Energy Poverty in Brazil: a perspective on Access to Energy Services

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Overview

This work aims to discuss energy poverty in Brazil focusing on the accessibility of energy services. In Latin America and the Caribbean (LAC), there is a dichotomy concerning the availability of energy services. Despite achieving an electrification level of approximately 97% in 2018, the region exhibits one of the lowest per capita consumption rates globally, standing at 2,156 kWh per year, compared to the world average of 3,131 kWh per year (Carvajal et al., 2020; World Bank, 2014). Studies show that the low energy intensity in LAC results from limited accessibility to energy services and insufficient utilization of household appliances (Carvajal et al., 2020; Ravillard et al., 2019). This is attributed to financial constraints that hinder the acquisition of equipment and technologies or accessing electrical services. Notably, there is a scarcity of fundamental energy services, particularly those related to thermal comfort and water heating, accessible to only 36% of the Latin American population. Furthermore, communication, entertainment, and laundry services are available to approximately 66% and 70% of individuals in the region, respectively (Carvajal et al., 2020).

This lack of access to sustainable energy services constitutes energy poverty. According to the World Economic Forum (2010), this condition prevails in any situation marked by insufficient, expensive, unreliable, substandard, unsafe, and environmentally unsustainable energy services that hinder developmental progress. In this sense, Ochoa (2014) proposes to analyze energy poverty through the method of Satisfying Absolute Energy Needs. According to this, a household is in energy poverty when its occupants do not meet absolute energy needs, which are related to a set of factors and economic goods considered essential in a specific place and time, according to social and cultural conventions.

In Brazil, electricity is accessible in 99.8% of households (IBGE, 2019), indicating the successful resolution of connection issues. However, studies suggest that many Brazilians are unable to consume energy services in sufficient quantities to ensure well-being and to meet modern energy demands, once the discount on social tariffs is modest and appears insufficient to provide financial relief to families and/or to ensure the consumption of energy services (Mazzone 2019; Mazzone et al. 2020, and Marcoje 2021). Nevertheless, the availability of certain electrical appliances, such as air conditioners, washing machines, and electric showers, is relatively limited, highlighting a deficiency in energy services associated with these devices. According to Eletrobras (2019), 66.1% of Brazilian dwellings own a washing machine, 37.5% have an electric shower and only 16.7% present air conditioner.

Especially, the low ownership of air conditioners can reinforce the energy poverty issue in the mid and long-term, because the access to energy services related to thermal comfort becomes a crucial concern in the face of the global increase in temperatures, even turning into a public health issue. According to the World Meteorological Organization (WMO), 2023 was the hottest year in the history of the planet, with the average global surface temperature 1.4 °C above the 1850/1900 average. Extreme heat is already affecting thousands of people worldwide and is expected to increase the demand for energy for cooling. Futhermore, recent studies indicate that specific social groups, including women, individuals with lower levels of education, and non-white individuals, are more likely to experiencing energy poverty (Legendre and Ricci, 2014; Phimister et al., 2015).

With this situation in mind, our work highlights the importance of addressing energy poverty in areas with limited access to modern energy services and experiencing extremely high temperatures. In this context, the present study investigates energy poverty in Brazil, providing insights into different climatic zones as well as urban and rural regions. Furthermore, we explore the socio-economic determinants of energy poverty and the lack of access to energy services. The database come from the Family Budget Household Survey (FBH 2017/2018) produced by the Brazilian Institute of Geography and Statistics (IBGE) and Köppen-Geiger climate classification, the most frequently used method of climate types in the literature on geography and climatology, was employed to analyze the energy needs of the different regions.

Methods

For the analysis of energy poverty in Brazil, the Absolute Needs Satisfaction method proposed by Ochoa (2014) was employed. According to this method, energy poverty occurs when a household lacks all economic goods considered essential to meet its needs. Furthermore, the number of economic goods varies depending on the climatic zone where a specific household is located. In the analysis, we considered a set of six energy services, namely water heating (WH), food cooking (FC), thermal comfort (TC), food refrigeration (FR), entertainment (ENTERT), and laundry (LAU). We incorporated the last service into the method proposed by Ochoa (2014). We utilized microdata from the Brazilian Institute of Geography and Statistics 2017/2018 Household Budget Survey (HBS) along with the Köppen-Geiger climate classification.

Formally, this proposition can be mathematically expressed by the Energy Poverty Index (EPI) as in equation (1), calculated per household h:

$$EPI_h = Energy\ poverty\ if\ \ \frac{1}{n}\sum_{i=1}^{n} EB_i^h < 1 \quad \text{(eq.1)}$$

$$EPI_h = Not\ energy\ poverty\ if\ \ \frac{1}{n}\sum_{i=1}^{n} EB_i^h = 1$$

where EB_i^h = if the household h own (=1) or not (=0) the economic good i; n = total of economic goods (variable according to the region's climatic needs).

We also estimate the determinants of energy poverty and the deprivation of access to energy services through a logit model. Therefore, we assess the degree to which households are vulnerable to energy poverty. We examine factors such as observable characteristics of the heads of households (gender, ethnicity, age, and years of education) and household attributes (income and geographical location within climate zones) that either heighten or mitigate the risk of energy poverty. For dependent variables, we have the Energy Poverty Index (EPI) and dummy variables that identify deprivation of energy services. Therefore, we estimate the probability of not having, for example, thermal comfort, food refrigeration, and so on.

