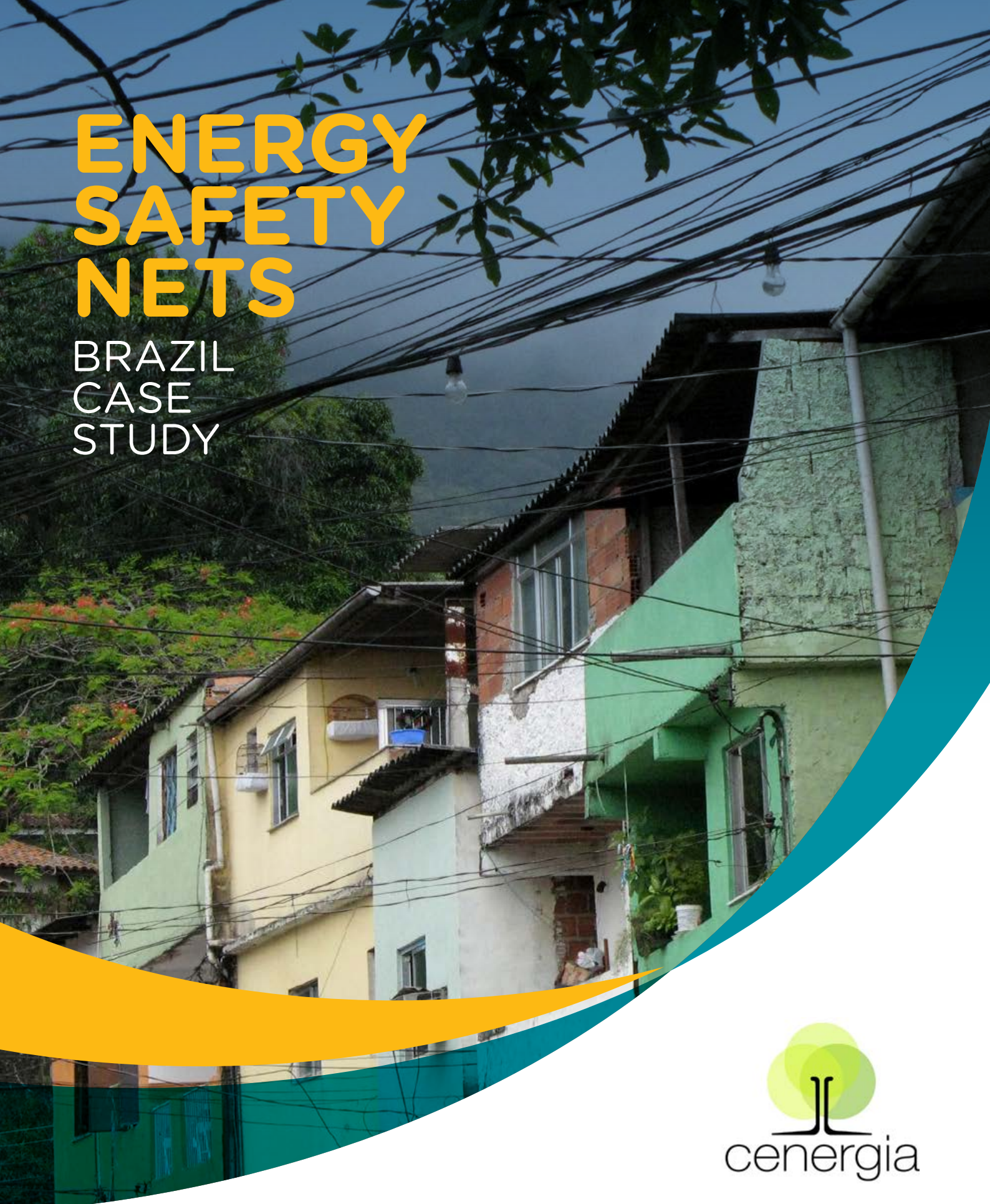


ENERGY SAFETY NETS

BRAZIL
CASE
STUDY



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ABBREVIATIONS

ANEEL	<i>Agência Nacional de Energia Elétrica</i> (Brazilian Electricity Regulatory Agency)
BF	<i>Programa Bolsa Família</i> (Family Allowance Program)
BPC	<i>Benefício Assistencial ao Idoso e à Pessoa com Deficiência</i> (Benefit for Elderly and Disabled People)
CAD	<i>Cadastro Único para Programas Sociais</i> (Single Registry for Social Programs)
CAFOD	Catholic Agency for Overseas Development
CCC	<i>Conta de Consumo Combustível</i> (Account for Cross-Subsidization)
CCC-ISOL	Fossil Fuels Consumption Account of Isolated Systems
CDE	<i>Conta de Desenvolvimento Energético</i> (Account for Energy Development)
CEPEL	<i>Centro de Pesquisa em Energia Elétrica</i> (Electric Energy Research Center)
COPPE/UFRJ	<i>Instituto Alberto Luiz Coimbra de Pós-Graduação e Pesquisa de Engenharia da Universidade Federal do Rio de Janeiro</i>
CRAS	Social Assistance Office
EPE	<i>Empresa de Pesquisa Energética</i> (Energy Research Company)
HDI	Human Development Index
IBGE	<i>Instituto Brasileiro de Geografia e Estatística</i> (Brazilian Institute of Geography and Statistics)
IEA	International Energy Agency
IPEA	<i>Instituto de Pesquisa Econômica Aplicada</i> (Institute of Applied Economic Research)
LPG	Liquefied Petroleum Gas
LpT	<i>Programa Luz para Todos</i> (Light for All Program)
MCTIC	<i>Ministério da Ciência, Tecnologia, Inovações e Comunicações</i> (Ministry of Science, Technology, Innovations and Communications)
MDS	<i>Ministério do Desenvolvimento Social</i> (Ministry of Social Development)
MMA	<i>Ministério do Meio Ambiente</i> (Ministry of Environment)
MME	<i>Ministério de Minas e Energia</i> (Ministry of Mines and Energy)
NGO	Non-governmental Organization
ONS	<i>Operador Nacional do Sistema Elétrico</i> (Brazilian's Energy System Operator)

PRODEEM	Brazilian Program for Rural Electrification Using Photovoltaics
RF	Person Responsible for a Family Unit within CAD
SIN	<i>Sistema Interligado Nacional de Energia Elétrica</i> (National Interconnected System)
TS	<i>Programa Tarifa Social</i> (Social Tariff Program)
VG	<i>Vale Gás</i> (Gas Assistance Program)

A note on currency

The Brazilian real (Portuguese: *real*, pl. *reais*; sign: R\$; code: BRL) is the official currency of Brazil. Currency conversions were carried out using year-averaged values available from the World Bank/IMF (<https://data.worldbank.org/indicator/PA.NUS.FCRF?locations=BR>). If a specific year was available from the context, this was used, otherwise the most recent data (i.e. 2018) were used.

MAP OF BRAZIL



EXECUTIVE SUMMARY

This research aims to provide guidance for policy- and decision-makers, by identifying measures in Brazil that have been successful in enabling very poor people to access modern energy services and exploring the reasons for their success and challenges encountered. Its findings are based on quantitative and qualitative analyses of three programs that directly and indirectly impact the access and consumption of modern energy sources: *Luz para Todos* (Light for All) and *Tarifa Social* (Social Tariff) for electricity, and *Bolsa Família* (Family Allowance) for LPG for cleaner cooking.

Luz para Todos was launched in 2003 to extend access to electricity connections in rural and remote areas of Brazil. Like *Tarifa Social*, it is supported by cross-subsidies funded via levies on consumer electricity bills. Through successive iterations, the program has focused on connecting households and communities using a prioritization scheme that attempts to ensure the most disadvantaged communities are connected first. Although the vast majority of the unconnected households are located in regions of the country scoring low on the Human Development Index (HDI), the scheme appears to have been broadly effective. Since its inception, it has invested more than USD 7.1 billion (BRL 26 billion, 2018 prices) to reach over 16 million people through more than half a million projects, putting Brazil on track to achieve universal access to electricity well before 2030.

Tarifa Social was launched in 2010 to complement universal access to electricity connections. The program was built on previous experience with subsidizing electricity consumption to increase af-

fordability for poor and vulnerable households. It has expanded rapidly and more than one in ten of all households currently benefit from *Tarifa Social* to some degree. The volume-differentiated tariff applies discounts to the energy bills of households enrolled in the *Cadastro Único* (CAD), the unified gateway registry for social programs. An analysis of consumption levels by poor households suggests that *Tarifa Social* has largely insulated electricity consumption in low-consuming poor households from the recent economic downturn. However, the same analysis shows that the scheme would need to be modified to adequately support poor households to consume more than very basic levels of electricity.

In 2003, the Brazilian Government launched the *Bolsa Família* integrated cash transfer to bring together support previously provided by 12 individual social assistance programs. This included support for LPG for cooking under the *Vale Gás* and *Auxílio-Gás* programs. *Bolsa Família* also uses the *Cadastro Único* to identify recipients and represents an important resource for families that has successfully lifted many millions out of poverty. However, the program is poorly set up to ensure access to modern cooking energy such as LPG and data show a recent uptick in the number of households reverting to using traditional biomass for cooking. This is, in part, because the program's energy component is non-earmarked, which allows households to use the benefit to pay for other services, especially during times of economic hardship. The scheme's effectiveness in supporting LPG consumption is also hampered by the cost of LPG rising much faster than

the amount the cash transfer provides to poor households. In 2015, the cost of a 13kg cylinder of LPG represented 58 percent of the monthly *Bolsa Família* transfer, but by 2019 this figure had increased to 79 percent.

The final section of this report details opportunities to improve the extent that current programs

support low-income groups to access affordable, reliable, sustainable and modern energy services. These include adapting programs to reflect sub-national variations, increasing awareness among eligible beneficiaries, and changes to the way that support is targeted and delivered to enhance the programs' ability to support energy access by poor and vulnerable households.



INTRODUCTION



BACKGROUND

Social assistance measures can enable access to affordable energy. The use of targeted support measures may face inclusivity challenges. Different mechanisms (e.g. cash transfers, vouchers and price controls) may yield different results, and they may require levels of administrative and institutional capacity that are not found in every country. Country case study research is meant to build an understanding of the degree to which different mechanisms have been successful in different contexts, and identifies areas for further innovation, piloting or research. The overall objective of the research is to provide guidance for policymakers and decision-makers, by identifying measures that have been successful in enabling very poor people to access modern energy services and exploring both the reasons for their success and challenges encountered.

