciles in the Dominican Republic than in Argentina, which is expected given the consumption patterns observed across the scenarios. Panel (a) shows that Cases 4 and 5 result in the lightest financial burden for households in the lower income deciles, particularly the first two deciles, in contrast to Argentina, where the Base Case imposes the lightest burden across all deciles. This pattern emerges because our proposed targeted subsidy program significantly benefits lower-income households in the Dominican Republic. Since electricity consumption among lower income deciles

in the Dominican Republic is approximately 130 kWh, a social policy that heavily subsidizes the first 100 kWh substantially reduces their average variable charge and, with it, their monthly electricity expenditure.

Moreover, for the Dominican Republic, the Base Case (blue circles) has the lowest total expenditure for deciles 5–10, but all the alternative cases converge to substantially higher spending for the wealthiest households, demonstrating that all the alternative scenarios are more progressive than the Base Case. Cases 5 and 3 result in the highest expenditure for the 10th decile, whose spending reaches approximately

FIGURE 28. Charges and Consumption by Income Decile in the Dominican Republic



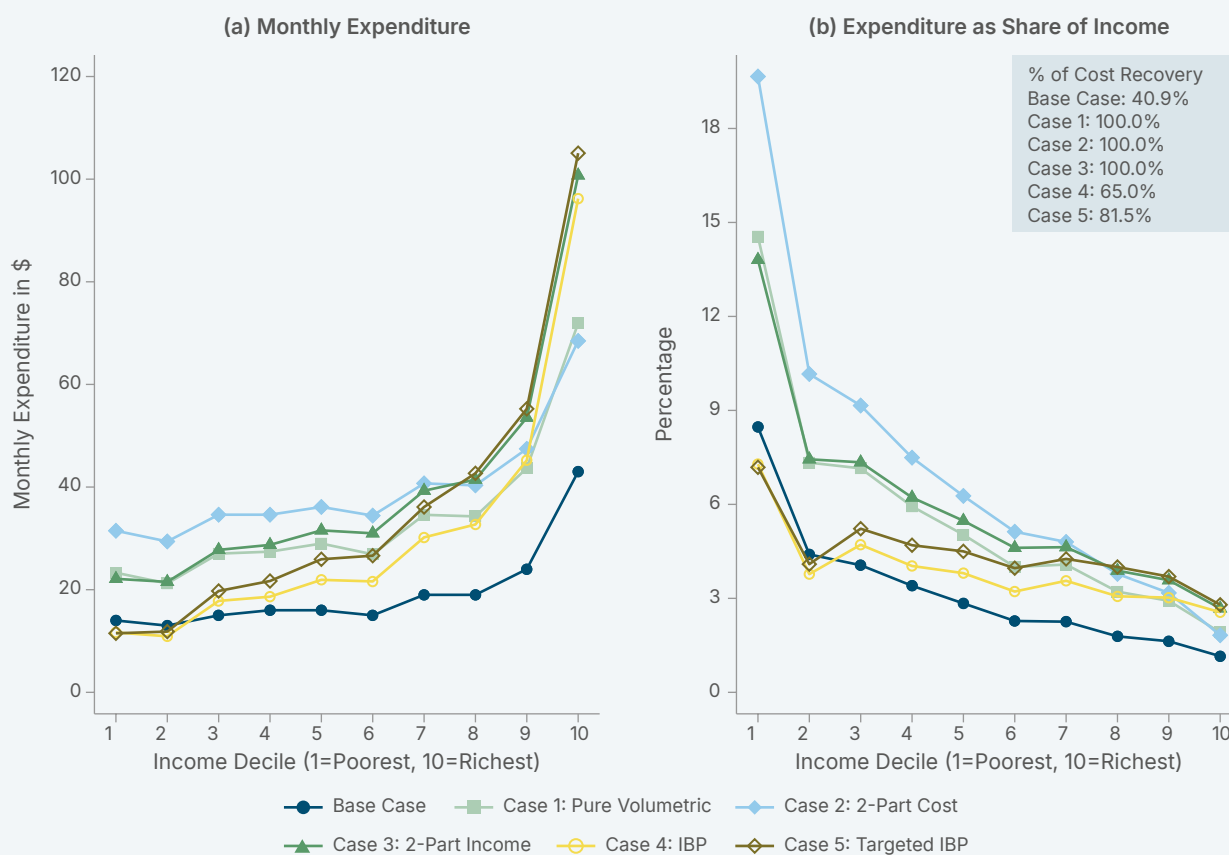
Note: The figure illustrates how fixed and average variable electricity charges vary across income deciles in the Dominican Republic under the different pricing regimes and their effects on consumption. Panel (a) shows the fixed charge per household by income decile, Panel (b) the cents paid per kWh by income decile, and Panel (c) the total consumption by decile for each tariff and subsidy scheme. The change in consumption is higher for lower income deciles than for higher income deciles because the change in the average variable charge for lower income deciles is higher.

Source: Authors' own elaboration based on the five simulated scenarios.

\$105, while Case 2 shows relatively higher expenditure for poorer households. The right panel demonstrates that electricity absorbs a much larger share of income among the poorest households, as expected for a necessity good whose consumption rises less than proportionally with income. Case 2 (light blue diamonds) places the heaviest burden on the poorest households at nearly 20% of income. However, with

the proposed social policy, low-income households can reduce this burden to 7% of their income—still high but a substantial improvement. The cost-recovery box indicates the Base Case requires a 59% subsidy and Cases 1–3 achieve full cost recovery (0%), while Cases 4 and 5 require subsidies of 35.0% and 18.5%, respectively.

FIGURE 29. Expenditure Across Income Deciles in the Dominican Republic



Note: The figures show how expenditures vary across income deciles under different pricing schemes in the Dominican Republic. Panel (a) shows monthly spending on electricity across income deciles, while Panel (b) shows monthly spending as a percentage of monthly income. **Source:** Authors' own elaboration based on the five simulated scenarios.



ECUADOR (2012/2013)

In Ecuador, the fixed and variable electricity charges exhibit distinctive patterns across income deciles. Panel (a) of [Figure 30](#) shows that Case 1 (light green squares with dotted line) displays a gradual increase from approximately \$2 for the 1st decile to about \$15 for the 10th decile, illustrating how the fixed costs are effectively distributed when prorated by consumption. Case 2 (light blue diamonds) has a uniform fixed charge of \$11 per household for all income levels. Cases 3, 4, and 5 follow nearly identical, strongly progressive trajectories, with the fixed charges distributed according to household income. Under these cases, the wealthiest households (10th decile) pay almost \$35 monthly, while the poorest households (1st decile) contribute approximately \$3. Panel (b) shows that Cases 2 and 3 maintain constant variable charges of ¢8 per kWh while Case 1 has a consistently higher rate of ¢16 per kWh across all deciles. Cases 4 and 5 show variable charges that increase with income, with Case 5 demonstrating a particularly sharp increase between deciles 1 and 7, reflecting the decreasing subsidy levels, on average, as household income rises.

Panel (c) of [Figure 30](#) demonstrates a clear positive relationship between income and electricity usage in Ecuador. All the pricing scenarios show consumption levels that steadily increase as household income rises, with a pronounced surge for the wealthiest (10th) decile. The Base Case (blue circles) and Case 4 (IBP, yellow circles) show the highest consumption levels and track each other closely: the base is highest at the two poorest deciles, while from the third decile onward Case 4 edges marginally above it, with Case 5 (Targeted IBP) just below. Case 1 (Pure Volumetric, light green squares) consistently exhibits the lowest consumption across all deciles, starting around 30 kWh for the poorest households and reaching about 190 kWh for the wealthiest. Its fall is steepest at the

