Article

Electrification in Remote Regions: An Analysis of the More Light for Amazon Program

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Abstract: This study aims to provide a comprehensive analysis of the More Light for Amazon (MLA) program, examining the roles played by each stakeholder involved in the concession process and identifying the limitations faced for program success. The research employs a content analysis methodology, analyzing a variety of documeTnts, including the Program Operational Manual, Commitment Terms, news articles, and concessionaires' notes. The findings reveal the crucial role of the government as an inducer of actions, establishing objectives and guiding norms for the private sector. Conversely, concessionaires assume the role of program implementers but encounter specific limitations in remote locations, challenging the provision and maintenance of the electrical system in beneficiary communities. The implementation of microgrid systems through concessions enhances coordination and integration between generation and distribution services, allowing for increased government control and ensuring transparency, efficiency, and program effectiveness. These identified elements represent significant challenges for the implementation of public policies in remote regions of the Amazon. Overcoming these challenges take coordinated and strategic actions involving both the government and concessionaires to ensure the complete fulfillment of energy needs in MLA program beneficiary communities.

Keywords: Public Administration; electrification; concessions

1. Introduction

Electricity is vital for a country's development, serving as a foundational infrastructure that drives economic growth, improves quality of life, and promotes social inclusion. Responsible production and distribution of electricity are crucial, considering the social, economic, and environmental aspects. Ensuring universal access to electricity, particularly in rural and low-income communities, is essential for fostering social inclusion and equity.

In Brazil, despite having a robust electrical system with a diverse energy mix (1), there are challenges in expanding electricity access to rural and remote areas. For instance, the Amazon region poses significant obstacles due to its vast and difficult-to-access territory, dense tropical forests, extensive rivers, and complex topography (2). Moreover, some municipalities in the region have limited political capacity (3), which can hinder the effectiveness of public concessions, regulations, and the construction and maintenance of the electric system.

Consequently, constructing and maintaining electrical infrastructure in this area presents significant logistical challenges. It involves opening roads, building transmission lines, and installing poles and transformers in hard-to-reach locations (4). To address these challenges, the federal government has invested in universalizing electric energy through concession-based programs like the More Light for the Amazon Program (MLA). This initiative aims to provide electricity to rural communities in the Legal Amazon region (5).

The MLA Program provides tax incentives, credit lines, and favorable financing options to interested companies. Subsidies are available to reduce investment and operating costs, and utilities that invest in expanding electricity infrastructure in the region also receive contractual benefits (4,6-

8). However, companies face challenges due to the unique geographic, socioeconomic, and environmental characteristics of the region.

When implemented through concessions, the federal government follows a partnership model between the public and private sectors, allowing long-term contracts for managing services, works, or public assets (9). However, critics argue that the profit-maximizing objectives of private concessionaires may not align with social goals (10). While concessions are widely used in developed countries for infrastructure projects and public services, there are concerns that they may not generate the expected outcomes and could exacerbate regional inequality (11). Comprehensive studies addressing the socioeconomic and political challenges of electrifying remote regions like the Amazon are lacking.

While research exists on technological solutions and concession models, a deeper understanding of the social, economic, and political factors impacting project implementation is needed. This paper aims to analyze the Federal Government's MLA Program, examining the roles of the parties involved in the concession process and the constraints faced in achieving program success.

Policy analysis is crucial for understanding the benefits and risks associated with substantial investments and their impacts on the local economy (12-15). The existing literature often neglects the economic and social aspects of electrification in these areas, such as job creation, sustainable development, and effects on local communities.

Governance and policy in public concessions also require further study. The design and implementation of concession contracts have significant implications for the success and sustainability of electrification projects in remote regions (12,16). Operating conditions in these regions present risks and opportunities for anti-competitive behavior, resulting in concentrated market structures and inefficient regulation (17-19). Therefore, it is essential to plan and coordinate actions that promote competition and efficiency in the electricity sector.

The lack of in-depth analysis regarding institutional and policy challenges in this context hinders the development of effective electrification strategies. Research focusing on the socioeconomic and political aspects of electrification in remote regions and public concessions is necessary to inform planning and successful project implementation. This paper includes sections on theoretical framework, methodology, results and discussion, and final considerations in addition to this introduction

2. Theoretical framework

The organization of electricity generation, transmission and distribution services in Brazil evolved throughout the country's history. Electrification in Brazil began to develop in urban areas in the late 19th and early 20th centuries, driven by private companies (12,20). However, rural electrification was practically non-existent in this period, due to the lack of infrastructure, the low development of rural areas and logistical difficulties.

Because of this, the Brazilian government promoted the nationalization of the electricity sector, with the creation of Eletrobras in 1962, responsible for the coordination and management of state-owned electricity companies. In this way, the government implemented policies to encourage rural electrification, such as financing programs and incentives for private sector participation. However, it was only with the restructuring of the Brazilian electricity sector from 1990 onwards that there was an increase in awareness of the importance of rural electrification as a way of promoting the socio-economic development of rural communities (20–23).