The Brazil case study

The Brazil case study aims to identify programs and public policies that have been successful in enabling access to modern energy services in regions with low HDI values (Figure 1). The programs analyzed are *Luz para Todos*, *Tarifa Social* and other governmental programs, such as the *Bolsa Família*, which can indirectly impact the access and consumption of modern energy sources.

This research used quantitative and qualitative methodologies to build a comprehensive picture of different experiences of the use of social assistance mechanisms for energy access. The case study—like the other five, covering Ghana, India, Indonesia,

Kenya and Mexico—seeks to answer four research questions:

- What policy measures have been used to enable very poor and marginalized people to access and use modern energy services?
- How effective have these measures been in enabling the poorest social groups to access and use modern energy services?
- What links have there been/are there between these measures and wider/other social assistance programs?
- What changes could be made to enhance the effectiveness of existing policy measures in enabling very poor people to access modern energy services?

Using these general research questions, the case study began by developing questions more directly relevant to the context of access to modern energy services and social assistance programs in Brazil. A literature review was then carried out to identify the main government policies and programs comprising Brazil's Energy Safety Nets (ESNs).

Two stakeholder workshops were also carried out. The first reviewed the specific research questions and identified data sources. The second validated the preliminary research findings, addressed remaining information gaps, and agreed preliminary conclusions and policy recommendations. Twenty key informant interviews based on the research questions were also carried out with stakeholders directly involved in the design, implementation, or evaluation of the government programs and/or research related to them.

Energy Safety Net (ESN) is an umbrella term for government-led approaches to support very poor and vulnerable people to access essential modern energy services, defined as electricity and clean fuels and technologies for cooking, by closing the affordability gap between market prices and what poor customers can afford to pay.

ESNs can make physical access (i.e. connections) to electricity or clean fuels affordable for poor and vulnerable people, or they can make the unit price of electricity or fuel affordable to consume. ESNs include some form of targeting or eligibility criteria to direct benefits to those who need them.

Figure 1

Brazil: HDI values by region (2010)



Source: Authors' elaboration based on UNDP Atlas 2012 and IBGE 2019.

ENERGY ACCESS IN BRAZIL – A CONTEXTUAL OVERVIEW



Brazil is an urban-industrial country with an agricultural sector that plays a leading role in the global economy. One of the country’s most distinctive characteristics is its energy mix, with a significant share of its renewable sources, particularly in the generation of electric energy, affording the sector a low-carbon profile.

Poverty is often the result of a complex economic and sociocultural system that favors inequality, and energy access can play an important role in eliminating poverty, isolation and deprivation. Current definitions of energy poverty focus on a lack of modern energy services and the reliance on what is available in nature (IEA 2016). However, such definitions often do not specify the reasons for the ‘lack’ of modern energy services, which can be linked to a family’s financial constraints and the unaffordability of energy services, whether energy poverty is the result of geographical isolation (Bouzarovski 2014), or a ‘complex combination of factors, including lack of physical availability of certain energy types and high costs associated with using

energy’ (Pachauri et al. 2011:36). In this study, energy poverty is interpreted as the inability of individuals or groups to consume energy services that are affordable and reliable (UNDP 2000; IE/ UFRJ 2005), yet it should be noted that it can be difficult to separate the definition of energy poverty from the general concept of poverty.

Despite the wider definition of poverty conceptualized in the Brazilian Constitution, the *Instituto Brasileiro de Geografia e Estatística* (IBGE), which carries out the national census, measures poverty according to the following values: “extreme poverty” indicates an individual earning below USD 0.75 per day (BRL 89 per month); while “poverty” is defined as individual income between BRL 89 and BRL 179 per month (USD 1.5 per day) (IBGE 2015). In 2017, the numbers of people living in poverty and extreme poverty were 23 million and 12 million, respectively (IBGE 2019). In Brazil, energy access is commonly reported using the metric of the percentage of households with access to electricity and clean cooking fuels—100 percent and 96 percent, respectively, in 2017—see

Table 1

Relevant information about Brazil

Territory	Total area of 8,515,759,090 km ² ; divided in five political-administrative regions - North, Northeast, Midwest, South and Southeast; composed of 26 states and the Federal District
Population (2018)	209.5 million
Gross Domestic Product - GDP (in US\$ billions/2018)	1,689
GNI per capita (in US\$/2018)	9,140
Energy Mix	In 2017, renewables accounted for 43.2% of the Brazilian energy mix, a significantly higher share than world (13.8%) and OECD (10%) averages. Biofuels and sugarcane biomass supplied 40.3% of total energy. Renewables supplied 80.4% of electric energy. Hydraulic sources generated 59.4% of total electricity, natural gas 10.5% and wind 6.8%

Source: IBGE 2018; MME 2018; World Bank 2019

Figure 2 (IEA et al. 2019). It is not entirely clear how well these figures reflect the actual number of households using electricity and modern cooking fuels. For example, one study noted that in 2004 more than 98 percent of households had access to liquefied petroleum gas (LPG) (Jannuzzi et al. 2004), while another in 2015 showed that 54 percent of the population in the northern regions was still exclusively using firewood versus 46 percent relying on LPG (Coelho et al. 2018). Similar proportions were observed for the most developed regions such as the south and south-east, in which firewood is still used by 42 percent and 45 percent of the population, respectively

(Ibid 2018:45). It is worth mentioning that while firewood is largely used for cooking (Coelho et al. 2018), it also has other uses. In the south it is mostly used for space heating (EPE 2013), while in the warmer north, it is also used in livelihood activities such as brick and pottery making (Mazzone 2019b).

In this context, the next chapter aims to present the design, implementation and evolution of government programs such as *Bolsa Família*, *Luz para Todos* and *Tarifa Social*, which can indirectly impact access to and consumption of modern energy sources.

Figure 2
Brazil's progress towards achieving SDG7



Source: IEA et al. 2019

THE DESIGN,
IMPLEMENTATION
AND EVOLUTION
OF *BOLSA FAMÍLIA*,
LUZ PARA TODOS
AND *TARIFA SOCIAL*



BOLSA FAMÍLIA

Separate ministries provide separate safety nets (mid-1990s to 2003/4)

Modern social assistance programs were developed in the mid-1990s with a series of policies emerging to provide food security and eradicate child labor. In 1995, President Fernando Henrique Cardoso initiated the Social Safety Net Project (*Rede de Proteção Social*) aimed at redistributing wealth and protecting the most vulnerable people in Brazilian society. Attention to the poorest and the most marginalized in Brazil increased in the mid-1990s because of the social consequences of hyperinflation (1985-1994), which increased the divide between rich and poor and the number of the extreme poor.

From 1995 to 2002, 12 programs were progressively included in the Social Safety Net Project, including *Bolsa Escola* (School Allowance), *Vale Gás* (VG) and *Bolsa Alimentação* (Food Stamps). Individual ministries were responsible for specific programs. For example, the Ministry of Education implemented the *Programa Agente Jovem* (Youth Program) in 2001, a cash transfer measure for education that was later

transformed into the *Bolsa Escola*; the Ministry of Health launched *Bolsa Alimentação*; and the Ministry of Mines and Energy launched *Auxílio-Gás* in 2001 (more commonly known as *Vale Gás* after incorporation into *Bolsa Família* in 2003/2004) (Zimmerman 2006). *Auxílio-Gás* provided families with BRL 7.50 (USD 1.99) each month to assist with the purchase of a refill for a 13kg LPG cylinder.

The introduction of *Auxílio-Gás* took place in the context of the liberalization of the cost of oil products in Brazil that started in the mid-1990s and ended a policy of universally subsidizing LPG that had lasted from 1954 to 1995 (ANP 2017). This long-term policy of LPG subsidization was aimed at helping families buy and refill LPG cylinders and at encouraging a switch in cooking fuels from wood to modern cooking gas. The liberalization of LPG prices meant that policymakers needed to introduce a monthly allowance to support low-income families' continued consumption of LPG (ANP 2017). According to Coelho et al. (2018), generous subsidisation programs aimed at replacing firewood with modern fuels such as LPG were made available all over the country to make LPG affordable for poor people.

Box 1: Support for energy as support for nutrition

It can be argued that supporting a transition to modern energy sources was not the only reason why the Brazilian Government started the LPG-support programs. As Zimmerman (2006) argues that Brazil's first social protection program targeted food poverty and malnutrition. Cooking meals guarantees nutrient absorption and increases energy intake. For this reason,

ongoing specific measures aimed at fighting extreme poverty and hunger went hand-in-hand with LPG programs to guarantee food security and nutrition for the poorest. The joint coordination of social safety nets and energy subsidies for low-income families and marginalized groups can be an effective way to target specific aspects of poverty such as malnutrition.

Integration into *Bolsa Família*

A desire to address bureaucratic inefficiencies and weak communication between different ministries appears to have driven the unification of different social programs into the *Bolsa Família* program, beginning in 2003/2004, as shown in Table 3. For Zimmermann (2006:149), the lack of effective coordination in implementing existing social policies resulted in leaving newly impoverished people behind. As an example of these systemic problems, Zimmermann notes that each

municipality received a fixed annual budget that was based on its current number of low-income households. This meant that if any additional families were identified, conditions of vulnerability in the following year would not be included in the program (Ibid. 149). For these reasons, the *Cadastro Único para Programas Sociais (CAD)*, a unified system that could more easily identify families eligible for more than program was created in 2003. This allowed the government to create a unified social safety net program in the form of *Bolsa Família*.

Table 2

The composition of *Bolsa Família* (values updated to 2019)

COMPOSITION OF BOLSA FAMÍLIA	FOR WHOM?	VALUE (IN BRL)
Basic benefit	For families living in extreme poverty (income up to BRL 89 per family per month)	89
Conditional benefits (additional)		
Children	For families with children and adolescents (0-15 years old)	41
Pregnancy	For pregnant women	41 (x 9 months)
Nutrition	For families with children (0-6 months)	41 (x 6 months)
Adolescents	For families in extreme poverty with adolescents (16-17 years old)	48 (each family can accumulate up to two benefits = BRL 96)
Benefit against extreme poverty	For families living in extreme poverty.	Additional support on top of basic benefit (amount varies depending on circumstances)

Observation

Families living in extreme poverty can accumulate the basic benefit and all the conditional benefits (pregnancy, nutrition, adolescents) up to a maximum of BRL 372 per month. In addition, families can accumulate up to one benefit against extreme poverty.