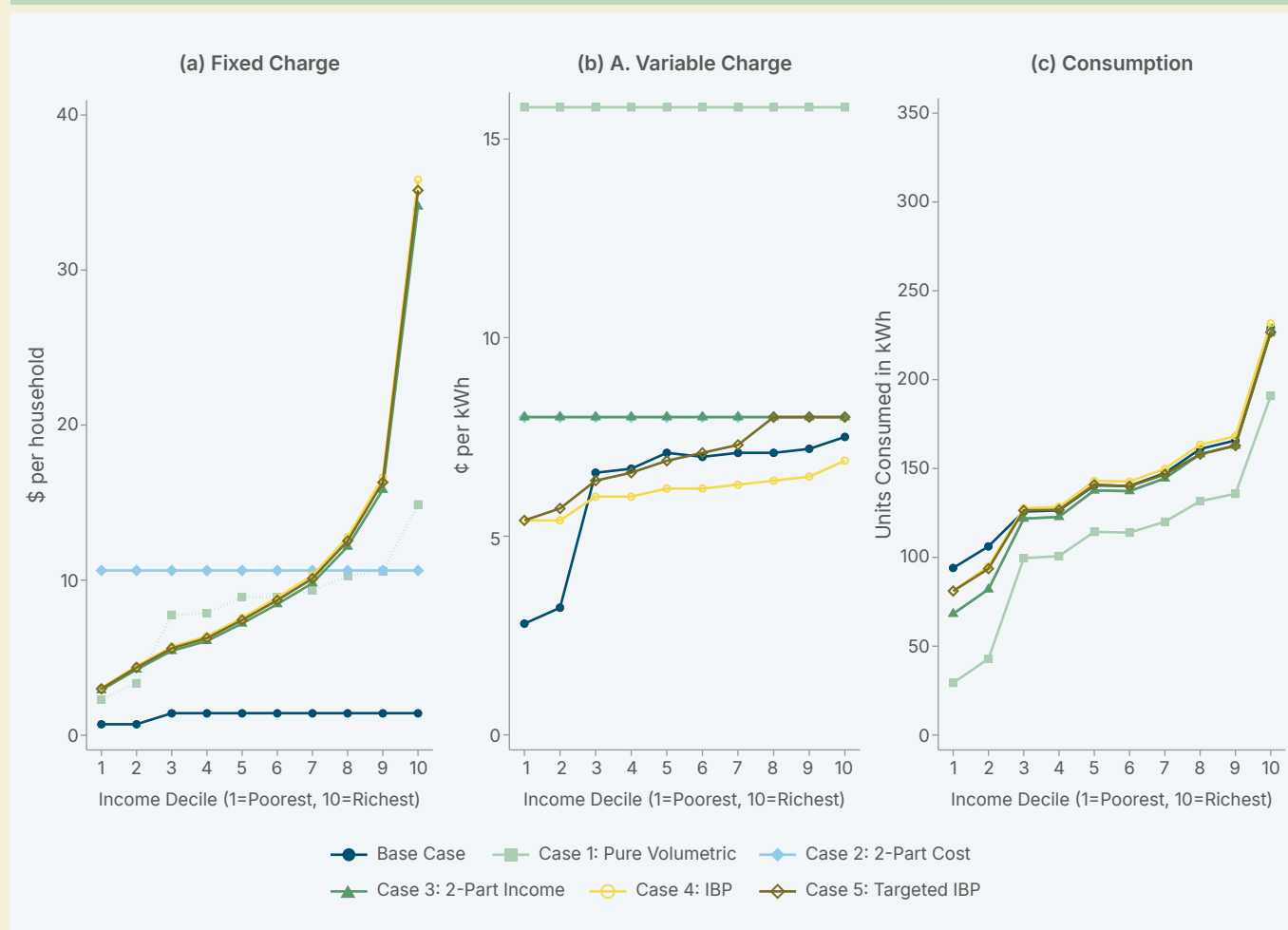
bottom of the distribution: the poorest deciles start from a heavily subsidized average charge (near ¢3 per kWh, against ¢16 under Case 1), so they face by far the largest proportional price increase and cut consumption the most. For higher-income households all schemes except Case 1 converge to similar consumption levels—their average variable charges are all close to marginal cost—whereas Case 1, at roughly twice that rate, remains distinctly lower.

Ecuador's expenditure patterns reflect significant variations across the pricing schemes. As shown in the left panel of [Figure 31](#), the Base Case (blue circles) results in the lowest total expenditure for all income deciles, beginning at approximately \$3 for the poorest households and rising to about \$19 for the wealthiest. Cases 3 and 5 generate the highest monthly expenditures for households in the 10th decile, at approximately \$53. Case 2 imposes relatively higher expenditures on lower-income households than the other alternatives. The right panel shows that the poorest households devote the largest share of income to electricity under the cost-recovery cases (Cases 2–5), as expected for a necessity good, though less pronounced than in the other countries, in large part because the provision costs observed and used for Ecuador are lower than elsewhere. Under the Base Case and Case 1, however, that share peaks around the third decile rather than the first—in the Base Case because Ecuador's heavily subsidized tariff makes electricity very cheap for the poorest, and under Case 1 because those households cut their consumption so sharply that their spending stays low despite the high volumetric rate. This last point also carries a methodological lesson: the steep consumption drop attributed to the poorest under Case 1 follows mechanically from applying a single, constant price elasticity to the group whose baseline price is by far the lowest, so that the same elasticity yields the largest

proportional response—whether the poorest would truly curtail an already-minimal consumption to that extent is uncertain. It thus points to a limitation of the method (the absence of decile-specific elasticities), to the value of a disaggregated, decile-by-decile analysis that makes such heterogeneous responses visible rather than burying them in an aggregate, and, where consumption would otherwise contract so sharply, to the importance of a social policy that helps sustain an

adequate level of consumption rather than pursuing cost-reflectivity alone. Case 2 places the greatest burden on the poorest households at approximately 5% of income. The cost recovery box indicates the Base Case requires a 53% subsidy, Cases 1–3 achieve full cost recovery (0%), and Cases 4 and 5 require moderate subsidies of 11.1% and 5.5%, respectively, demonstrating varied approaches to balancing affordability with financial sustainability.

FIGURE 30. Charges and Consumption by Income Decile in Ecuador



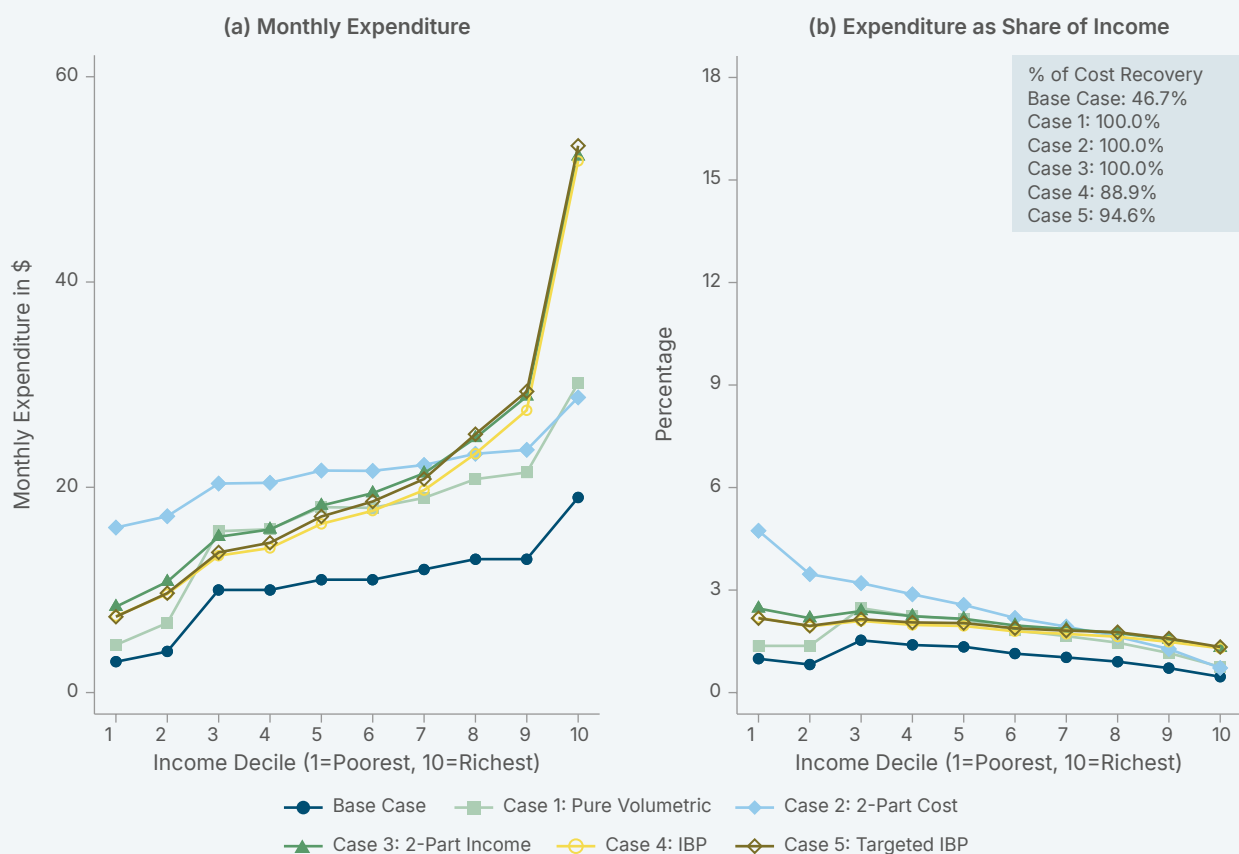
Note: The figure illustrates how fixed and average variable electricity charges vary across income deciles in Ecuador under different pricing regimes and their effects on consumption. Panel (a) shows the fixed charge per household by income decile, Panel (b) the cents paid per kWh by income decile, and Panel (c) the total consumption by decile for each tariff and subsidy scheme. The change in consumption is higher for lower income deciles than for higher income deciles because the change in the average variable charge for lower income deciles is higher.