As a means to regulate the sector, the National Electric Energy Agency (ANEEL) was established in 1996, with the main function of guaranteeing the quality of the service, promoting competition and protecting consumers' interests. (22,24). Since then, specific programs have been implemented aimed at rural electrification, such as the National Program for Universal Access and Use of Electric Energy (Luz no Campo), launched in 2000, the Light for All Program (2003) and, finally, More Light for the Amazon (2020).

All programs established new technical service criteria for concessionaires and permit holders, which ensured the inclusion of millions of Brazilians historically placed on the margins of the

electrical system and represented a breakthrough in relations between concessionaires and consumers (21). In electrification programs in remote regions, the concession plays a key role in establishing a model of partnership between public authorities and the private sector. This partnership aims to make investments viable, promote the expansion of rural electrification and bring electricity to communities that previously did not have access to this essential service.

The concession appears as a solution to mitigate one of the biggest challenges faced by electrification programs in remote regions: financial barriers. By transferring the responsibility and investment burden to the interested concessionaires, through a tariff paid by the user, the concession model allows access to financial resources from the private sector, which are essential for the implementation and operation of electrification systems in these areas.

In this context, the concessionaires assume the commitment to provide the electrification service and assume the financial risk inherent to the operations, seeking to recover the investments made through the revenues generated by the tariffs. Depending on the context and regulatory structure, concessions can operate under a monopoly regime or in a competitive environment, encouraging efficiency and quality of services provided.

Concession as a public-private partnership model offers significant benefits. It allows the transfer of resources and technical knowledge from concessionaires to the public sector, as well as the sharing of risks and responsibilities between the parties involved. The public concession is a means of enabling the improvement of public services, attracting private capital to alleviate government costs. Public administration does not alienate its attributions in this regard. There is a simple temporal delegation, subject to constant control, for the mere provision of the service (14,25).

Based on this, the concession transforms the public service into an enterprise, which causes the service to lose its intrinsic characteristics of being public (12, 16, 26). Thus, markets need to be financially viable to ensure their continuity and sustainability in the long term. However, low family income, low electricity demand and high investment costs characterize rural markets that are dispersed and unattractive, leading governments to institute subsidies to minimize economic distortions and operational viability (16, 27, 28), as a means to allow the concessionaire to adequately fulfill these obligations given the responsibilities towards its stakeholders, such as shareholders, customers, employees and communities where they operate.

Consequently, concessionaire companies seek to ensure that they have consistent contracts and the quality of differentiated institutional conditions in terms of support: political, legal, fiscal and financial (12, 16, 29), to operate in the region. In this way, attention is required to commitments, planning, government budgeting and stakeholder coordination (16, 27, 28, 30). Therefore, contracts must reconcile the interests of federal, state and municipal governments and companies in the electricity sector so that the burden does not make it unfeasible for the user to benefit from the service.

These facts create emblematic and complex projects for companies that do not know the reality of the region, especially the Amazon that generates emblematic and complex projects (1). In the market context, the geographic characteristics and challenges of the Amazon may make electrification in the region unfeasible or less attractive for companies in the electricity sector. This is due to the remote location of the Amazon region and its specific socio-environmental characteristics (1). The lack of adequate infrastructure in the region presents an additional challenge, not only concerning the transmission of electricity but also the need to build roads, railways, ports and airports (31).

The lack of these basic infrastructures hinders investments, since the high costs involved in building new roads and transmission lines to connect remote areas to the national electricity grid may not be attractive for companies. It is important to emphasize that these specific challenges faced in the Amazon have not been captured by other studies that explore the challenges for electrification in remote regions, such as Bangladesh, Haiti, Malaysia, India, Senegal and Kenya (27, 28, 30). Each region has its own geographic, socioeconomic and political characteristics, which influence the challenges faced in implementing electrification programs. Therefore, it is essential to consider these specificities when pointing out solutions and lessons learned in different contexts.

In addition, concessions are susceptible to changes in government policies, regulations and commercial agreements, which can create uncertainty and impact investments and operations in the sector (30). In this way, the consolidation of this market is subordinated to the increasingly

financialized accumulation logic and marked by the sharing of risks, resources and technical knowledge to boost the development of the electrical infrastructure (16). In this context, the Public Administration has increased responsibility, as it is the agent that plans and regulates the process.

The Public Administration during the bidding process must conduct and judge if the proposals from the private sector are technical, economic, financial and operationally sound to ensure the community's wishes and also provide profit to the commissioner, as well as ensure the execution of the contract agreements (16,26). It's necessary to be attentive to ensure fair competition and avoid abuse of a dominant position, as this regulation will ensure economic efficiency, competition and benefits for consumers (15,32). Therefore, the concession contracts must be properly structured, addressing legal, economic and technical aspects (14,25). Next, the proper modeling of contracts is essential to ensure the efficiency and quality of the services provided, as well as to protect the public interest.