Source: Authors' elaboration based on CAIXA 2019

According to the official government website CAIXAⁱ, the main objectives of *Bolsa Família* are:

1. to fight hunger and promote food and nutritional security
2. to fight poverty and other forms of deprivation
3. to promote access to public services, especially health, education and social assistance.

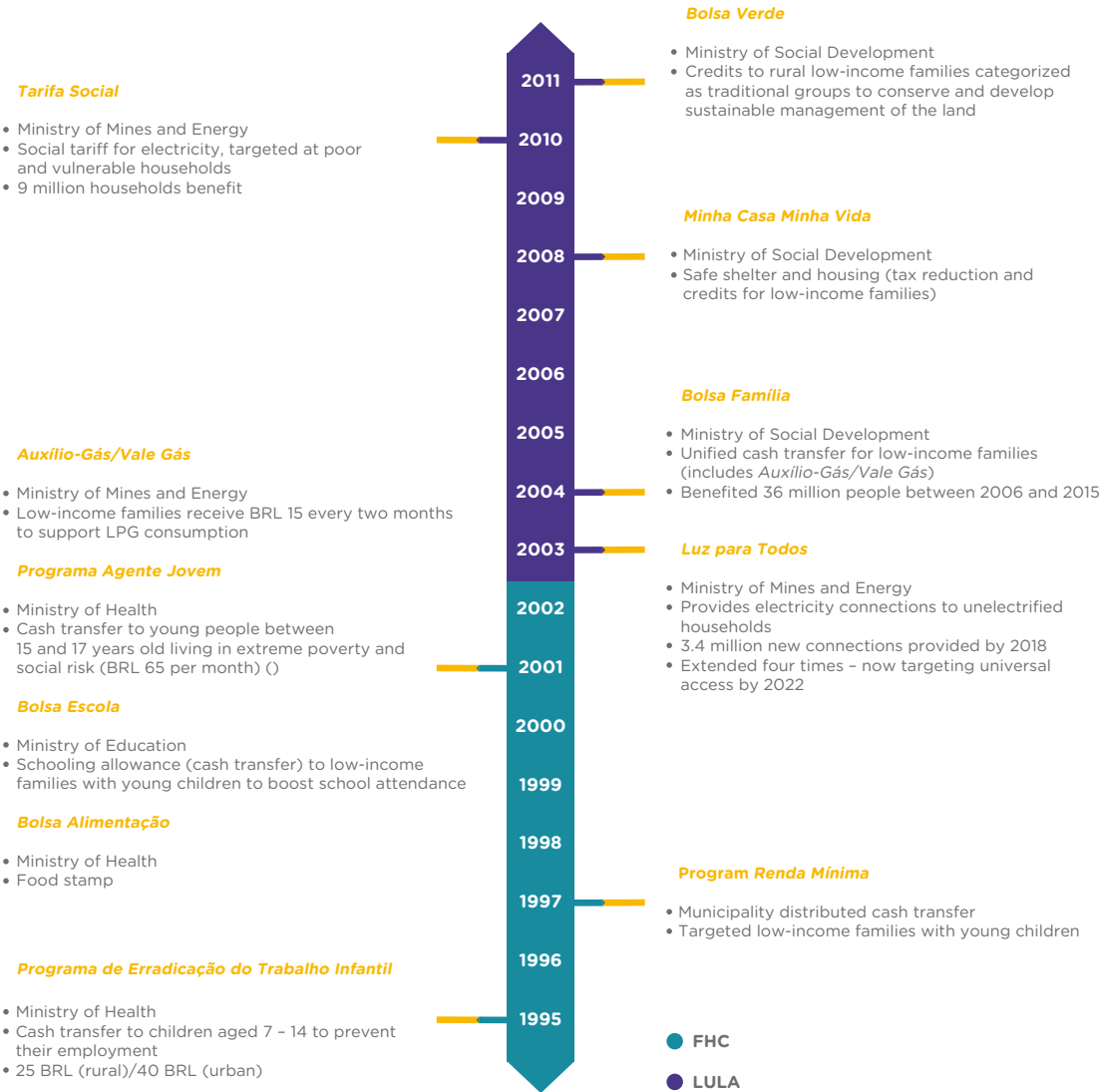
Bolsa Família supports families with children living below the poverty line to different degrees depending on their situation. Each family receives a cash card (*cartão*) to which the benefit amount is transferred monthly. Cardholders then use their

cartão to pay for designated goods and services. In 2019, the value of the basic benefit of the allowance was raised to BRL 89 per month (USD 23.59). Details of the basic benefit and the conditional benefits, i.e. those granted in addition to the basic benefit based on family composition, are shown in Table 2.

In addition to *Bolsa Família*, the government also provides support to households through the Zero Hunger (*Fome Zero*), My Home My Life (*Minha Casa Minha Vida*), and the Green Grant (*Bolsa Verde*) programs. For more details of the evolution of social assistance policies, see Figure 3.

Figure 3

Timeline: Introduction of Social Policies in Brazil (1995-2011)



Source: Authors' elaboration based on Zimmermann 2006 and MDS 2019

Box 2: Cadastro Único (CAD), Single Registry for Social Programs

In 2002, a self-identification registry called *Cadastro Único* (CAD) was created to facilitate the distribution of social programs and to act as the ‘gateway for poor people to access a set of over 20 policies’ (MDS 2015). This includes *Bolsa Família* and *Tarifa Social* (as per Decree 9357/2018) as well as other sectoral programs such as the Water for All Program. The CAD is ‘the main tool for the state to select and include low-income families in federal, state and municipal programs aimed at inclusive social participation in public policies’ (IBGE/PNAD 2014:22).

The enrollment guidelines developed by the MDS outline the application procedure as follows:

- A member of the family (generally the household head) is responsible for providing information about the other family members. The MDS clearly states: ‘the person – named as Person Responsible for the Family Unit (RF) – must be at least 16 years old, and preferably be a woman’ (MDS 2015).
- The person must visit a Social Assistance Office (CRAS) to enroll. In many cases the compilation of relevant information is carried out by social workers.
- The only documents requested for the enrollment in CAD are the RF’s identify card (also

called RANI in the case of indigenous people) and national insurance number (*Carteira de Trabalho*).

- The condition for enrollment in the CAD is that the household’s income should not exceed three minimum wages. In the case of a single person household, the beneficiary should not earn more than one minimum wage monthly. In 2019, the national minimum wage was equivalent to BRL 998 per month (USD 246), but state governments can vary the level of the minimum wage depending on local living standards.ⁱⁱ
- The beneficiary must notify the CAD of any changes in the household’s situation (household income, change of address).

In a household survey released by IBGE in 2014, 40.6 percent of households surveyed in Brazil were not aware of the existence of CAD and were not fully aware of all social assistance programs to which they may be entitled (IBGE 2016 p.26). This finding was corroborated during the first stakeholder workshop organized by COPPE/UFRJ for this research project in June 2019. Several participants flagged how citizens, mainly in remote areas, are often unaware of the main information regarding social policies in the country.

LUZ PARA TODOS

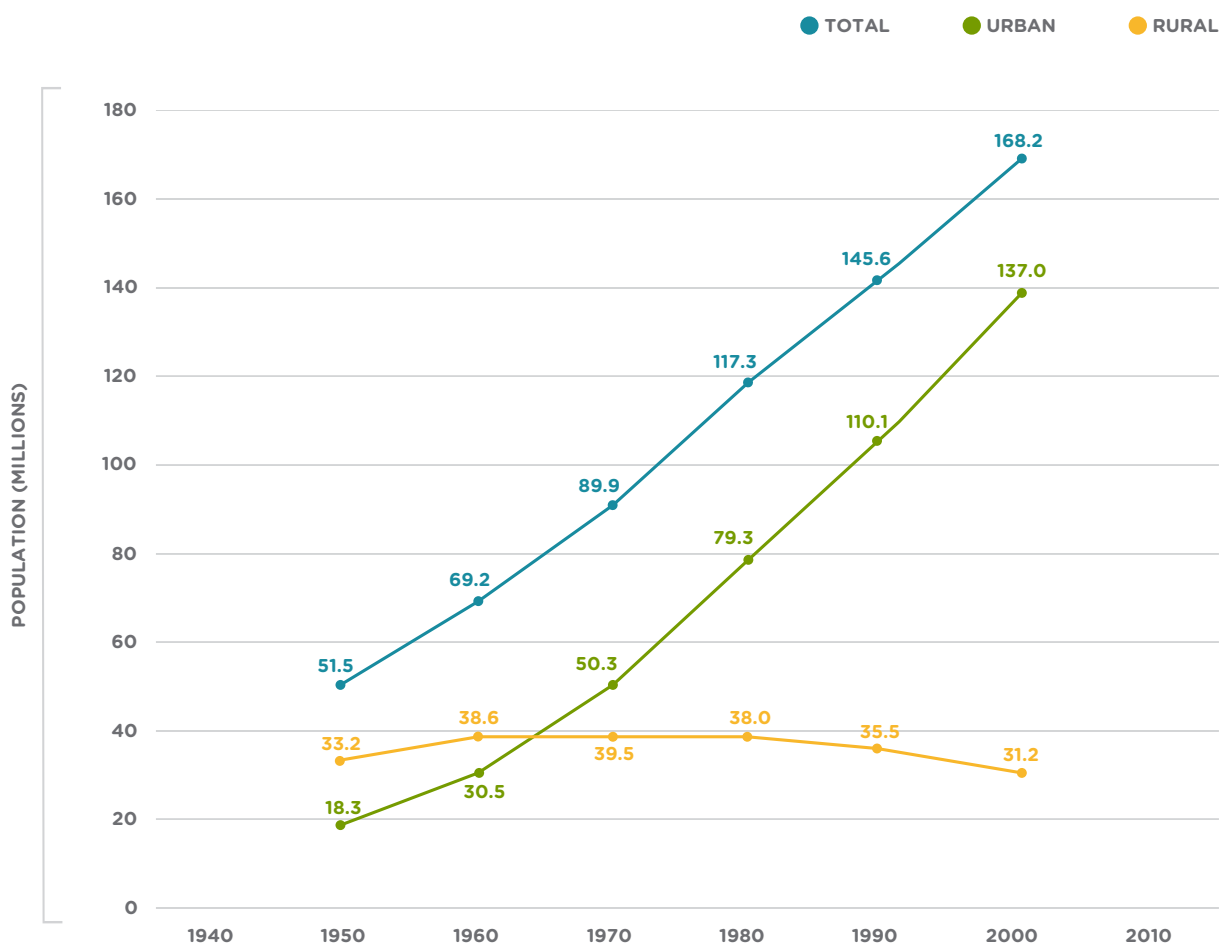
Electricity access prior to Luz para Todos

Prior to the introduction of *Luz para Todos* in 2003, household electricity coverage was 93 percentⁱⁱⁱ (urban and rural) with 97 percent access in urban areas and 70 percent in rural areas (IBGE 2002). This result was realized by alternating stages of public and private investments that can be divided into four main phases:

- i) Initiatives led by foreign investments and private companies (1879-1930)
- ii) Creation of the state-owned company *Eletrobras*, which held a monopoly over the sector and expansion of the hydroelectric park (1930-1990)
- iii) Privatization of the electricity sector and creation of the Electricity Regulator – ANEEL (1990-2003)
- iv) Reform of the electricity sector, rural electrification and energy development that is now subsidized by the government (2003-today).