Source: Authors' own elaboration based on the five simulated scenarios.

The situation differs from that of the Dominican Republic. There, high provision costs make the subsidized first block a large reduction in the poorest households' bills. In Ecuador prices are already low, and the poorest are covered by an existing social tariff whose rate lies below the average charge implied by our proposed policy. As a result, moving from the Base Case to Cases 4 and 5 raises the average price the

poorest pay: their consumption falls somewhat and their expenditure rises relative to the Base Case—from a very low base (roughly \$3 to \$7 per month for the first decile), though it remains a small share of income. This is the opposite of the Dominican Republic, where the social policy lowers the poorest households' bills, and it occurs because Ecuador's existing social tariff is already more generous to the poor than the reform.

FIGURE 31. Expenditure Across Income Deciles in Ecuador



Note: The figures show how expenditures vary across income deciles under different pricing schemes in Ecuador. Panel (a) shows monthly spending on electricity across income deciles, while Panel (b) shows monthly spending as a percentage of monthly income.

Source: Authors' own elaboration based on the five simulated scenarios.



URUGUAY (2016/2017)

[Figure 32](#) depicts the distribution of electricity charges across income segments in Uruguay under the various pricing structures. Panel (a) shows that Case 1 (light green squares with dotted line) has moderate income-based progression, with charges increasing from approximately \$24 for the poorest households to \$41 for the wealthiest, reflecting the differences in consumption levels between deciles. Case 2 (light blue diamonds) shows a flat fixed charge of \$34 for all households regardless of economic status. Cases 3, 4, and 5 show a pricing scheme that scales with household income, with higher incomes having a steeper slope—the most affluent segment (10th decile) bears charges of approximately \$88 monthly, while the lowest-income households (1st decile) pay a fixed charge of about \$11.

Panel (b) shows that Uruguay's average variable charge structure is simpler than the structures of the other countries analyzed, as Cases 2, 3, 4, and 5 all have identical average variable charges. While Cases 2 and 3 typically have the same rates across all countries, Uruguay is unique in that Cases 4 and 5 also share the same average variable charges as Cases 2 and 3. This occurs because our proposed social policy sets the variable charge for the first 100 kWh as the minimum value between the variable cost and the charge that ensures the expenditure on the first 100 kWh does not exceed 2.5% of household income. In Uruguay's case, the latter threshold is higher than the variable cost, so the variable cost applies. This happens for two reasons: First, the lowest income decile in Uruguay has higher income than the corresponding decile in the other analyzed countries,

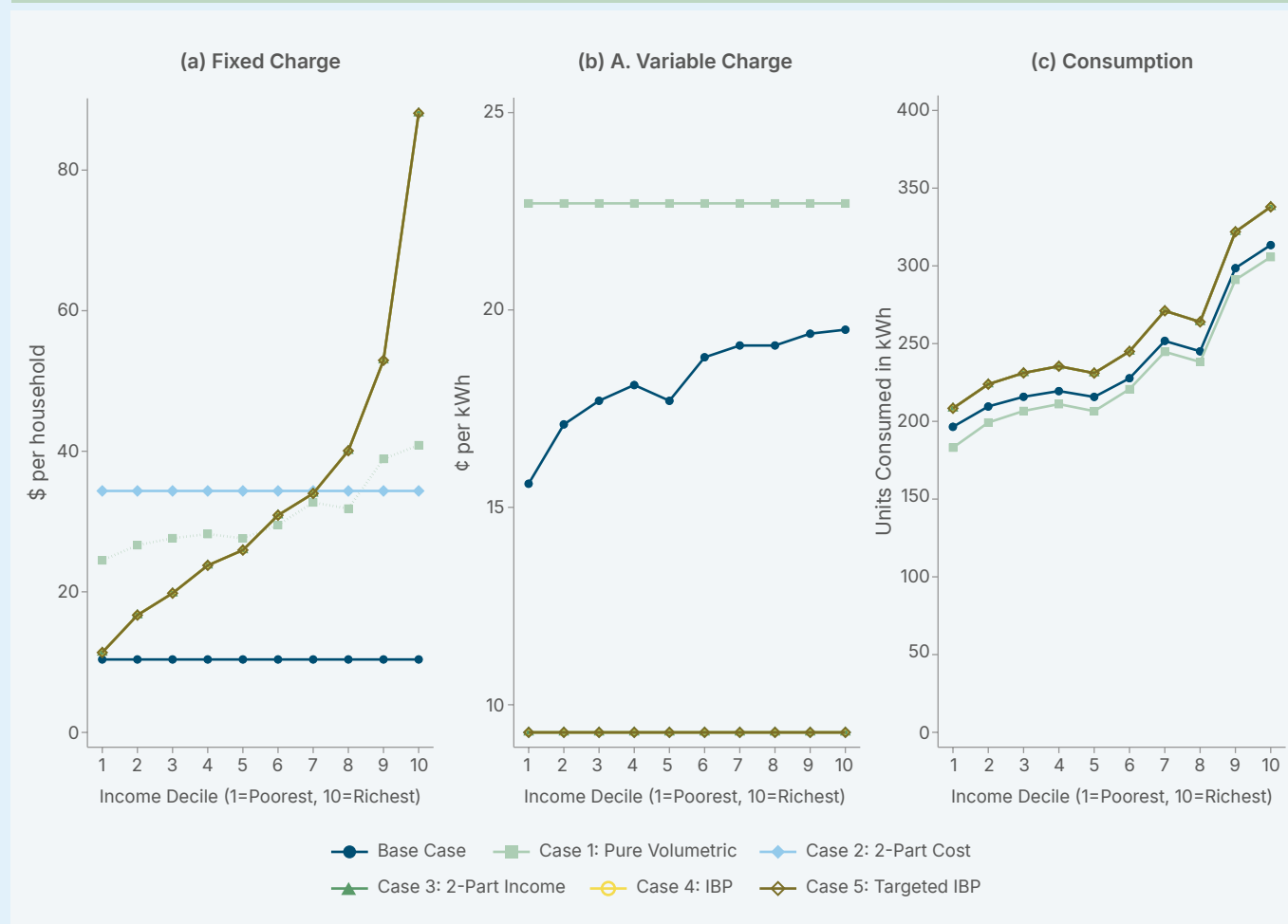
and second, Uruguay's variable cost is already low relative to the other countries. Consequently, the average variable charge associated with the social policy equals the variable cost of service provision, resulting in identical average variable charges of \$9.3 per kWh for Cases 2, 3, 4, and 5. As a consequence of this, consumption for these four cases is the same since we assume that consumption responds to the average variable charge.