Therefore, an adequate regulatory structure is necessary, with effective supervision mechanisms and transparency to guarantee the efficiency and accountability of concessionaires from the electricity sector (13,33,34). Through this framework, the government will be able to adequately monitor and make sure companies comply with contractual and regulatory obligations, especially concerning quality of service, fair tariffs and adequate investments (35).

In the presence of inadequate regulatory structures, there may be anti-competitive behavior, such as abusive prices and discrimination between competitors, as well as hindering the creation of a competitive environment (18,19). And the lack of competition can be a result of concentrated market structures and ineffective regulation. (36). For sure not modernizing the rules can create distortions, threatening the sustainability of one of the most important sectors of the economy.

However, the effectiveness of regulations can be complex, especially in a fragmented political and institutional environment, as is the case in the Amazon region, where there is a great diversity of governmental, political and social actors. In certain states of the region, such as Macapá and Amapá (12), in which the government made an effort to establish efficient markets, regulation failed to guarantee compliance with sectoral contracts in favor of service quality.

This shows that transferring public services to the private sector, guided by competition and financial profitability, does not necessarily result in improving the quality of public services (15,32), but the transfer of the risks of the undertaking, the cost of services and user income in favor of the State (14, 26, 37). In practical terms, the concession implies reducing costs for non-users and worsening the users' economic situation.

These problems tend to be more common in an environment where lack of state capacity limits state action and the state can be dominated by powerful actors causing regulation to be weak and there is little transparency and accountability (38–43). One of the main reasons for this is the complexity of the electricity sector, which involves a large number of actors and interests, in addition to the lack of capacity and resources of regulatory agencies to adequately monitor and regulate the electricity sector.

In many cases, regulatory bodies do not have sufficient resources to effectively oversee companies, which can lead to failures in oversight and enforcement of regulatory standards. In addition, in some situations, the regulatory bodies themselves may be seen as lacking in independence or ineffectiveness, which can lead to situations in which companies have little incentive to comply with rules and regulations.

Lack of clarity and control in the electricity sector can arise when companies have ties to political groups or private interests. This can result in a lack of transparency and accountability, as these connections can protect from public scrutiny (44). This lack of clarity and control can lead companies to operate without social commitment, disrespecting the rights of local communities and workers. This includes practices such as the exploitation of illegal labor, forced removal of local communities and violations of labor rights.

The absence of clear regulations and strict controls can allow companies to provide inadequate or low-quality services without incurring penalties. This could harm the competitiveness of the electricity sector and affect the region's economic development. Quickly, the succession of facts, in turn, contradicts the supposed effectiveness of the private sector in a context of competition, to the

detriment of public action, attributed to neoliberalism, which causes the Amazon region to end up having a limited service provision (12), and the lack of transparency in the management of services (10,31). Still, public concession can also lead to inequality in the quality of services provided, the increase in service prices, and the loss of public control over the provision of services.

In this context, Public Policy Analysis provides a way of understanding choices, processes and their consequences (9). Firstly, this interdisciplinary approach, which spans from economics and public administration to sociology and philosophy, enables public managers and other stakeholders involved in policy-making to analyze the safety, effectiveness and efficiency of public policies, as a means to guarantee compliance with the established objectives and compliance with the general principles of public administration (29). This tool is important to help public managers identify the problems faced, find effective solutions to solve them, implement and monitor public policies and assess changes in political, economic and social contexts. Through public policy analysis, public managers can deepen the analysis and understanding of how public policies affect people's lives.

It is a tool that can help public managers to identify problems, evaluate the costs and benefits of public policies, identify the main barriers to success and establish short and long-term goals for the implementation of public policies. In addition, public policy analysis allows public managers to better understand the impact of policies in terms of cost, time and results, helping to ensure that policies are implemented more effectively and transparently.

3. Materials and Methods

This is a descriptive research study. The descriptive approach is used to describe or explain a problem or situation. The main purpose of descriptive research is to provide a more detailed description of a phenomenon or point of view, rather than analyzing or explaining its causes (45). This approach involves collecting qualitative data such as interviews, questionnaires, observation and document analysis.

The material analyzed is from a documentary source and consists of official public documents, such as the manual for operating the programs, monitoring reports and other materials released by the companies on the subject. The documents studied include Decree No. 10,221, from February 5th, 2020, which establishes the MLA program, based on Art. 13, item I, of Law No. 10,438, from April 26th, 2002 (7), which aims to promote the universalization of the electricity service throughout the national territory.