Figure 4

Population with access to electricity, 1960-2000



Source: Authors' elaboration based on ANEEL 2002 and IBGE 2000

The second and third phases were when the bulk of residential electricity access was achieved, especially in urban areas where every urban household that requested a connection from the local energy company distributor was provided with one. However, in rural areas, consumer demand for new electricity connections was largely ignored, resulting in the development of private initiatives. Rural households organized themselves into energy cooperatives that would carry the costs of rural electrification. In return for covering these costs, rural consumers received large discounts on their electricity bills from the local energy enterprise responsible for that area. According to one of the energy stakeholders interviewed for this report: "rural electrification from 1930s to 1990s was largely driven by private initiatives and the creation of energy cooperatives" (AMX 2019). From 1990 to 2002, rural electrification became a concern for the government and several initiatives, including *Luz no Campo* (Light in the Countryside) and PRODEEM (the Brazilian Program for Rural Electrification Using Photovoltaics – 1996-2003),^{iv} set out to provide rural households with electricity access in the form of renewable electricity. These programs were largely funded by foreign enterprises and development finance institutions.

Electricity sector reform and the launch of *Luz para Todos*

In 2002, a significant shift in the electricity sector occurred when the rules for achieving universal electricity access became stricter. Law N°10,438/2002 required electricity distribution companies to respond to new requests for residential electricity connection within three days in urban areas and five days in rural areas and prevented them from charging the final consumer for the costs (ANEEL 2016). The 2002 law also required energy distribution companies to maintain all new electric connections free of charge to the final user. Funding comes from various sources but flows through the *Conta de Desenvolvimento Energético* or CDE (Account for Energy Development) (see Box 3).

Building on reforms, Brazil launched *Luz para Todos* in 2003, with the aim of providing access to electricity in still-unserved rural areas. According to the IBGE, more than 2 million rural households, or over 12 million Brazilians, lacked access to electricity in 2002. Further aggravating their exclusion, approximately 90 percent of these households were estimated to be living in areas with a low HDI and on less than three times the minimum wage^v

Box 3: *Conta de Desenvolvimento Energético (CDE), Account for Energy Development*

Conta de Desenvolvimento Energético (CDE), Account for Energy Development was established in 2002 under Law N°10,438/2002 and is regulated by the ANEEL. The CDE covers the costs of universal energy access, funds the subsidies

provided through *Tarifa Social* (affordability) and supports *Conta de Consumo Combustível (CCC)*, the cross-subsidization account. The CDE is financed through levies added to consumer electricity bills.

i.e. the level at which households were eligible for support from *Bolsa Família* and other social safety nets.

Initially, the *Luz para Todos* program was to end in 2008, but it was subsequently extended several times, most recently to 2022 (under Decree 9357 of 2018). The initial target of connecting 12 million rural people by 2008 has been revised to that of achieving universal access by 2022 (MME 2015; 2017; 2019).

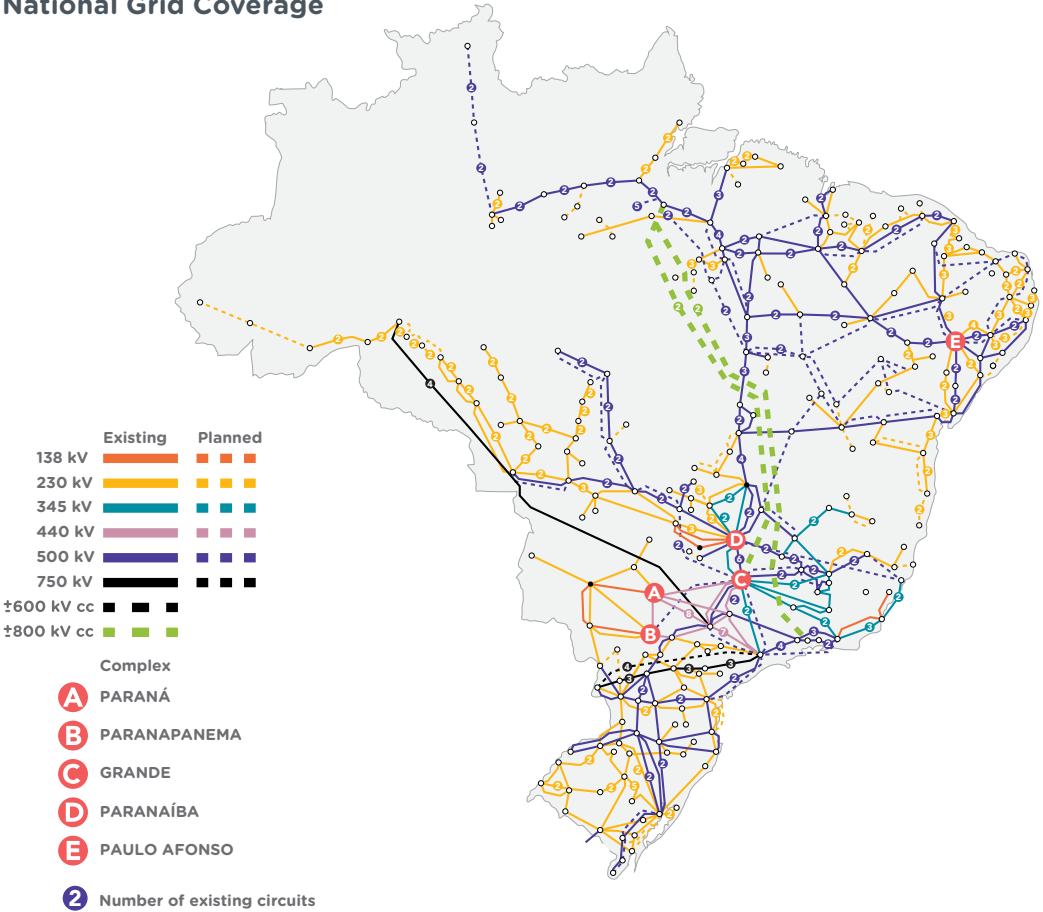
The limitations of grid extension for providing electricity access

The preferred strategy for increasing electricity access in Brazil has been characterized by contin-

ued expansion of the hydropower park and extension of the national grid, starting with urban, densely populated areas and then moving to rural and isolated areas. The reliance on hydropower for electricity generation entails a complex organization of resources and interconnections between the reservoirs, in addition to distribution to the final consumer.

In 2017 the national interconnected grid covered 141,388 km across the south and east of the country (see Figure 5) but remained largely absent in the state of Amazonas and in parts of Acre, Mato Grosso, Roraima, Pará and Amapá (the Legal Amazon). The grid is unlikely to be expanded into the Amazon forest for a number of reasons (ANEEL 2010). These include the geomorpho-

Figure 5
National Grid Coverage



Source: ONS 2017

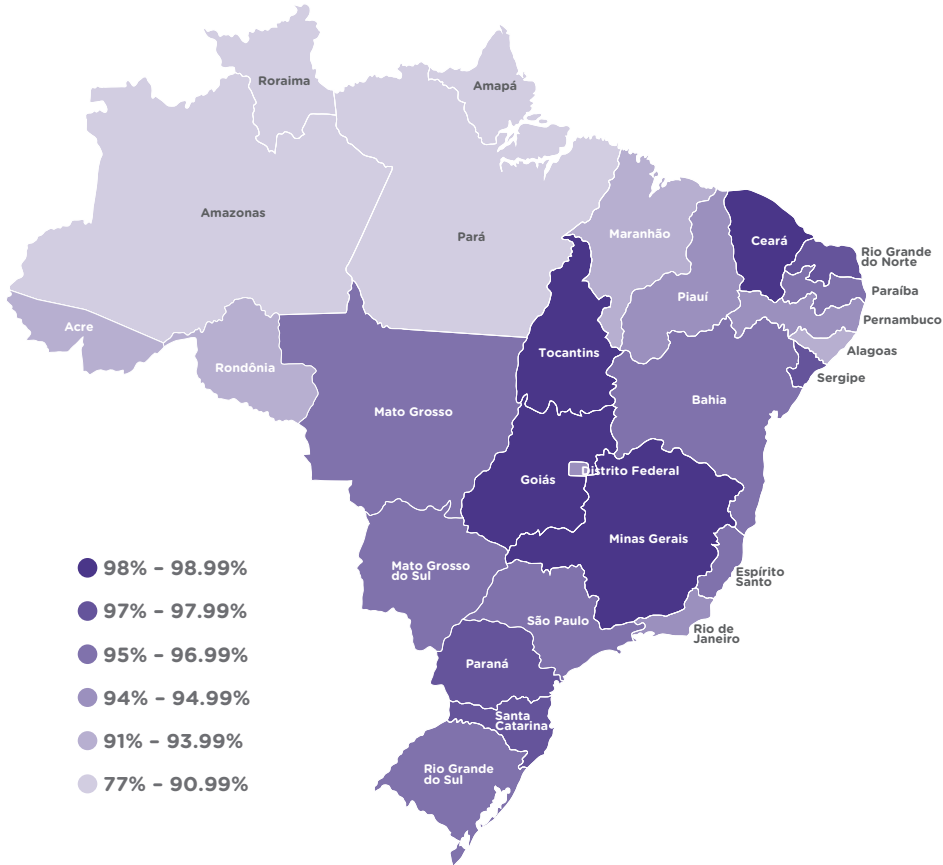
gy of the Amazon forest with its thick vegetation; low-density population and the low return over investment on energy development projects in this area. Moreover, the Amazon forest hosts one of the most ethno-culturally diverse populations living in natural parks and sustainable reserves where development plans are not encouraged by conservation plans.