Even though consumption is the same for Cases 2, 3, 4, and 5, electricity expenditure differs for Case 2. This is because the fixed charge affects electricity expenditure but not consumption, which is determined by the average variable charge. In Case 2, the fixed charge is per customer and equal for all, while in Cases 3, 4, and 5, the fixed charge is distributed according to income, which makes it more progressive. The electricity expenditure patterns in Uruguay show distinct variations across the pricing schemes as illustrated in Panel (a) of [Figure 33](#). Cases 3, 4, and 5 create the most upward-sloping curve, with the wealthiest households spending about \$120. This contrasts with Case 2 (Two-Part Cost-Reflective, light blue diamonds), which maintains a relatively flat expenditure pattern across all income groups, starting at approximately \$54 for the poorest households and gradually increasing to about \$66 for the highest income decile. The Base Case (blue circles) shows moderate expenditure for lower-income households that increases steadily across deciles, while Case 1 (Pure Volumetric, light green squares) follows a similar pattern, reaching about \$70 for decile 10.

Panel (b) of [Figure 33](#), as expected, reveals that across all the pricing schemes, electricity absorbs a larger share of income among the poorest households than among wealthier ones, as expected for a necessity good. Case 2 (light blue diamonds) places the highest burden on the lowest income decile at nearly 6% of income, while the other cases show percentages

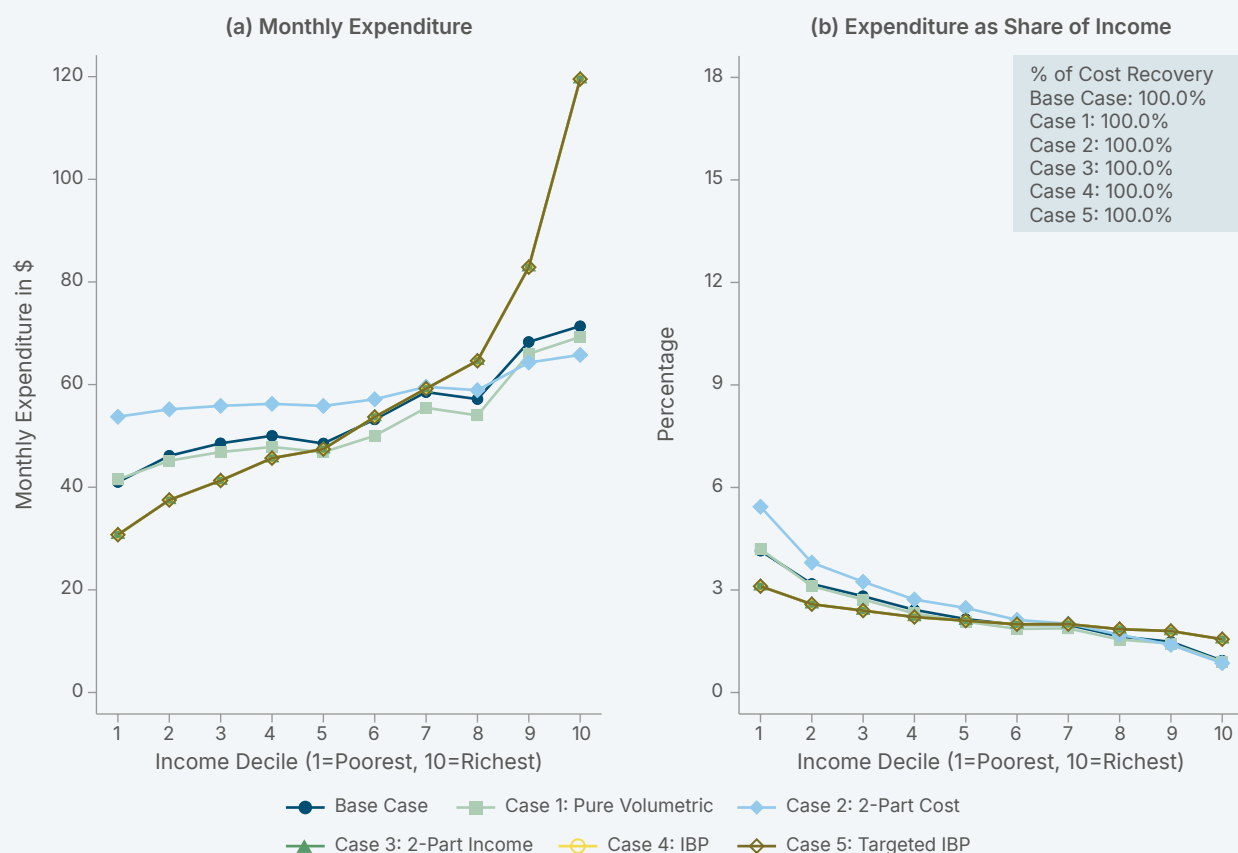
around 3–4% for the poorest households. All cases converge to approximately 1–2% of income for the wealthiest households. Notably, all the pricing schemes (Base Case through Case 5) achieve full cost recovery, suggesting that Uruguay's electricity pricing system is financially sustainable regardless of which scheme is implemented.

FIGURE 32. Charges and Consumption by Income Decile in Uruguay



Note: The figure illustrates how fixed and average variable electricity charges vary across income deciles in Uruguay under different pricing regimes and their effects on consumption. Panel (a) shows the fixed charge per household by income decile, Panel (b) the cents paid per kWh by income decile, and Panel (c) the total consumption by decile for each tariff and subsidy scheme. The change in consumption is higher for lower income deciles than for higher income deciles because the change in the average variable charge for lower income deciles is higher.

Source: Authors' own elaboration based on the five simulated scenarios.

FIGURE 33. Expenditure Across Income Deciles in Uruguay

Note: The figures show how expenditures vary across income deciles under different pricing schemes in Uruguay. Panel (a) shows monthly spending on electricity across income deciles, while Panel (b) shows monthly spending as a percentage of monthly income.

Source: Authors' own elaboration based on the five simulated scenarios.