In addition, the Program Operationalization Manual was analyzed, which defines the Operational Structure and establishes the Technical and Financial Criteria, Procedures and Priorities to be applied in the program (8). The Terms of Commitment between service providers and the Ministry of Mines and Energy were also examined (5) and made available during the monitoring of state services. In addition, journalistic materials, notes from the concessionaires and scientific articles that address the topic and provide support for the information presented were considered.

This variety of documentary sources allows for a more comprehensive analysis of the program, considering different perspectives and sources of information. By combining the analysis of official documents with journalistic materials and scientific articles, it is possible to obtain a more complete and grounded understanding of the MLA Program and its developments. It also provides a better understanding of its operational structure, technical and financial criteria, procedures and priorities, as well as examining the terms of commitment between service providers and the Government.

The documents will be organized in a logical and coherent structure to facilitate the analysis and interpretation of the data. To analyze the selected documents, technical procedures of content analysis were applied. As defined by Bardin (2011), content analysis is a set of techniques that aim to obtain, through systematic and objective procedures, the description of the content of messages, allowing the inference of knowledge about the conditions of production and reception of these messages. The objective is to identify key information, such as aspects of the program's operational structure, technical and financial criteria, established procedures and priorities, in addition to any other relevant information contained in the documents and materials.

The data were analyzed and interpreted using the IRAMUTEQ software (Interface de R pour les Analyses Multidimensionnelles de Textes et de Questionnaires). The software performs the analysis based on the linguistic characteristics of a text as a means to identify the frequency of words, grammatical forms, the vocabulary used, etc., as a means to identify based on the structure of correlation between the words and the explanatory context that appears in the text (3,47).

The method used to capture the correlation structure was the Correspondence Factor Analysis (CFA), which allows for identifying the degree of association between large sets of words and the explanatory context (48), as well as facilitating counting via word cloud and interconnection structure through similarity analysis. The word cloud (49) is grouped and organized graphically according to its frequency, enabling quick identification of keywords in an analyzed corpus.

The similarity analysis is based on graph theory and allows the identification of co-occurrences between words, resulting in indications of a connection between terms (50) as a means to support interpretations and identify trends, gaps or challenges highlighted in the documents studied on the MLA program.

4. Results and Discussion

As a means to understand the role and challenges of the actors involved, the analyzed corpus is composed of a set of documents with their 26 texts, with 567 text segments, 2,370 forms, 13,278 appearances, containing 1,620 lexemes, 1,480 forms in use, there are 39 additional variations, of which 85.9% were classified. Among the keywords presented through the word cloud are: program, More Light for Amazon, electricity, community, legal Amazon, system and government, figure 1.