The area outside national grid coverage is called the isolated system. It is composed of medium-size thermopower plants supplying energy to the consumers of the northern states (Amazonas, Pará, Roraima, Amapá and Mato Grosso as well as the island of Fernando de Noronha). As Figure 6 shows, the territory covered by the isolated system corresponds in large part to ar-

reas with the lowest electrification rates and lowest HDI values in Brazil.

The Ministry of Mines and Energy (MME) identified specific contexts in which access to electricity was particularly challenging, such as vulnerable indigenous or traditional communities living in remote and sensitive ecosystems (natural parks, extractive reserves and indigenous lands). In these areas, the MME ascertains that, as the national grid can not be expanded, local populations should be served by renewable and decentralized systems (ANEEL 2017). Among the available technological options, the MME encourages mini- and micro-hydropower plants, thermopower plants fueled by biofuels or natural gas, wind power, and solar photovoltaics.

Figure 6
Access to Electricity by State, 2010



Source: Authors' elaboration based on UNDP Atlas 2012 and IBGE 2010.

In addition, there are hybrid systems involving a combination of options including diesel/renewable hybrids (ANEEL 2017).

Shifting focus to prioritize those left furthest behind

The priorities of *Luz para Todos* have evolved over time. Initially the program prioritized low-HDI communities located near the grid, whose connection was at the lowest cost. As these near-grid communities were connected, the focus shifted to more remote communities and then, in the final phase, to families located in regions farthest from the grid, especially in the Amazon. In recent years, *Luz para Todos* has targeted low-income families, ethnic minorities and vulnerable populations living in protected areas such as national parks, extractive reserves and conservation areas (Decree N° 9357/2018). These areas correspond to the regions with the lowest HDI in Brazil – see Figure 6.

To accelerate the completion of *Luz para Todos* in rural areas, the MME issued a regulation in 2012 requiring energy distributors (currently still relying on the CDE to finance universal electricity access)^{vi} to give priority to remote communities and ‘traditional’ groups. The Ministry of Environment (MMA) categorizes these as specific groups of people who share distinctive low socioeconomic status, geographies and sociocultural identities, including: a) indigenous Indians; b) *Seringueiros* (rubber workers); c) *Quilombolas* (people of African-Brazilian heritage); *Castanheiros* (nut collectors); d) *Quebradeiras de coco-de-babaçu* (babaçu coconut workers); e) *Pescadores Artesanais* (artisanal fishermen); f) *Ribeirinhos* (riverine people); g) *Ciganos* (Romani people); and h) *Caatingueiros* (people living in the Caatinga biome) among others (MMA 2017). *Luz para Todos* relies on these categories to prioritize future connections. The 2012 regulation stipulated that the most vulnerable and marginalized groups should be given priority for electricity connection. For

example, if the electricity distribution company in the state of Amazonas received two connection requests in the same period, one in a peri-urban village and the other in a *quilombola* village, they should connect the *quilombola* one first, even if the peri-urban request (because of geographical vicinity) were easier to connect in terms of distance and cost.

TARIFA SOCIAL

The history of subsidized electricity consumption

The *Luz para Todos* program aims to achieve universal electricity access, but once connected, how do low-income families pay for their electricity services? Gomes and Silveira (2012:160) suggest that the creation of social tariffs is ‘instrumental in the process of ensuring the sustainability of the [universal electricity access] program’. This led to the creation of a social tariff to complement *Luz para Todos* and ensure affordability of electricity by consumers. The *Tarifa Social* program was created under Law N°12,212/2010 and is the most important subsidy for electricity consumption for low-income people. While the tariff was only introduced in 2010 (considerably after the launch of *Luz para Todos*), discounts on electricity consumption had been used since 1985 in the context of economic recession, inflation and high national debt. Prior to 2010, discounted tariffs were not introduced explicitly as a tool to reduce energy poverty. Due to economic recession, the demand for electricity in the late 1980s and 1990s decreased. This coincided with several hydropower plants (commissioned during the 1970s) coming onstream. As a result, the supply of electricity exceeded demand and consumers were encouraged to consume more electricity with the introduction of discounted tariffs (Tavares 2004). Hence, discounted tariffs were originally a way to increase electricity consumption and avoid financial losses on in-

vestment in the hydropower plants operating during the economic crisis.

A volume-differentiated tariff that varies by region and beneficiary group

Tarifa Social has two components – one targeted at low-income households and the other at the most vulnerable marginalized social groups.

To be eligible for the low-income *Tarifa Social*, households must be enrolled in the CAD. The *Tarifa Social* is a volume-differentiated tariff. A lifeline block mandates that if a household consumes 30 kWh per month or less, they will receive a 65 percent discount on their electricity bill. As a household’s monthly electricity consumption increases, the percentage discount decreases (see Table 3).

The same tariff structure is also available to vulnerable groups of people likely to be affected by energy poverty, such as the elderly and disabled. The *Benefício Assistencial ao Idoso e à Pessoa com Deficiência* (BPC) or Benefit for Elderly and Disabled People, is a cash transfer program targeting older people (over 65) and people with

permanent disabilities (of any age).^{vii} Households with a BPC beneficiary also receive discounts on their total electricity bill.

Electricity tariffs in Brazil also vary by region. The average tariff in 2018 was 0.568 BRL/kWh (ANEEL 2019). This means that without the discount, a family consuming 30kWh would pay BRL 17.00 (USD 4.10) per month. With a discount of 65 percent the family would pay BRL 5.95 (USD 1.44). In addition to the volume-differentiated discount, electricity is also cross-subsidized in some regions, especially in the northern regions where the costs of generation and distribution of energy are higher than in other parts of the country. Here, consumers of isolated systems receive electricity generated by decentralized thermal power plants that rely on fossil fuels. The lack of energy infrastructure together with low population density and large distances between urban centers contribute to high prices of goods and services. Higher tariffs than in other regions would be needed to cover the extra costs of generation compared to electricity generated by the national grid. Given that these northern areas have some of the lowest HDI values in Brazil, fossil fuels for transportation, cooking and electricity

Table 3
***Tarifa Social* for low-income households**

MONTHLY CONSUMPTION QUOTA (MCQ)	DISCOUNT (%)
MCQ <= 30 kWh	65
31 kWh < MCQ <= 100 kWh	40
101 kWh < MCQ <= 220 kWh	10
221 kWh < MCQ	0

Source: Authors' elaboration based on ANEEL 2016

Table 4**Tarifa Social for indigenous groups**

MONTHLY CONSUMPTION QUOTA (MCQ)	DISCOUNT (%)
MCQ <= 50 kWh	100
51 kWh < MCQ <= 100 kWh	40
101 kWh < MCQ <= 220 kWh	10
221 kWh < MCQ	0

Source: Authors' elaboration based on ANEEL 2017

generation are subsidized. The ANEEL, through Resolution No. 350/1999, and the *Câmara de Comercialização de Energia Elétrica* (CCEE), through Law N°13,360/2016, manage the Fossil Fuels Consumption Account of Isolated Systems (CCC-ISOL), a levy collected in transmission and distribution tariffs that subsidizes the energy prices concessionaires and distributors charge in areas within the isolated systems (OLADE 2017). In 2004 this subsidy reached BRL 1.2 billion (USD 318,000) and in 2008 it tripled to BRL 3 billion (USD 800,000) (ANEEL 2008).

As with the evolving phases of *Luz para Todos*, the *Tarifa Social* has been modified to specifically target more support toward Brazil's most marginalized and vulnerable people. The MME under Decree N° 8.387/2014 identified a series of groups who should receive further reductions in their energy bills. These categories include

indigenous groups (*Indians, Quilombolas, Ribeirinhos*) living in areas of extreme poverty and remote rural dwellers, both of whose socioeconomic conditions and geographical isolation make them the most disadvantaged segments of the population. This second component of the *Tarifa Social* provides a greater discount rate and higher consumption thresholds (per Table 4). Households consuming up to 50 kWh of energy per month are exempt from any payment for electricity.

The consumption of electricity is also subsidized for people living in the vicinity of, or in the same territory as, energy development programs (e.g. hydropower plants). As per Article 146 of the Indigenous People Statute (2009:38), communities (mostly indigenous) negatively impacted by the energy sector are not be charged for electricity connection or consumption.

*BOLSA FAMÍLIA,
LUZ PARA TODOS
AND TARIFA SOCIAL:
IMPACTS AND INSIGHTS*

BOLSA FAMÍLIA AND THE IMPACTS OF THE LPG ALLOWANCE

Poverty reduction

The numbers of poor and extremely poor people in Brazil totaled 59 million and 25 million, respectively, in 2001 (IBGE 2019). While these numbers decreased slightly in the 2000s, it was only after the launch of *Bolsa Família* in 2006 that the numbers decreased significantly, to 14 million and 5 million respectively in 2014 (IBGE 2019). Between 2006 and 2015, *Bolsa Família* benefited 36 million people and increased living standards in Brazil (IDB 2015:38). Its coverage among the poorest 20 percent of the Brazilian population has increased over time, reaching 60 percent in recent years. Its incidence coefficients—measuring the redistributive impacts of the first real disbursed by the program—have also become more negative, which indicates the measure has become increasingly progressive. About 70 percent of the benefits of *Bolsa Família* have reached the country's poorest 20 percent. In 2017, *Bolsa Família* trans-

fers lifted 3.4 million people out of extreme poverty and 3.2 million out of poverty (IPEA 2019). Currently in Brazil there are 13.9 million people receiving the benefit (MDS 2019).