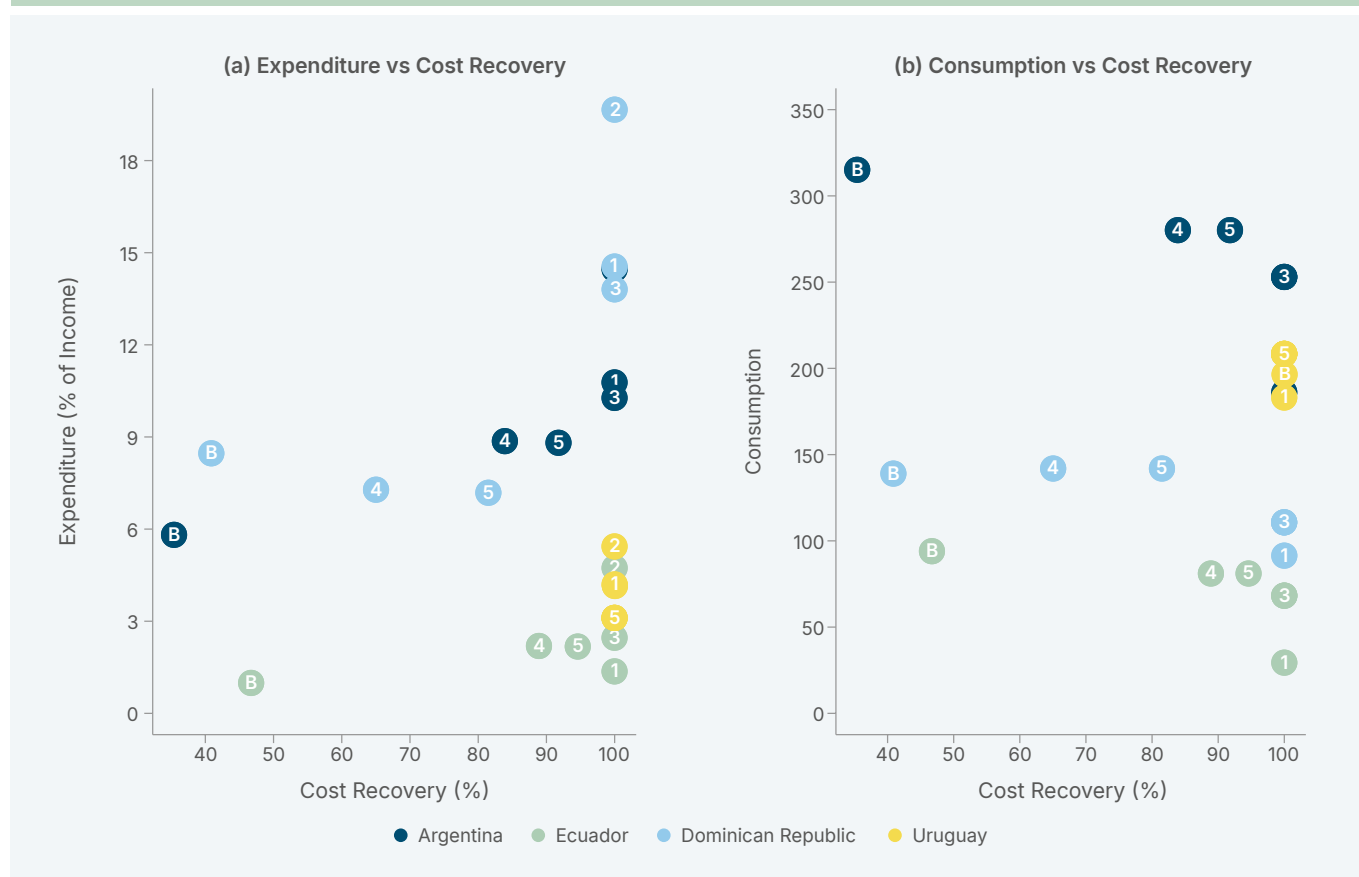
5.4. General Results

We have analyzed the implications of various alternative tariff schemes for each individual country and noted that one of the advantages of this unified framework is that it enables relatively straightforward cross-country comparisons, which we now undertake. Figure 34 shows for the first decile the relationship between cost recovery and affordability, which we measure as total household expenditure and consumption for each country, for the six scenarios analyzed, allowing us to see the trade-offs that may exist between the two principles. Panel (a) shows the relationship between electricity expenditure as a percentage of income for

decile 1 and the cost recovery level of each scheme. Each color represents a country, the label *B* represents the Base Case scenario, and each number represents the respective alternative scenario.

First, note that, by construction, Cases 1, 2, and 3 are cost-recovery schemes, which is why we see that for all the countries they are at 100. What varies is which of the three schemes guarantees greater affordability for the poorest decile. As explained previously and observed in this graph, Case 2 is the most regressive because the fixed costs are distributed homogeneously among households. In Case 1, the distribution is by household electricity consumption, while in Case 3, it is by household income distribution. Since the income distribution is more inequitable than the consumption distribution, allocating the fixed cost based on income

FIGURE 34. Cost Recovery Trade-offs Under Different Scenarios (1st Decile)



Note: This figure examines the trade-offs for the poorest (1st) income decile across four countries: Argentina (blue), Ecuador (green), Dominican Republic (light blue), and Uruguay (yellow). The horizontal axis represents the percentage of the cost that the tariff recovers, while the vertical axis in Panel (a) represents the percentage of expenditure based on family income and the vertical axis in Panel (b) the total consumption in kWh. In Panel (a), we show the relationship between the cost-recovery percentage (x-axis) and the expenditure as a percentage of income (y-axis) for the first decile. In Panel (b), we illustrate how electricity consumption (in kWh) varies with the cost-recovery percentage.

Source: Authors' own elaboration based on the five simulated scenarios.

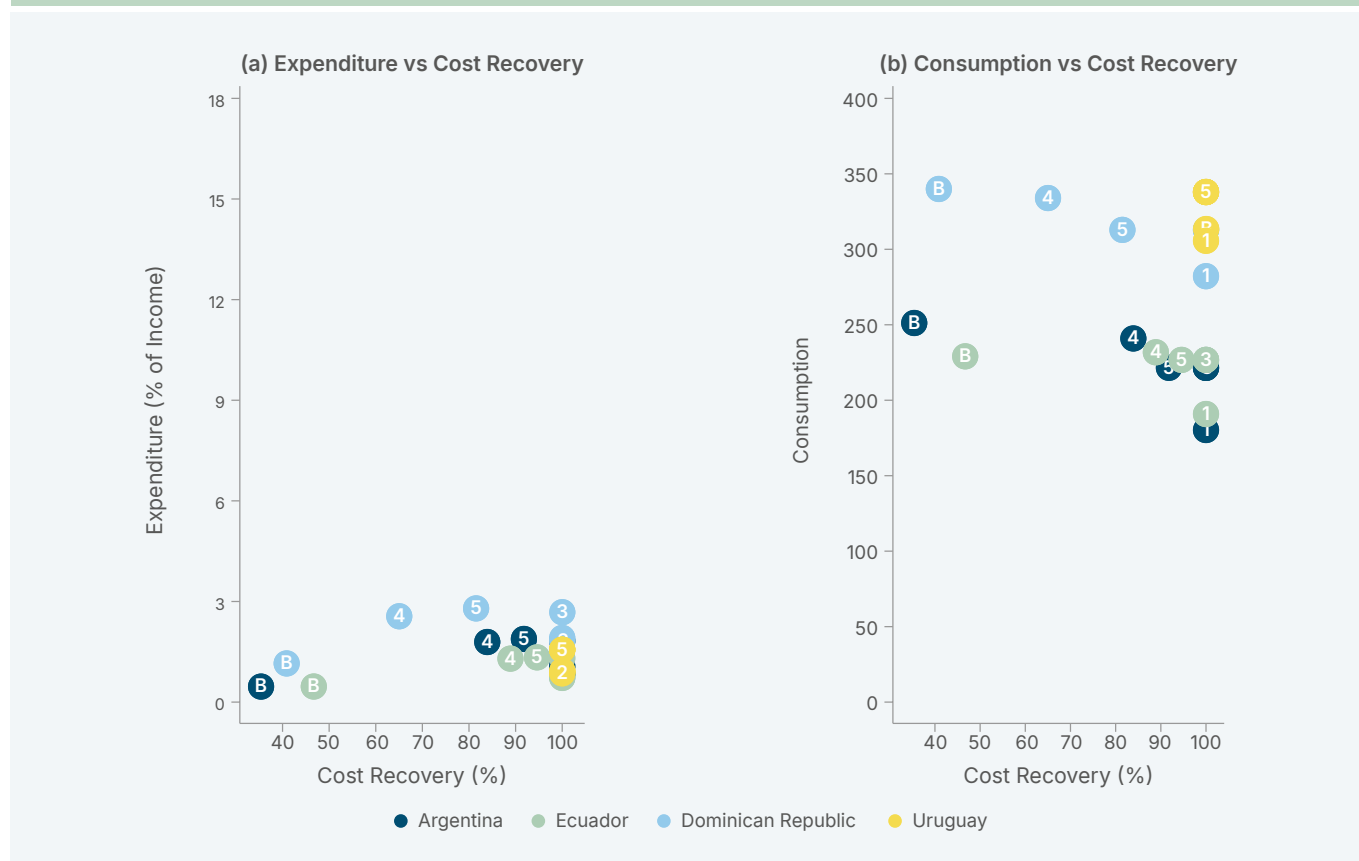
distribution results in a more progressive scheme. Therefore, we see that, for example, for the Dominican Republic, circle 2 is above 1, and 1 is above 3. For Argentina, this is not observed since the blue circle of Case 2 sits over the blue circle of Case 1; that is, it covers it. This is because the consumption distribution in Argentina is relatively even across the income distribution, so in the end, there is not much difference between distribution of the fixed cost by consumption or homogeneously for all households.

Another interesting observation from Panel (a) is that which tariff scheme is better also depends on the country context. For example, for Ecuador, Cases 4 and 5 substantially improve cost recovery at little affordability cost (spending by the poorest decile stays around 2% of income), while the same two cases improve cost recovery but make the service

less affordable for first-decile households in Argentina and improve both affordability and cost recovery in the Dominican Republic. For Uruguay, all the schemes turn out to be cost-recovering. Panel (b) shows the effect on consumption—a relevant variable to analyze since the objective is not only for households to reduce their expenditure but also to preserve their consumption.

Figure 35 is the analogue of the previous figure for the tenth decile. Here, the results are clearer, since we generally observe consumption decreases for the wealthiest households as cost recovery advances because, in all the analyzed scenarios, subsidies are removed from this decile. Additionally, we observe in Panel (a) that electricity expenditure as a percentage of income is not greatly affected since the price increases but consumption decreases, so expenditure as a percentage of income tends to remain stable.