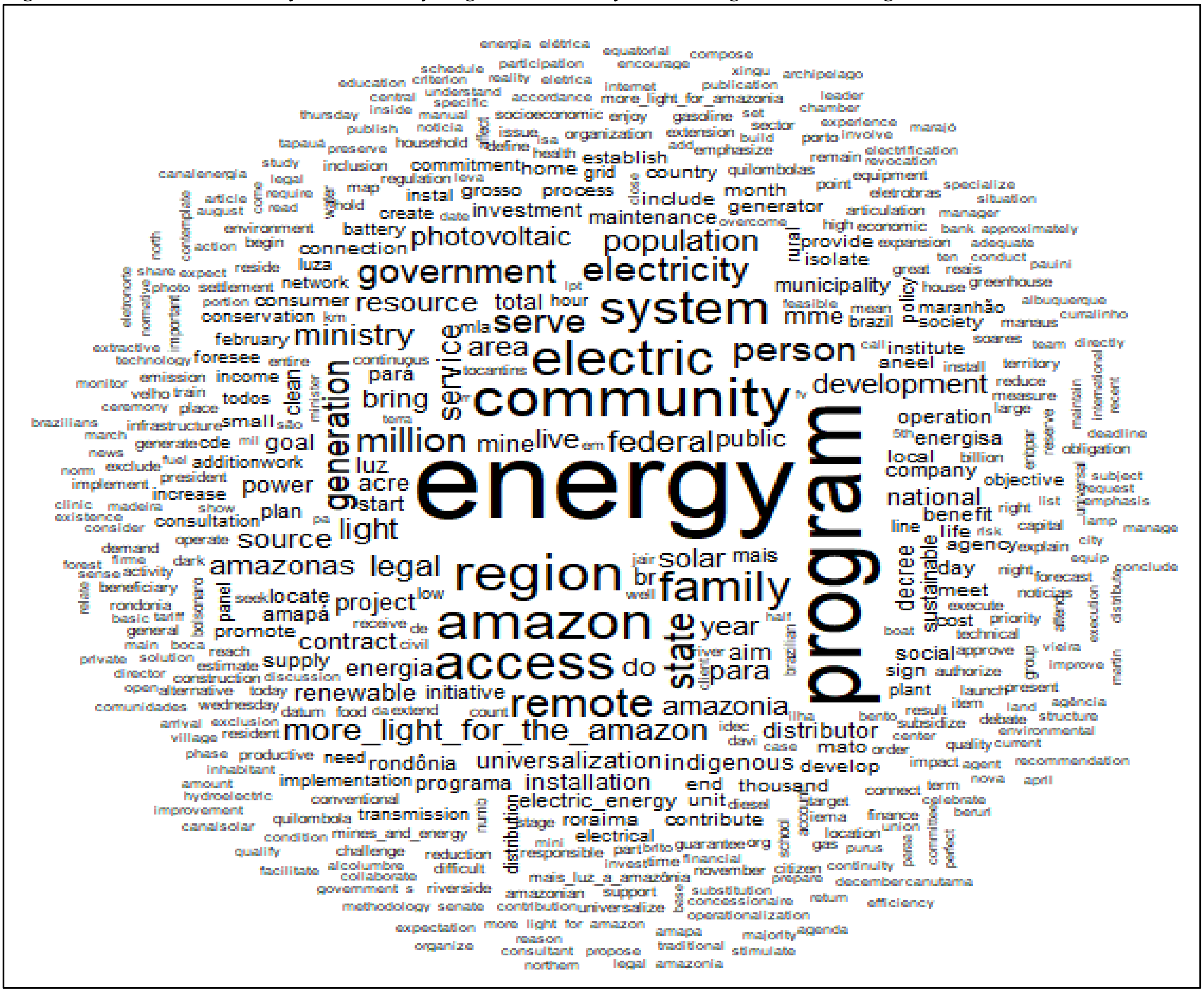

Figure 1. Vocabulary that appeared most frequently in the analyzed corpus.

The word PROGRAM is the central element of the "More Light for Amazon" policy, as it describes the plan and objectives to be achieved. In fact, programs like this are public policy initiatives designed to address specific challenges and fill gaps in particular areas or sectors. In the case of "More Light for Amazon", the program was designed to address the lack of access to electricity in communities located in regions with difficult access to the Legal Amazon (5,7).

In the context of public administration, programs like this play an important role in implementing policies and achieving specific objectives. To be effective, a program requires careful planning, adequate management and partnerships between the various actors involved, such as local governments, regulatory bodies, companies in the electricity sector, civil society organizations and the beneficiary communities themselves. In addition to filling the lack of access to electricity, the program must consider environmental and social sustainability, adopting sustainable technologies and practices.

Systematic monitoring and continuous evaluation are essential to measure the program's impact, correct gaps and promote learning for future initiatives. The program aims to promote regional development, improve quality of life, reduce the energy deficit and promote social inclusion. Among the actions implemented are the use of low-cost technologies to generate clean energy and the granting of subsidies for low-income families to purchase solar energy equipment.

The central focus of the program is the provision of ELECTRICITY for the population and the term refers to the essential service capable of expanding opportunities for socioeconomic change in the region. The program has taken electricity to different communities and promoted advances, such as the expansion of electrical coverage, clean and accessible energy, improvement in the quality of life of populations, greater energy security, economic and social development in the region, reduction of energy costs, greater social inclusion and development of low-cost clean energy technologies (51). Achieving these goals is only possible thanks to the most appropriate type of generation SYSTEM (grid or photovoltaic systems extension).

This system, in addition to reducing operating costs, enables the implementation of medium and long-term projects, such as microgeneration and mini-generation projects in remote locations, described here as the LEGAL AMAZON, a region where families don't have access to electricity. These families are represented by the highlighted word COMMUNITY. They are the beneficiaries of the MLA program, residing in remote access regions.

These areas are comprised of indigenous communities, quilombola territories, rural settlements, and riverside communities. The difficult access to these areas deprives those people of social benefits such as home lighting; use of household appliances; use of the means of communication; electrification of health clinics (makes it possible to conserve vaccines and purchase equipment); and adequate lighting and ventilation of schools, among other benefits generated by access to and use of electricity (20). Therefore, it is important to consider the specific challenges faced by these communities in terms of access to electricity.

These communities are located in regions of difficult access, where the electricity infrastructure is precarious or non-existent. The communities mentioned in the passage face significant challenges in terms of accessing electricity due to their remote location and adverse geographic conditions. (31). The lack of electrical infrastructure in remote areas results in limitations in the use of household appliances, poor lighting, lack of reliable communication and difficulties in essential services. However, power utilities face financial challenges in these sparsely populated areas due to high construction and operating costs.

In addition, the implementation of electric energy projects can have environmental and social impacts, requiring mitigation measures that increase costs. The energy demands of remote communities are different from those of urban areas, requiring additional investments in sustainable solutions such as solar energy and micro-hydroelectric power plants. However, it is important to recognize that these solutions do not always offer an immediate financial return for electric power concessionaires, as pointed out in previous studies on electrification in remote regions of Bangladesh, Haiti, Malaysia, India, Senegal and Kenya (27, 28, 30).