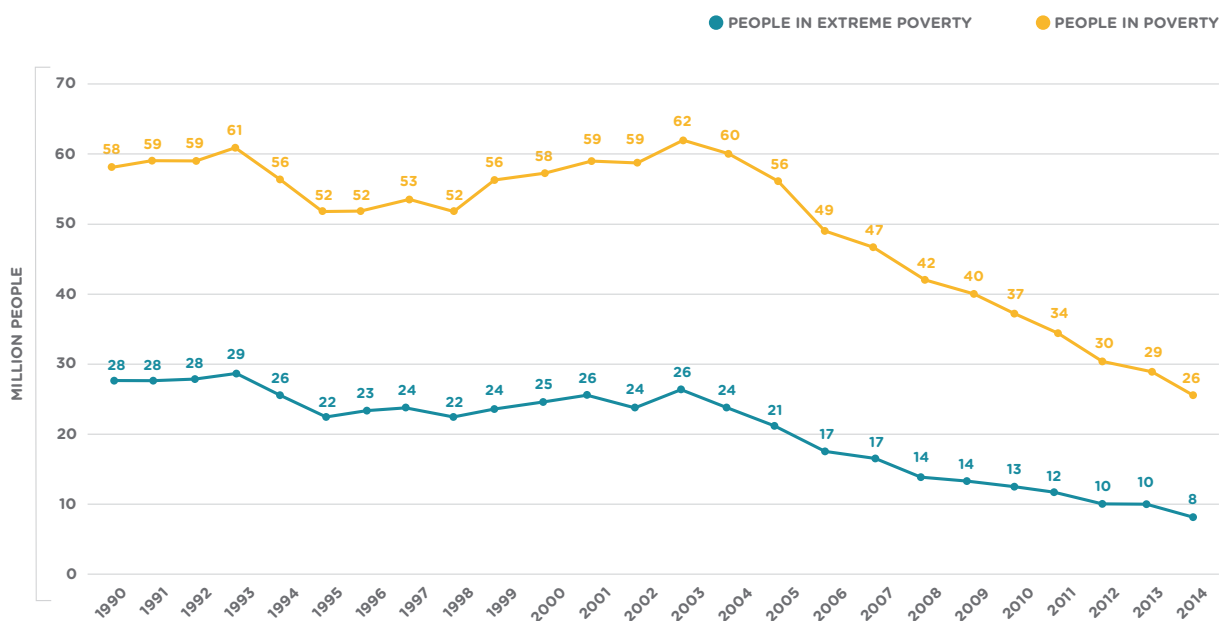
Bolsa Família represents an important resource for low-income families. However, two issues—diversion to other goods and services, and failure to keep pace with real cost increases in LPG—raise serious questions over the continued effectiveness of the program in supporting energy access for the most disadvantaged groups.

Challenges of subsidizing energy access within *Bolsa Família*

During the second stakeholder workshop, participants (energy stakeholders, academics and NGOs) were asked about the effectiveness of consolidating diverse safety nets under *Bolsa Família*. The participants disagreed with the analysis in the literature discussed above that this integration helped the government to have better control over the transfer, thus minimizing the risk

Figure 7

Evolution of poverty in Brazil



Source: Authors' elaboration based on IBGE 2019

of fraud, arguing that the consolidation neither simplified the process nor reduced bureaucracy.

In addition, participants suggested the delivery of *Bolsa Família* limited its ability to promote energy access. Families receiving *Bolsa Família* simply receive a lump sum cash transfer each month with no limitations attached to how it may be spent. No assessment was found as to whether the LPG portion of *Bolsa Família* contributed to household energy expenditure, however, it appears that ‘invisibility’ of the energy access subsidy within the non-earmarked *Bolsa Família* means families have the freedom to allocate their LPG allowance to other goods (mostly food and educational materials). As a result, the government is considering a return to the old *Vale Gás* voucher program exclusively aimed at subsidizing the monthly purchase of an LPG cylinder.

The value of *Bolsa Família* has not kept pace with the cost of LPG

The workshop participants also highlighted that the amount of money transferred under the *Bolsa Família* has become increasingly insufficient to cover the purchase of LPG. The impact varies between regions, due to disparities in delivery costs, and has been compounded by the rise in

the market price of LPG and the fall (in real terms) of the value of the *Bolsa Família* with inflation averaging 6.5 percent in the 2000-2017 period (IPEADATA 2019). This inability to keep pace with inflation may also have led to recent increases in the numbers of poor and extremely poor between 2015 and 2017.

Table 5 shows the nominal annual price of LPG in comparison to the value of the *Bolsa Família* in Brazilian reals, both of which have increased in recent years. The figures are not directly comparable because *Bolsa Família* is paid monthly, while a cylinder may last longer than one month. However, the bottom row clearly illustrates that for a household to consume the same amount of LPG, they had to use more of their *Bolsa Família* transfer in 2019 than in 2015, i.e., the cost of a 13kg cylinder represented 58 percent of the monthly *Bolsa Família* in 2015, while in 2019 it represented 79 percent of its value.

Moreover, the liberalization of the LPG market initiated in the mid-90s leading to a complete withdrawal of subsidies by the end of 2000 (Coelho et al. 2018) also created regional disparities. For example, monthly reports released by the MME show that the northern region has the highest prices for LPG due to the distribution margin and transportation costs (MME 2015 N109, 2015: 9).

Table 5
Nominal price of LPG and value of *Bolsa Família*

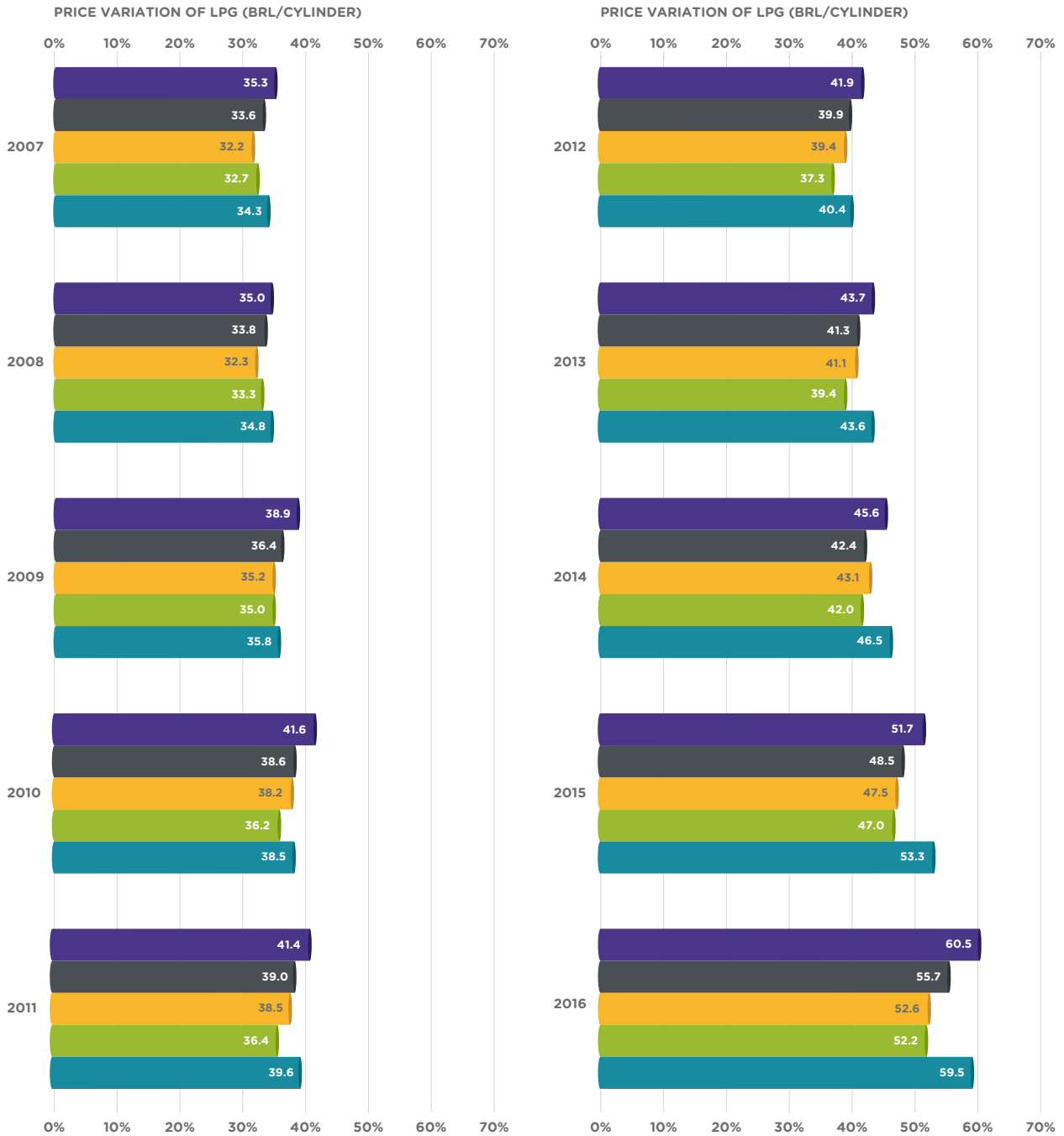
	2015	2016	2017	2018	2019
Value of monthly <i>Bolsa Família</i> transfer (BRL)	77	82	85	89	89
Cost of 13 kg LPG (BRL)	45	50	55	65	70
Cost of LPG cylinder as share of value of monthly <i>Bolsa Família</i> transfer	58%	61%	65%	76%	79%

Source: Authors' elaboration based on ANP 2019 and Ministry of Social Development 2019