FIGURE 35. Cost Recovery Trade-offs Under Different Scenarios (10th Decile)

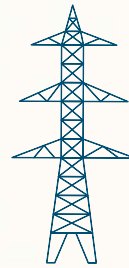


Note: This figure examines the trade-offs for the wealthiest (10th) income decile across four countries: Argentina (blue), Ecuador (green), Dominican Republic (light blue), and Uruguay (yellow). The horizontal axis represents the percentage of the cost that the tariff recovers, while the vertical axis in Panel (a) represents the percentage of expenditure based on family income and the vertical axis in Panel (b) the total consumption in kWh. In Panel (a), we show the relationship between the cost-recovery percentage (x-axis) and the expenditure as a percentage of income (y-axis) for the tenth decile. In Panel (b), we illustrate how electricity consumption (in kWh) varies with the cost-recovery percentage.

Source: Authors' own elaboration based on five simulated scenarios.



6.



Conclusions



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6. Conclusions

This report shows that significant opportunities exist to improve electricity tariff and subsidy systems across LAC without sacrificing affordability for vulnerable households. Through our unified analytical framework applied to four LAC countries, we show that simple recalibrations of fixed and volumetric charges can enhance allocative efficiency while preserving or improving distributional equity. These findings suggest that the persistent trade-offs among cost recovery, cost reflectivity, and affordability can be mitigated through careful tariff design that recognizes the interconnected nature of pricing and subsidy schemes.

Our analysis reveals that the tariff structures we analyze often fail to achieve their intended objectives not only because on average they do not cover the cost of service provision but also because of fundamental design flaws with recurrent misalignment between tariff components and underlying cost structures. Moving from complex block pricing schemes toward more transparent two-part tariffs, combined with targeted income-based subsidies, can simultaneously advance multiple policy objectives. This is particularly relevant for LAC countries, where electricity subsidies represent substantial fiscal burdens while often failing to reach their intended beneficiaries effectively.

That said, because they rely on the latest household survey available for each country at the time of the analysis, the country cases should be read as illustrations rather than as a description of current policy: they reflect the tariff and subsidy schemes in force in each survey year, and several of these countries have since reformed their subsidies. What the exercise offers are the mechanisms it uncovers—how fixed and variable charges, block structures, and targeting rules shape cost recovery and who receives the subsidy—and these remain relevant for current and future reforms in the region. In particular,

the framework helps identify where each country's problem lies: whether provision costs are high, the tariff structure fails to recover moderate costs, or subsidies are poorly targeted. Each diagnosis calls for a different reform, and the same tools can be applied to current data for different countries as they become available.

Our work also highlights critical data and methodological limitations that constrain the precision of tariff design in the region. Three areas merit particular attention for future research and policy development. First, improved cost estimation methodologies are essential for accurately determining the fixed and variable components of service provision costs. Before that, however, it is necessary to have access to information because, while information exists, it is difficult to interpret and identify and is not always completely transparent. It would be ideal to have cost accounting systems that can clearly separate generation, transmission, and distribution costs, which would allow us to calculate costs by type of client and have the option to recover the cost components that hinder the design of cost-reflective tariffs.

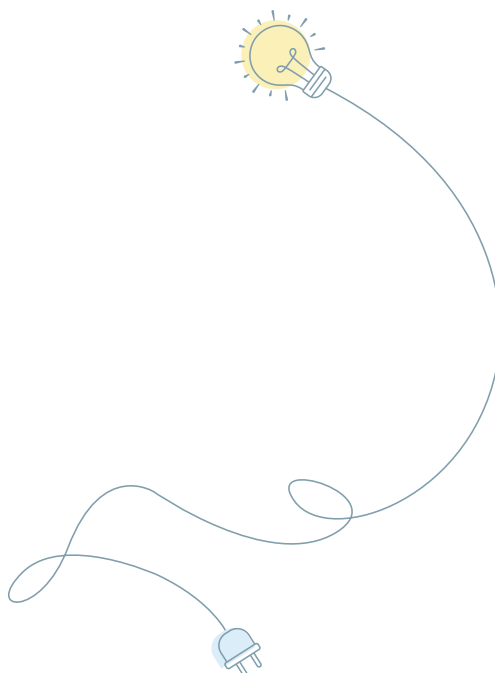
A limitation of a different kind concerns cost reflectivity. Because our analysis is static and works with annual-average costs and tariffs, it captures the reflectivity of the fixed-variable split but not its temporal dimension: a fully cost-reflective tariff would track how the marginal cost of supply varies within the day and across seasons, through time-of-use or real-time pricing. This is why cost reflectivity receives less attention here than cost recovery and affordability. Extending the framework to intraday and seasonal cost variation, where smart metering allows, is a natural next step that would give this principle the fuller treatment our annual snapshot cannot provide.

Second, enhanced administrative data systems for tracking electricity consumption across different income levels would significantly improve subsidy targeting and tariff design. In some cases, it is possible to access administrative data, but in general, these lack household income data. On the other hand, through surveys, we can have access to household's income and reported expenditure on consumption, through which the quantity consumed can be recovered, which is what we did here. These data on electricity expenditure, however, are always self-reported and cover only one month of the year, so the measure is not comparable to actual consumption data.

Third, empirical estimates of price elasticities of electricity demand across different income groups remain scarce for LAC countries. This area of research, which is relatively simple but currently limited, would

be ideal to develop further in the region. Understanding how different household types respond to price changes is fundamental for predicting the welfare and behavioral impacts of tariff reforms, yet most policy discussions proceed without this crucial information.

Addressing these three data and methodological gaps would substantially enhance the quality of tariff and subsidy design decisions. Better cost estimation would enable more precise cost-recovery and cost-reflective pricing, improved consumption data would facilitate more effective targeting, and robust elasticity estimates would allow more accurate impact assessments. Importantly, our unified analytical framework can readily incorporate these improvements as they become available, making it a flexible tool for ongoing policy development.





Appendices



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A. Cost Estimates

This appendix documents how the provision costs used throughout the report were estimated. These costs are difficult to observe directly and would require dedicated country-level studies to estimate with precision, which lies beyond the scope of this work. The figures used throughout the report are therefore illustrative rather than definitive: alternative estimation methods could reasonably be employed, and the resulting estimates would vary accordingly. As for the estimation itself, variable costs are relatively more straightforward to estimate, as they can be approximated from observed electricity market spot prices and observed energy contracts, which are taken as proxies for the underlying energy cost. This energy cost is then grossed up by a loss factor and augmented by a capacity charge that captures the scarcity value of capacity not fully reflected in observed energy prices. Fixed costs, by contrast, are less directly estimated. They correspond to the network investments that must be remunerated, and translating them into a per-household magnitude is not straightforward: the distribution network serves residential, commercial, and industrial users alike; investment is lumpy, undertaken at intervals rather than continuously; and operation and maintenance expenditure accrues permanently. The information required for this exercise is also not readily accessible, even where it exists. In addition, fixed costs are inherently sensitive to policy choices: they depend, among other factors, on the level of network resilience and service quality that each country seeks to achieve, which in turn is shaped by its geographic and climatic conditions, making them as much a policy variable as a technical one.

Our approach relies on observable information published by each country's regulator, system operator, or electric utility and, where such data are unavailable—which, for fixed costs in particular, is common—on the observed network costs of Colombian distribution markets matched to each country.

Colombia as a Reference for Network Costs

A practical obstacle to estimating provision costs in the region is that most authorities do not publish a cost of service that separates its components. Colombia is an exception: its regulator, the Comisión de Regulación de Energía y Gas (CREG), defines the *Costo Unitario de Prestación del Servicio* (CU), an itemized unit cost disaggregated by activity and reported through the Sistema Único de Información de Servicios Públicos (SUI). From it we take the fixed cost and the capacity cost per kWh of four Colombian utilities, which serve three of the country's largest cities—Bogotá, Medellín and Cali—and the Caribbean coast, which includes cities such as Cartagena, Barranquilla and Santa Marta. Note that the CU reports all costs on a per-unit basis, that is, per kWh, regardless of their underlying nature. The first magnitude we draw from it is the unit fixed cost of provision, which comprises the fixed costs of transmission and distribution, so that F^G is set to

zero in the empirical implementation.³⁴ The second is the capacity cost, which seeks to capture the fact that marginal costs extend beyond immediate energy provision when there are capacity constraints at the generation, transmission, or distribution level: while these constraints may be negligible during off-peak periods, they can be substantial during peak hours or periods of system stress.