The implementation of these technologies requires an in-depth understanding of the characteristics and specific needs of each remote region, taking into account the financial and technical barriers, and project design focusing on renewable energy and decentralized systems as a way for remote regions to overcome the implementation barriers (30). In this context, the term GOVERNMENT, highlighted in the word cloud, represents the inducing agent of public policies, responsible for reducing social inequalities. Faced with his inability to implement, supervise and inspect this program, it acts through concessions (contracts signed with private companies), guaranteeing greater efficiency and quality in the delivery of these services and assumes the role of supervisor, as a means to guarantee that its objectives are achieved.

In Brazil, the government plays a central role in rural electrification, including formulating policies, providing funding, creating specialized institutions and coordinating public-private partnerships, unlike what happens, for example, in Bangladesh, where there is a lack of government collaboration, particularly regarding support for energy policies (27,30). On the other hand, in other countries such as Haiti, Malaysia, India, Senegal and Kenya, governments act more by mobilizing financial resources together with different actors to diversify financing sources, seeking support from international organizations, development banks, sectoral funds and other sources of investment.

Certainly, the government plays a fundamental role in the concession of public services, acting as an inducing agent of public policies. It must define and delimit the activities to be carried out by the concessionaire, establish quality and price standards, supervise compliance with contracts, monitor compliance with user rights and ensure the transparency of processes (22). While there may be challenges in the government's ability to directly implement, supervise and oversee these programs, concessions signed with private companies allow for greater efficiency and quality in the delivery of services.

The government also assumes the role of supervisor, ensuring that the program's objectives are achieved and that there is a balance between the public and private interests involved in the concessions. When observing Figure 2, the government assumes the central role in the analysis of the MLA program, since it is largely responsible for defining the objectives and norms that must be followed by the concessionary companies.