Figure 8

Real price variation of LPG (to final user) by region in Brazil, 2007-2016

● CENTRE-WEST ● SOUTH ● SOUTHEAST ● NORTHEAST ● NORTHERN REGION



Source: Authors' elaboration based on ANP 2017

Impact of the increase in LPG price on energy access

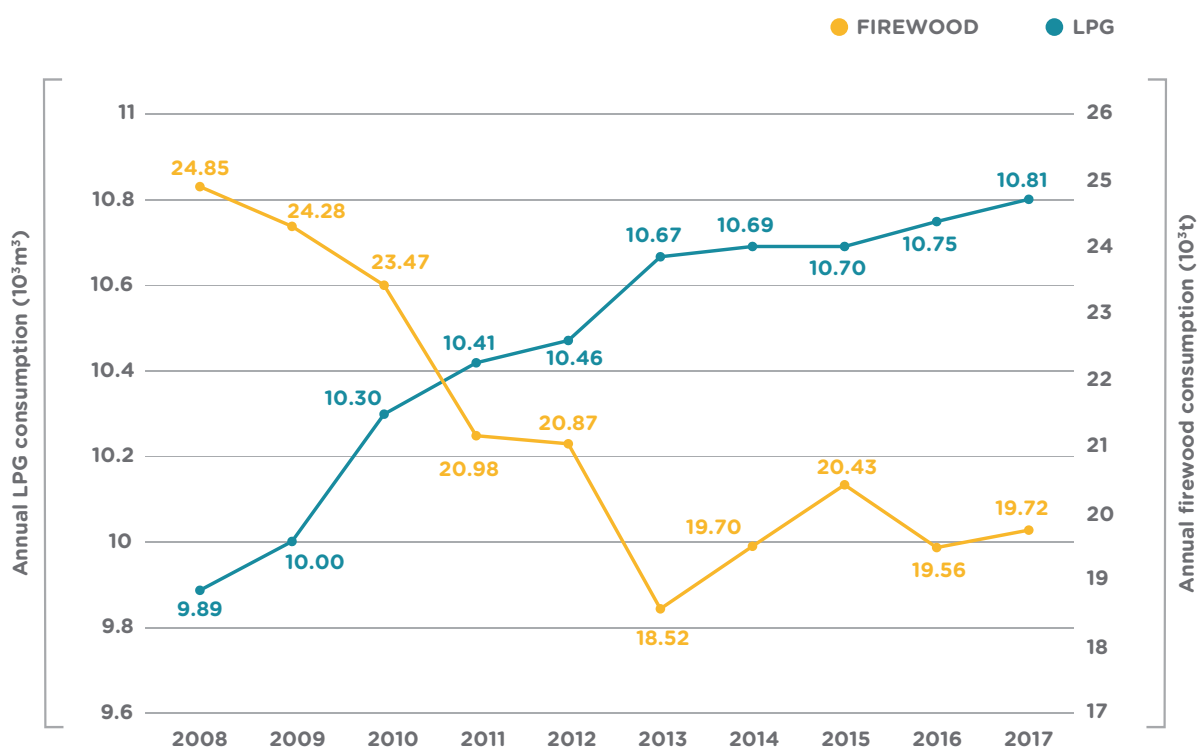
According to Gioda (2019:373) “the use of firewood by the low-income population seems to be directly associated with the price of LPG. In general, the firewood used by this population is of ‘picking’ quality (gathered from the land without cost) and the stoves are rustic”. Figure 9 presents data from the state-owned Energy Research Company (EPE 2017) showing a decrease in the use of residential firewood consumption from 2008 to 2013 (from 24.9 to 18.5 kilotons) along with a corresponding increase in LPG consumption. This supports the assertion by Coelho et al. (2018) that the LPG subsidization policies contributed to a 22 percent reduction in households consuming firewood between 2002 and 2012.

However, since 2013, levels of residential firewood consumption have shown a slight increase (to 20.4 kilotons in 2015) while consumption of LPG has remained constant (Figure 9). Although their analyses use different methodologies,^{viii} this increase was corroborated by the IBGE that calculated that there was an increase to 17.6 percent in households using firewood as fuel for cooking in 2017 compared to 16.1 percent in 2016 (IBGE 2019; Gioda 2019). More research is needed to understand how the recent economic crisis combined with the increase of LPG prices has impacted fuel choices in low-income households.

To minimize the impacts of the increase in LPG price on energy access, workshop participants also recommended decreasing fees and taxes on LPG and providing subsidies for the purchase of solar stoves in rural areas with poor LPG distribution networks.

Figure 9

Residential consumption of firewood and LPG in Brazil, 2008-2017



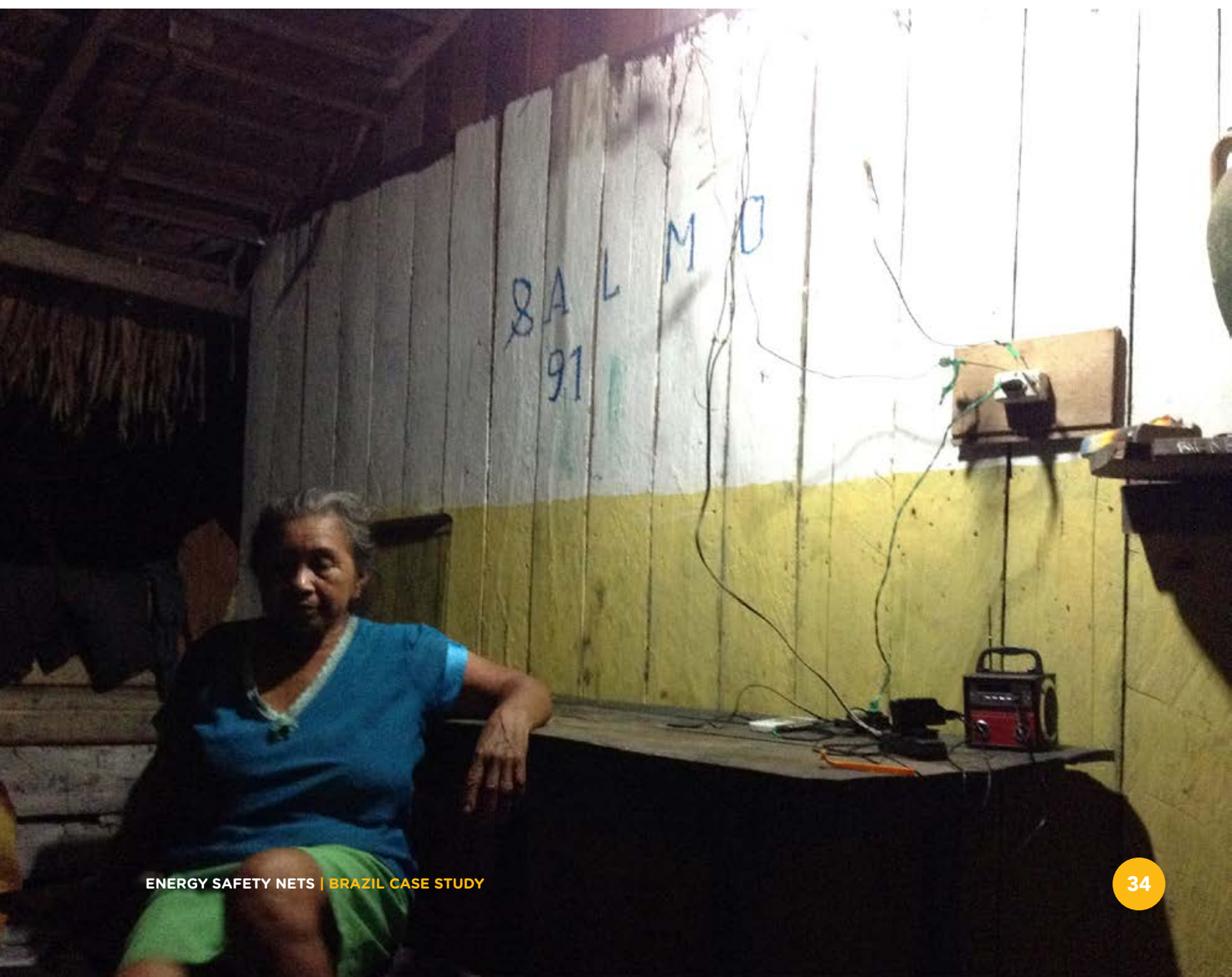
Source: Authors' elaboration based on EPE 2017

A lack of awareness of social protection programs by beneficiaries may hamper the programs' impact

A lack of information and awareness about social protection programs such as *Bolsa Família* may be preventing eligible households from accessing them. Communication via television and radio are popular ways to inform citizens about social programs, yet it is unclear whether this is the best way to reach everyone. For example, as noted above, the northern region has the lowest energy access rate, which is likely to limit households' access to electronic communication sources and may be a key contributor to the region also having the lowest level of awareness of social safety nets (IBGE 2019). In such regions, awareness raising is carried

out through local intermediaries and municipal secretaries. For example, each village in northern Brazil has a representative whose task it is to travel to nearby towns, talk to the local secretary/municipality and report back to the community on new programs being implemented.

No research was found that comprehensively investigates where communication is breaking down, yet anecdotal evidence points towards systemic failures in the way information about social programs is conveyed by village representatives. Further work is needed to investigate the degree to which households having access to electricity and being able to access information directly (i.e. without depending on intermediaries) increases awareness of social programs.



THE IMPACTS OF LUZ PARA TODOS AND TARIFA SOCIAL ON PROMOTING ACCESS TO ELECTRICITY

Luz para Todos: delivery of near-universal electricity access

When *Luz para Todos* began in 2002, more than 2 million rural households in Brazil did not have access to electricity. The lower population density in unconnected rural areas required the installation of large amounts of infrastructure, and a greater effort and longer-term investments from the electricity distribution companies and rural electrification cooperatives.

In terms of the success of *Luz para Todos*, respondents interviewed for this research stated that the goal of universal access to electricity in rural areas has mostly been achieved. The 2022 target for universal access is primarily aimed at the remaining unconnected households in the north and northeast of Brazil. In December 2018, *Luz para Todos* investments reached BRL 26 billion, with approximately 3.4 million new connections since 2004. In all, the program has benefited 16.4 million people in rural regions of the country or 7 percent of the total population (MME 2017). This involved 542,000 projects

being implemented across 5,435 municipalities, and included: installation of (i) more than 784,000 km of high and low voltage distribution electricity grids; (ii) 8.2 million poles; (iii) 1.1 million transformers; (iv) more than 3,500 individual solar home systems; and (v) 17 micro photovoltaic systems (MME 2019).

Tarifa Social has supported consumption for the poorest, but not for all poor groups

Alongside the gains made by *Luz para Todos*, there are currently almost 9 million households (11 percent of total households in the country) or 36 million people currently benefiting from the *Tarifa Social* (March 2019 – ANEEL). This has undoubtedly insulated some households from the decrease in electricity consumption witnessed across the economy generally since the economic crisis in 2015. In particular, aggregate consumption by households that consume small amounts of electricity increased by 11 percent and total residential consumption between 2015 and 2016 increased by 1.3 percent (EPE 2017). This was the opposite of the trend that occurred during the 1985 economic crisis, which pushed consumers to reduce their electricity consumption and that may be viewed as *Tarifa Social* successfully supporting low-income household electricity consumption even

Table 6
Regulated power consumption by end-use sector

	2012	2013	2014	2015	2016
Residential (GWh)	117,646	124,908	132,302	131,190	132,872
Low-Income Residential (GWh)	13,668	16,742	18,849	13,836	13,329
Residential (Million Households)	60.5	62.7	64.9	66.9	68.2
Low-Income Residential (Million Households)	10.5	12.1	13.0	9.6	9.3

Source: Authors' elaboration based on EPE 2017 and ANEEL 2019

during times of relative economic hardship. However, a breakdown of the statistics shows that the actual residential consumption among low-income households dramatically decreased from 18.849 GWh/year in 2014 to 13.329 GWh/year in 2016 (Table 6).