Table 7 reports, for each utility, the number of residential customers served, their average monthly consumption per household, and the two cost components we take from the CU.

Variable Cost for Each Country

Table 8 presents the variable cost structure for each country's respective analysis year, including the marginal cost of energy, transmission and distribution losses, and capacity costs. The last column reports the sum of them as the estimate of the effective cost, on average, of providing an extra unit of electricity (kWh).

TABLE 7. Colombia's Unit Cost Components, by City and Year

City (Utility)	Year	Fixed (¢/kWh)	Households (thousands)	Consumption (kWh/month)	Capacity (¢/kWh)
Bogotá (CODENSA)	2018	6.72	3,300	160	1.05
Costa Caribe (ELECTRICARIBE)	2018	7.21	2,400	275	1.05
Medellín (EPM)	2017	8.23	1,150	150	0.83
Cali (EMCALI)	2012	7.69	580	200	0.79

Note: Households is the number of residential customers served; consumption is their average monthly residential consumption per household. Fixed is the sum of the unit charges that do not vary with the household's consumption, notwithstanding that the CU expresses them per kWh. Capacity is the cost associated with the system's capacity constraints, which the marginal energy cost alone does not reflect and which is therefore incorporated into the variable cost of provision. Cost components are expressed in current U.S. dollars of the corresponding year.

Source: CU components from Sistema Único de Información de Servicios Públicos (SUI), commercial energy form 102 (*Costo Unitario*); CREG. Households and average consumption from SUI (form 102).

TABLE 8. Variable Cost Components by Country

Country	Year	Energy (¢/kWh)	Losses (%)	Capacity (¢/kWh)	Variable Cost (¢/kWh)
Argentina	2018	8.15	18.10	1.05	11.0
Dominican Republic	2018	13.20	23.30	1.05	18.3
Ecuador	2012	6.11	14.80	0.79	8.0
Uruguay	2017	6.30	13.90	2.00	9.3

Note: The variable cost is energy grossed up by losses plus the capacity charge, $\text{Variable} = \text{Energy}/(1 - \text{Losses}) + \text{Capacity}$.

Source: Authors' own elaboration; energy from CAMMESA, XM, CDEEE and UTE; transmission and distribution losses from Yépez-García and Jiménez Mori (2024); capacity from Colombia's *Costo Unitario* (CREG/SUI).

³⁴ Retail costs are not reported separately, as in the framework of [Section 2](#) they are subsumed within distribution. We assume that fixed generation costs are recovered through the energy price: when the price of energy is sufficiently high, the fixed costs of generation are covered by inframarginal rents, so treating them as a separate magnitude to be recovered would double-count them. However, because generation is non-convex, that condition is not always met, so wholesale markets add side-payment (make-whole) mechanisms that cover the committed units' own operating costs (Cramton, 2017; Eguiguren-Cosmelli, 2024; Graf et al., 2021; Reguant, 2014).

The energy cost is the marginal cost of generation. For Argentina we use the operated marginal cost (*Costo Marginal Operado*, CMO) of the wholesale market—the demand-weighted average of the highest variable cost of the last unit dispatched each hour, including fuel and operation-and-maintenance costs—published by CAMMESA. For the Dominican Republic we use the distributors’ average energy *purchase* price—a blend of contracted and spot generation, the latter elevated by the system’s reliance on imported fuel oil and diesel (CDEEE, *Indicadores de Gestión Comercial y Financiera*). Ecuador is a special case: reliable public information on its generation cost is limited, so we proxy it with Colombia’s wholesale spot price (XM), given the two countries’ similar hydro-based matrices—about \$6.1 per kWh in 2012, a national figure, since generation clears in a single wholesale market. For Uruguay we use UTE’s contracted wind supply, whose tenders—awarded in 2011, 2012 and 2014—cleared at US\$63/MWh.³⁵

Transmission and distribution losses are taken from a single, internationally harmonized source (Yépez-García and Jiménez Mori, 2024) so that they are defined consistently across the four countries. We use its 2019 estimates of combined transmission-and-distribution losses: 18.1% for Argentina, 14.8% for Ecuador, 23.3% for the Dominican Republic, and 13.9% for Uruguay. We prefer to rely on a single, harmonized source for all four countries. Although network losses tend to change only gradually from year to year, it would nonetheless be ideal to have estimates for each specific analysis period; lacking harmonized cross-country measures for those years, we use the 2019 figures.

The capacity charge recognizes that system costs extend beyond immediate energy provision when there are capacity constraints at the generation, transmission, or distribution level. We take it from the capacity component of Colombia’s published unit cost, using the national average for that specific year rather than a city-specific value: \$1.05 per kWh in 2018 and \$0.79 in 2012 (CREG/SUI). Uruguay is the

exception: we apply \$2 per kWh because its large share of variable renewables should raise the capacity cost. We take this value from Borenstein et al. (2021), whose analysis of California—also a system with high variable-renewable penetration—supports it.

Fixed Costs for Each Country

Once variable cost estimates are established, we estimate fixed costs following two different approaches, depending on the country. Given that Uruguay’s tariffs achieve cost recovery, its fixed cost can be inferred directly from the average tariff: it is the residual that, added to the variable cost, equates the total cost of provision with average revenue—about \$32.0 per household per month. We adopt this residual approach for Uruguay in full awareness that the unit fixed cost in Montevideo is probably lower than in the rest of the country—a dense metropolitan network spreads infrastructure over more customers—but we take advantage of the fact that UTE’s uniform tariff recovers cost without relying on subsidies. The fixed cost is then obtained as a residual: because the average tariff recovers the average cost of provision, the fixed component is whatever remains once the variable cost of provision is subtracted. Defined this way, it need not correspond exclusively to the efficient cost of the network: it may also absorb other elements embedded in the regulated tariff, such as the utility’s return. It is therefore best read as an approximate upper bound on the fixed cost of provision rather than a precise measure of it. For the other three countries, whose tariffs do not recover cost, the fixed cost cannot be read off the tariff. We therefore draw on Colombia, whose regulator publishes the fixed portion of the unit cost, and match each metropolitan area to a Colombian distribution market of comparable profile—Buenos Aires to Bogotá (CODENSA), Greater Santo Domingo to the Caribbean coast (ELECTRICARIBE), and Quito to Cali (EMCALI). Multiplying Colombia’s

³⁵. Energy-cost data: CAMMESA, operated marginal cost (Argentina); Colombia’s wholesale spot price, XM (Ecuador proxy); CDEEE, *Indicadores de Gestión Comercial y Financiera* (Dominican Republic); ADME, [Informe Anual 2017](#), and Uruguay’s 2011–2014 wind tenders ([Fundación Bariloche](#)) (Uruguay).

fixed cost per kWh for the matched city and year by the representative household consumption of *the country under analysis*—not the Colombian consumption levels—yields the monthly fixed cost per household reported in Table 9.³⁶

Two clarifications about how these figures are constructed. First, while fixed costs are presented elsewhere in this publication as dollars per household per month, Colombia publishes them—as it does every component of the CU—per unit of energy, so the intermediate figures are expressed in cents of a dollar per kWh and converted using representative consumption. Second, we report more than one Colombian market rather than a single one for two reasons. The first is diagnostic: the fixed charge per kWh varies within a relatively narrow band across markets that differ substantially in size, density and

average consumption—Medellín, at ¢8.23, is not far from Bogotá or the Caribbean coast—which suggests that the choice of benchmark is not decisive for the magnitudes we report, and looking at more than one market—rather than relying on a single, possibly atypical, benchmark—makes it possible to see whether any of them is an outlier. The second is practical: having several markets allows the match to be made on more than one dimension—year, city size, customer density and average household consumption—rather than defaulting to whichever market happens to be available.