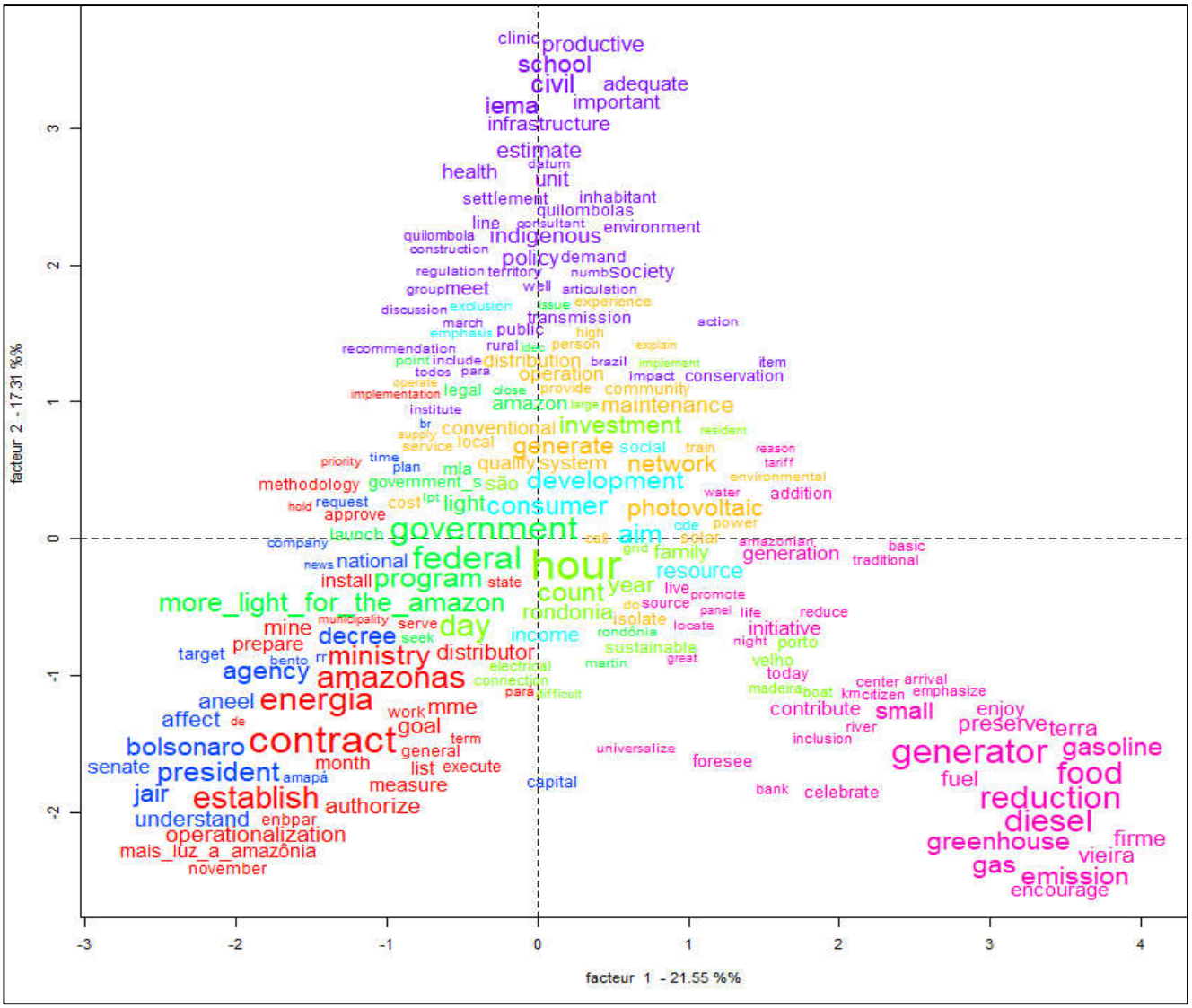

Figure 2. Correspondence factor analysis.

Figure 2 shows a Cartesian plane with the distance between elements inserted in this debate and their connections with the research center - MLA Program articulated by the Government. In this program, the government faces several administrative challenges to mitigate the precarious infrastructure for the energy service in the north of the country. The first challenge is financial. Since the program is financed by state resources (7,8), governments must provide sufficient resources to finance infrastructure projects.

Adequate funding is crucial to the success of the MLA Program, which seeks to electrify remote regions in the Legal Amazon. Resources will come from agents in the electricity sector, the Energy Development Account and other sources regulated by the Ministry of Mines and Energy in conjunction with government agencies (52). The program prioritizes serving households in these regions and emphasizes the social nature of the investment. The distribution of resources is based on the need to mitigate tariff impacts, address regional needs and consider the financial contribution of the Executors (52).

When comparing the funding system of the MLA program with other similar programs in different parts of the world, we can see that it is based on the use of grants from own resources. These grants are intended to cover the operating costs of the concessionaires, ensuring the project's economic viability and the provision of electrification services in remote regions. In this way, the Brazilian government strives to ensure the provision of public services (15,32) and minimize the transfer of enterprise risks and the cost of services to users (14, 26, 37) aiming to promote social and

economic impacts, as a means to improve the living conditions of the beneficiary communities, which is not observed in other programs around the world.

In some countries, such as Bangladesh and India, specific funds are established to finance rural electrification (27). These funds come from different sources such as international donations, governments, financial institutions and public-private partnerships. Another financing approach adopted in some countries is charging specific fees or contributions for rural electrification. For example, in certain regions of Malaysia, urban consumers pay an additional fee on their electricity bill, which is used to fund electrification programs in remote rural areas (28). This model seeks to balance costs between urban and rural areas, enabling access to electricity in more distant regions.

This own grant financing approach differs from other systems that may rely on external sources such as international loans or public-private partnerships. While the use of grants itself is an interesting strategy to ensure the economic viability of the MLA program, it is important to point out a few restrictions of this funding model. Relying solely on internal resources can restrict the scale and scope of the program, as available funding may be limited. This could hinder the program's ability to reach a larger number of households or to implement more extensive electrification projects.

Furthermore, relying only on self-sustaining grants can pose risks in terms of financial stability. Economic fluctuations or changes in the energy sector can impact resource availability and disrupt program continuity. Reliance on a single funding source can also limit the flexibility to adapt to unforeseen circumstances or incorporate innovative solutions.

Comparatively, alternative financing systems that involve external sources, such as international loans or public-private partnerships, can provide additional financial resources and expertise. These partnerships can bring capital investments, technical expertise, and operational efficiencies that can contribute to program effectiveness and sustainability.

However, it is essential to carefully assess and manage any dependency on external sources of funding. Potential challenges can arise from negotiating and paying off loans, as well as aligning objectives and priorities among the various stakeholders involved. Furthermore, the involvement of private entities can introduce for-profit interests that can influence the direction of the program and potentially impact its social objectives.

Combining self-sustaining grants with external investment and partnerships can help mitigate the limitations of relying solely on internal resources, ensuring both financial viability and the ability to achieve broader, more impactful results. Strategic planning and effective financial management are crucial to balancing these various sources and ensuring the program's long-term success and sustainability. In addition, it is essential to establish efficient mechanisms for monitoring and controlling resources, to avoid waste and ensure that they are directed to priority areas and communities most in need.

Another challenge is to establish an effective concession system. This concession must ensure that the projects are carried out safely, efficiently and that they comply with legal requirements. In addition, it is also necessary to take measures to prevent and control corruption and fraud in the granting of these projects. Finally, there is also an implementation challenge. These projects can be complex and time-consuming, requiring effective coordination between the different levels of government, in addition to being monitored to verify compliance with the goals established with the concessionaires.