Some of this decrease may be explained by a potential drop in households benefiting from the *Tarifa Social*. Data from ANEEL (2019) show that in 2012, 10.5 million residences were benefiting (17.4 percent of households). In 2016, the number of households decreased to 9.3 million (3.6 percent of total households). However, further disaggregation of the data shows that the overall decrease in consumption by low-income groups between 2014 and 2015 was in fact driven by those households that consume relatively high levels of electricity: consumption in the 101-200 kWh bracket decreased by 4 percent and consumption in the >200 kWh fell by 10 percent (EPE 2017).

This suggests that although the *Tarifa Social* may be protecting those households with very low electricity consumption levels,^x it is not sufficient to cover the modern electricity demands of most poor households, that is, to run computers, washing machines and other appliances that alleviate household chores and help with education and livelihood diversification (Mazzone 2019). More data are required to understand how electricity consumption in low-income households is affected by broader economic hardship, and the impact on the aggregate numbers of newly poor households (see Figure 7) but it appears that modifications to *Tarifa Social* would be required to successfully insulate all poor groups.

This need for modifications to ensure that *Tarifa Social* benefits low-income groups was also highlighted by participants in the second workshop. As one respondent commented:

"Currently the Social Tariff only helps a proportion of the population. This because the selection criteria for this program tend to exclude households with more than one family unit."

THE GENDERED IMPACTS OF ENERGY SAFETY NETS IN BRAZIL

The need to apply a gender lens to any analysis of energy access is increasingly being realized. Literature on energy and gender focuses on two main areas. Work in the first area analyzes the impacts of consumption of energy on health, food security, job opportunities and mobility. In the second area, energy and gender research focus on the inclusion of women in the energy sector (both as policymakers and as energy entrepreneurs), which is not the focus of this research. However, a recent publication by Falcao et al. (2019) analyzed the impacts of *Luz para Todos* on gender equality.

The Ministry of Mines and Energy (MME 2013), cited in Falcao et al. (2019), claims a direct correlation between access to *Luz para Todos* and an increase in women's safety, economic activities and educational levels. According to Falcao et al., (2019:26) 245,000 women started a productive activity after gaining access to electricity. However, the report does not provide any evidence in terms of the impacts of ESNs on gender equality. For example, an increase in women's economic activities often does not translate into gender equality, instead being more likely to increase women's time poverty (Chant 2006). Providing targeted interventions that promote income creation—including but not limited to energy access—can give women another tool to fight extreme income poverty. However, an over-emphasis or assumption that access to energy automatically promotes gender equality through increasing women's income is reductive. More systemic social and cultural changes in gender norms and ideologies are required (Mazzone 2019b). Further data and analysis are needed to understand what linkages, if any, exist between the provision of ESNs in Brazil (i.e., the *Bolsa Família/Auxílio-Gás*, *Luz para Todos*, and *Tarifa Social* programs) and improvements in women's well-being and gender equality.

CONCLUSIONS



This case study provides an assessment of the main policy measures used in Brazil to enable very poor and marginalized people to access and use modern energy services. The *Luz para Todos* and *Tarifa Social* programs have had a positive and important impact in terms of increasing access to electricity for the country's most vulnerable groups. *Luz para Todos* has been effective at expanding access to electricity to present near-universal levels, with universal access expected to be achieved before 2030. *Tarifa Social* has helped to make electricity consumption for the lowest-consuming poor households more affordable. However, the scheme has not guaranteed affordable electricity for all poor households and it would need to be modified to fully support poor households to consume more than very basic levels of electricity. *Bolsa Família* represents an important resource for low-income families, and has successfully lifted many out of poverty. However, the program is not well set up to promote access to modern cooking energy such as LPG. This is, in part, because the program's energy component is non-earmarked, which allows households to use the benefit to pay for other services, and, in part, because the amount it provides to poor households is inadequate to cover the rising cost of LPG.

Recent data show that the number of people using traditional biomass for cooking in Brazil has increased, likely due to the recession Brazil has experienced since 2014. In addition, reverting to a separate LPG voucher, as was provided under *Vale Gás*, and increasing the allowance might ensure greater access to cleaner cooking for some low-income households.

Finally, it is necessary to carry out impact analyses for *Tarifa Social* and *Bolsa Família* and apply a feminist perspective to assess the links between ESN programs and women's well-being and gender equality.

SUGGESTIONS FOR FURTHER RESEARCH

In the course of this study, data gaps were identified that point to areas for future research related to ESNs in Brazil. These can be grouped into three areas: (i) the need to gather more evidence on the experience of the beneficiaries of ESN programs (i.e. poor and vulnerable households); (ii) multidimensional, quantitative impact analyses; and (iii) analysis of the performance of ESNs during times of economic hardship. Further research should be informed by the following:

- Despite being supported by official data and statistics, this case study is mostly based on a qualitative analysis and the perceptions of interviewees and workshop participants. In this regard, broadening the range of stakeholders interviewed could build understanding of the role of such programs in the maintenance of ESNs in the country. In particular, representatives from actual or potential target beneficiaries (poor and vulnerable households) could provide insights into how these groups perceive the schemes, and to what extent these programs have provided access to energy, and their specific challenges or successful characteristics, to inform the future design and delivery of such programs.
- Statistical analyses are also needed to identify correlations between energy access, levels of income, quality of life and the support provided by the programs identified in this study. Such an analysis has not yet been conducted at the national level, but doing so would help to assess the validity of the qualitative analysis presented here.
- An important development of this study has been to assess how ESNs perform over the long term (i.e., the extent to which energy access can be maintained during times of economic hardship). However, more data and more analysis are required to inform future policy decisions. More relevant data should be available from the 2020 Census, which is set to include energy questions.

POLICY RECOMMENDATIONS

Brazil's electricity access programs have been broadly successful in their primary goals of providing electricity connections and supporting basic levels of consumption. However, they do not universally support access to electricity, particularly in those low-income households that consume over 200kWh. In this case, the physical connection to the electricity grid is not the only problem, since affordability is also a barrier in the use of electricity. To deal with this, it is necessary to invest in an awareness-raising campaign and amend eligibility criteria to expand CAD and allow *Tarifa Social* to support electricity consumption by poor and vulnerable households that are not included under the current scheme. These mechanisms should be articulated by the Ministry of Citizenship and the Ministry of Mines and Energy.

One option to promote the use of cleaner cooking energy could involve returning to an earmarked voucher program for LPG and subsidies for the purchase of solar stoves in rural areas with poor LPG distribution networks. Acquisition expenses could be paid back to utilities in the same way as for commercial losses, or subsidized directly via the CDE, which is managed by the MME.

Our expert focus group discussion also provided a number of other suggestions of how to better ensure that low-income groups have access to affordable, reliable, sustainable and modern energy services.

- Promote larger interaction between involved entities in support and concession of such resources to rural and urban low-income communities
- Decrease fees and taxes on LPG
- Localize ESNs by allowing subnational governments/departments to adapt instruments to meet the different needs of poor and vulnerable households in different regions
- Unify and improve energy access programs, by setting forth clear goals for access to modern power sources by low-income families
- Carry out impact analyses for *Tarifa Social* and *Bolsa Família* and apply a feminist perspective to assess the links between ESN programs and women's well-being and gender equality. This action should be implemented by the Ministry of Women, Family and Human Rights.
- Develop studies to assess the impact of *Tarifa Social* and *Bolsa Família* on the access of modern energy sources.

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Endnotes

- i Available at: <http://www.caixa.gov.br/programas-sociais/bolsa-familia/Paginas/default.aspx>.
- ii In 2019, BRL 998 was the value established by the Federal Government but there are some states in which the living standards are higher (e.g. Santa Catarina, Parana and Sao Paulo). Each state decides the threshold for the minimum wage according to the local living standards. For example, in the state of Parana, in 2019 the minimum wage was BRL 1,247 (source available online <https://g1.globo.com/economia/noticia/2019/01/04/salario-minimo-em-2019-veja-o-valor.ghtml>).
- iii In 2000 the population of Brazil was 175,300,000, of which 168,292,527 had access to electricity (ANEEL 2002; World Bank 2019)
- iv According to Galdino (2002) "The objective of the PRODEEM is to supply energy to poor rural communities that are far away from centralized electricity grids. In such cases, the cost of extending transmission/distribution lines is high, due to large distances, density of vegetation, rivers, etc, and normally is not economically viable, since the projected energy consumption is very low". P.77.
- v In 2000, the minimum wage was BRL 151.00 per month.
- vi The energy distributors currently benefiting from the CDE (mostly located in the north and northeast of Brazil) are: Celg, Celpa, Cemar, Cerr, Coelba, Eletrobras Distribuição Acre, Eletrobras Distribuição Alagoas, Eletrobras Amazonas Energia, Eletrobras Distribuição Piauí, Eletrobras Distribuição Rondônia, Energisa Mato Grosso, Energisa Mato Grosso do Sul and Energisa Tocantins.
- vii The program is available to elderly people and those with disabilities who are living in a family unit in which each household member is receiving up to one fourth of a minimum wage per month. Beneficiaries are guaranteed to receive up to a minimum wage per month. This benefit is non-cumulative with other social security programs such as unemployment benefit or pensions. MDS manages the coordination and monitoring of this program (MDS 2015).
- viii The IBGE and EPE analyses have different methodologies and measure different things. The IBGE survey measures the number of households who use firewood, while EPE calculates estimated household firewood consumption. Changes in firewood consumption do not necessarily reflect a change in LPG consumption in the same proportion. Moreover, there are limitations in the measurement of the amount of firewood/carboard *freely* collected and used as fuel for cooking.
- ix 30kWh per month only allows the consumption of electricity for a few appliances, including a refrigerator (efficient), four light bulbs, a TV/DVD combo and a fan.

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