Finally, it is worth reiterating that the estimates should be interpreted as orders of magnitude that discipline the analysis, rather than as precise measurements. Improving the measurement of these provision costs would strengthen this type of analysis.

TABLE 9. Fixed Cost of Provision by Country

Country	Year	Consumption (kWh/month)	Fixed cost (¢/kWh)	Total fixed cost (\$/month)
Argentina	2018	290	6.72	19.5
Dominican Republic	2018	186	7.21	13.4
Ecuador	2012	146	7.69	11.2
Uruguay	2017	240	13.3	32.0

Note: Total fixed cost = fixed cost per kWh × consumption. For Argentina, the Dominican Republic and Ecuador the fixed cost per kWh is Colombia's network-plus-commercialization charge for the matched city and year (Table 7). For Uruguay it is not taken from Colombia but derived as a residual under full cost recovery; the ¢13.3 shown is the implied value.

Source: Authors' own elaboration; Colombia's *Costo Unitario* (CREG/SUI); UTE and ADME for Uruguay.

³⁶ Fixed-cost data from Colombia's unit cost, SUI (form 102); for Uruguay the fixed cost is derived as a residual (UTE/ADME).

B. Social Policy and Other Charges for Recovering Consumption

Residential electricity prices in the four countries are shaped not only by the tariff schedule but by a layer of social policy—targeted subsidies, social tariffs, cross-subsidies, and, in some cases, non-electricity charges collected through the bill. This appendix summarizes these arrangements for each country, because they determine both the bill a household actually pays and

the consumption levels our method infers from that bill; in each case we describe the scheme in force in the year that country is analyzed. Throughout, we distinguish *targeted* instruments, which condition on household socioeconomic characteristics and/or consumption level, from universal ones embedded in the tariff and available to all residential users.





ARGENTINA (2017/2018)

Argentina combines a below-cost tariff with an explicit social tariff. On the universal side, the seasonal price that distributors pay for wholesale energy (the *Precio Estacional*) was held below cost, with the difference financed by the State. This price was not fixed: it was revised over the survey year, rising by roughly two-thirds in nominal terms between late 2017 and late 2018, and we apply the value in force in each quarter rather than an annual average. On average it covered only about half of the wholesale energy cost we adopt (the operated marginal cost, CMO).

On the targeted side, the *Tarifa Social Federal* grants a discount to vulnerable households previously identified by social-protection criteria. On the bill, households face a fixed charge and a variable charge, and the discount applies only to the seasonal-price (wholesale energy) portion embedded in the variable charge: this portion is waived entirely on the first 150 kWh per month and halved on the next 150 kWh (between

150 and 300 kWh), while consumption above 300 kWh—and the rest of the bill—is charged in full. We apply this benefit at the seasonal price in force each quarter, so its value tracks the energy price as it rises over the year. Because the survey records expenditure rather than quantity, we recover each household's consumption by inverting its reported bill through *both* the regular and the social schedules—yielding a regular-tariff quantity and a social-tariff quantity—and combine the two in proportion to the share of the decile covered by the social tariff. This targeted discount is modest relative to the universal subsidy above, since it lowers only the already heavily subsidized seasonal-price portion of the variable charge, and not its other components. Finally, the residential bill in the Buenos Aires metropolitan area carries value-added tax (21%) plus provincial turnover tax and municipal levies, together on the order of 29%, which we net out when recovering consumption from reported expenditure.³⁷



³⁷ Tarifa Social benefit structure and seasonal prices: Ministerio de Energía y Minería, Resolución E 403/2017, and ENRE (e.g., Resolución 207/2018). The AMBA tax composition and the broader distributional analysis of Argentina's energy subsidies follow Giuliano et al. (2020).



DOMINICAN REPUBLIC (2018)

The Dominican Republic operates both a large universal subsidy and an income-targeted transfer. The universal subsidy is the fiscal transfer that covers the distribution companies' overall deficit—not only the cost of the energy they purchase, but the whole gap between their costs and the revenue their regulated tariffs collect, widened by high distribution losses and low collection—which represents a substantial share of the sector's financing. The targeted instrument is *Bono Luz*, delivered through the ADESS payment system to households in the SIUBEN poverty registry: it finances consumption up to roughly 100 kWh per

month for eligible beneficiaries. We incorporate it as a fixed monthly transfer—about US\$9 (RD\$444), the amount that covers 100 kWh at the lowest block rate—that lowers the effective bill: we recover consumption by inverting the full regulated tariff, an increasing-block schedule set by the Superintendencia de Electricidad (SIE), and then treat *Bono Luz* as the targeted subsidy—a discount on the gross regular bill. As in Ecuador, and unlike Argentina and Uruguay, the residential electricity bill carries no value-added tax. We use the schedule in force in 2018, the year of analysis.³⁸



38. *Bono Luz*, administered through ADESS with targeting based on the SIUBEN registry; residential tariff schedule, SIE; sector subsidy (transfers to the distribution companies). On the drivers of the distribution companies' deficit (high losses, weak collection, and below-cost-recovery tariffs), see World Bank (2023). On the importance of the distribution companies' governance and management for their performance—service quality and profitability—see Weiss et al. (2022).



ECUADOR (2012/2013)

Ecuador's residential tariff is below cost and is complemented by two consumption-targeted schemes. The *Tarifa Dignidad* charges households whose consumption stays low a reduced price—US\$0.04 per kWh for energy plus US\$0.70 in commercialization—with eligibility defined by consumption and no income test: at or below 130 kWh per month in the Coast, Amazon and Insular regions (110 kWh in the Sierra) in at least eleven of the preceding twelve months. Our Ecuadorian data cover the Quito service area (Empresa Eléctrica Quito), which lies in the Sierra, so the threshold we apply is 110 kWh. For the analysis we adopt a simplification of this rule: any household whose consumption in the survey month is at or below the 110 kWh threshold is treated as covered by the social tariff on its entire consumption that month, as we do for Uruguay's *Tarifa de Consumo Básico*. Separately,

a cross-subsidy (*subsídio cruzado*) grants a discount to households consuming between 1 and 130 kWh per month, financed by a surcharge on the bills of higher-consumption users (those above 160 kWh). We recover consumption from the applicable schedule and treat the net cross-subsidy as a targeted reduction of the bill for its net beneficiaries. A distinctive feature of the Ecuadorian bill is that it also collects charges unrelated to electricity provision—garbage collection (about 15% of the energy charge), a fire-service contribution (US\$1.46), and public lighting (levied by consumption range)—which inflate reported expenditure and which we net out when recovering consumption. Like the Dominican Republic, the bill carries no value-added tax. We use the schedule in force in 2012, the year of analysis.³⁹

³⁹. *Tarifa Dignidad*, Decreto Ejecutivo 451-A (2007); *subsídio cruzado* (discount for consumption of 1–130 kWh, financed by a surcharge on consumption above 160 kWh), Empresa Eléctrica Quito (EEQ); public-lighting schedule (SAPG), ARCONEL/ARCERNNR; non-electricity charges as itemized in the EEQ residential bill.



URUGUAY (2016/2017)

Uruguay is the exception: UTE, the state-owned utility, applies a residential tariff scheme that, in the aggregate, covers the cost of provision but comprises two schedules: the standard *Tarifa Residencial Simple* and a consumption-targeted social tariff, the *Tarifa de Consumo Básico*. The latter—a fixed monthly charge covering the first 100 kWh—is cheaper than the standard schedule and, by regulation, may be used only while monthly consumption stays at or below 230 kWh. We assign households consuming up to 230 kWh to *Consumo Básico* and the rest to *Residencial Simple* to determine each household's bill. As in the

other countries, the subsidy is then measured against the cost of provision—which is the same for every household—so that a household paying below that cost is subsidized while one paying above it contributes to the system. Uruguay had no income-targeted social electricity tariff in the year of analysis; the means-tested *Bono Social* was introduced later. Because the standard tariff recovers cost, Uruguay's fixed cost can be inferred directly from the tariff (see [Appendix A](#)). The bill carries value-added tax, which—as in Argentina—we net out. We use the schedule in force in 2017, the year of analysis.⁴⁰



⁴⁰. UTE *Reglamento Tarifario* and pliego tarifario: *Tarifa Residencial Simple* and *Tarifa de Consumo Básico*.

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