Results

Our findings reveal that in Brazil, 47.8% of households are currently experiencing some energy deprivation, placing them potentially in a state of energy poverty. This highlights a substantial portion of the population falling short in meeting their energy-related needs. Notably, there is evident deprivation in access to thermal comfort services (20.1% of households lack this service), laundry facilities (35.3%), and water heating (22.9%), with significant implications for overall quality of life and poverty levels.

There is a distinct geographical variation in energy poverty and lack of access to electricity services when examining households across rural and urban areas as well as different climate zones. In rural settings, a substantial 71.6% of households are potentially experiencing energy poverty, compared to 44.5% in urban areas. When examined across the five climate zones, the most concerning outcomes emerge in the tropical and dry zone, where the energy poverty rate stands at 78.4%. This highlights significant deprivation in terms of access to energy services, particularly for water heating (63.0%), laundry facilities (52.1%), and thermal comfort (20.8%). Mix climate zone presents similar results, with 75.4% of households in energy poverty, followed by tropical zone, where the energy poverty index is 55.6%. These climatic zones primarily encompass states in the northern and northeastern regions of Brazil, which historically have struggled with limited access to essential public services.

In the analysis of socioeconomic determinants of energy poverty and access to energy services, it becomes evident that households with higher incomes are less likely to experience energy poverty. Households in the 2nd income quintile exhibit a 7.9% decrease in the probability of facing energy poverty compared to those in the 1st income quintile. This is largely attributed to the higher likelihood of accessing modern energy services as income increases. Additionally, the findings indicate that households led by individuals under 30 years old and those with lower levels of education are more likely to be classified as energy poor.

Conclusions

This work allows us to conclude that many Brazilians are facing shortages in access to energy services and are potentially in a situation of energy poverty. Moreover, there is a geographical distribution of energy poverty in the country, with certain social groups being more vulnerable to this situation. Additionally, that the possession of equipment may not be sufficient in terms of access to services and the same set of goods does not uniformly fulfill all needs.

Therefore, it is imperative to incorporate the dimensions of energy services and energy poverty in the formulation or reformulation of energy programs to design more effective policies. As highlighted in previous research, access to the energy grid falls short in ensuring access to energy services. Existing energy policies in Brazil, such as the social tariff and the "Light for All" initiative, are proving inadequate to guarantee the consumption of modern energy services in sufficient quantities (Marcoje, 2021; Mazzone, 2019; Mazzone et al., 2020). Furthermore, the formulation of policies must also consider additional components, such as socioeconomic characteristics and diverse family structures.

References

Carvajal, F., Lopez, D., María, S., Sanin, E., Mejdalani, A., Ravillard, P., Chueca-Montuenga, J.E., García-Ochoa, R., Hallack, M., 2020. Más Allá de la electricidad: Cómo la energía provee servicios en el hogar.

Eletrobrás, 2019. Pesquisa de Posse e Hábitos de Uso de Equipamentos Elétricos na Classe Residencial 2019. https://eletrobras.com/pt/Paginas/PPH-2019.aspx.

Legendre, B., Ricci, O., 2014. Measuring fuel poverty in France: Which households are the most fuel vulnerable? Energy Economics 49, 620–628. https://doi.org/10.1016/j.eneco.2015.01.022.

Marcoje, B., 2021. Dissertação apresentada ao Programa de Pós-Graduação em Economia Aplicada da Faculdade de Economia da Universidade Federal de Juiz de Fora. Avaliação de impacto do programa tarifa social de energia elétrica.

Mazzone, A., 2019. Decentralised energy systems and sustainable livelihoods, what are the links? Evidence from two isolated villages of the Brazilian Amazon. Energy and Buildings 186, 138–146. https://doi.org/10.1016/j.enbuild.2019.01.027

Mazzone, A., Rathmann, R., Lucena, A., Schaeffer, R., 2020. Energy Safety Nets: Brazil Case Study.

Ochoa, R.G., 2014. Pobreza energética en América Latina. Colección Documentos de proyectos. Comisión Económica para América Latina y el Caribe (CEPAL).

Phimister, E., Vera-Toscano, E., Roberts, D., 2015. The dynamics of energy poverty: Evidence from Spain. Economics of Energy and Environmental Policy 4, 153–166. https://doi.org/10.5547/2160- 5890.4.1.ephi.

Ravillard, P., Carvajal, F., Lopez, D., Enrique, S.J., Montuenga, C., Antonio, K.M., Ji, Y., Hallack, M., 2019. Towards Greater Energy Efficiency in Latin America and the Caribbean: Progress and Policies.

World Bank. (2014). Capturing the Multi-Dimensionality of Energy Access. Washington D.C.

World Economic Forum, 2010. Energy Poverty Action.

WMO, 2023. Provisional State of the Global Climate 202. Access: https://wmo.int/sites/default/files/2023-11/WMO%20Provisional%20State%20of%20the%20Global%20Climate%202023.pdf.