As part of the program, electric power concessionaires have the role of supplying energy to these communities, through generation, transmission, distribution and consumption infrastructure (8). In addition, they are also responsible for maintaining the installed electrical power systems, ensuring that energy is available for proper use (51). This responsibility implies the supply of reliable, continuous and quality energy to meet the needs of the beneficiary communities. This includes identifying and correcting faults, and repairing and replacing damaged equipment, thus ensuring availability and energy efficiency.

Another important function of electric power concessionaires in the MLA program is to provide information and advice on the proper use of electricity for residents of these communities (8). This involves educating residents about installing and maintaining electrical equipment, as well as encouraging responsible and efficient consumption practices. This orientation is important not only

for the proper use of energy but also for promoting safety, economy and sustainability. Non-involvement of communities causes failure in the maintenance process to reduce long-term maintenance costs (28), an important element to make the projects economically viable and adjust the roles of the actors.

The government assumes the role of inducing action and the concessionaires of implementing actions. These roles are complementary and essential to the programs' functioning and success. The government is responsible for conceiving, planning and coordinating the public policies necessary to enable access to electricity in remote communities in the Amazon (31). The government acts to promote the program; creating the necessary conditions for the actions to be implemented.

Concessionaires are responsible for supplying electricity to remote communities through the installation, operation and maintenance of generation, transmission and distribution infrastructures. In this sense, concessionaires are responsible for designing, building and operating the electrical distribution networks necessary to bring energy to remote communities.

To serve program beneficiaries, the initiative provides for the use of solar energy generation and the replacement of small generators, which today are the only source of energy for many families living in these regions, words shown in pink in the figure above. These generators run on diesel or gasoline, which is why the new system contributes to reducing the burning of fossil fuels, makes it possible to reduce the emission of greenhouse gases and encourages the sustainable use of resources in the Amazon rainforest.

Replacing polluting fuels with electricity also has positive socioeconomic implications. It can promote the establishment of traditional communities in their territories, preventing rural exodus and contributing to local development. In addition, environmental preservation promoted by reducing the consumption of fossil fuels contributes to mitigating climate change and conserving biodiversity.

These new technologies have contributed to greater rural electrification, driven by the use of renewable technologies such as solar and wind energy. These energy sources have proven to be more viable and accessible for remote areas, providing sustainable energy solutions for rural communities, especially those isolated in the Amazon region.

These technologies are in line with the growing concern with the diversification of the energy matrix and the promotion of renewable sources. Encouraging the use of these sources has been a priority to reduce dependence on fossil fuels and mitigate the environmental impacts caused by large hydroelectric projects (15). In addition to providing access to electricity, these decentralized and sustainable solutions have the potential to reduce utility operating costs, as they can be more efficient in terms of infrastructure and operating costs compared to expanding conventional electricity grids.

One of the additional advantages of the program when focusing on microgeneration from renewable sources is the improvement in the organization of the governance structure. This occurs because the process of generating and distributing electricity is concentrated in a single actor, breaking with the disorganization previously present in the governance of the sector (19,53). With this centralization, it becomes possible to direct energy generation actions towards renewable sources, avoiding the imposition of inflexible thermoelectric plants in the composition of the electrical system (19). This reorganization of the governance structure brings significant benefits.

By having a single actor responsible for the generation and distribution of electricity, it is possible to improve the coordination and operational efficiency of the sector. The centralization of activities allows for more agile and effective decision-making, in addition to facilitating the implementation of public policies aimed at promoting renewable energy sources (15,44). By directing generation actions towards renewable sources, the program seeks to mitigate environmental impacts and reduce dependence on thermoelectric plants powered by fossil fuels (12, 18, 44). This contributes to the energy transition and the sustainability of the electricity sector, in line with the goals of reducing greenhouse gas emissions and combating climate change.

By refuting the imposition of inflexible thermoelectric plants in the composition of the electrical system, the program encourages the diversification of the energy matrix, promoting the use of renewable sources that can adapt more flexibly to energy demand (15). This increases the resilience of the electrical system, reducing the risk of shortages or interruptions in energy supply.

In this way, the concentration of energy generation and distribution activities in a single actor, combined with the emphasis on renewable sources, promotes more efficient and sustainable governance, aligned with the objectives of sustainable development and environmental protection. This is particularly relevant in the Amazon region, which has a rich biodiversity and is considered one of the most important areas in the world in terms of environmental conservation. Therefore, overcoming the previous disorganization and directing toward clean energy sources represent important advances in the electricity sector, contributing to the construction of a more efficient, resilient and environmentally responsible system.

On the other hand, the sentences in yellow portray the logistical challenges in terms of operating and maintaining the implementation of the photovoltaic system in these territories, a fact that tends to make these projects financially unfeasible, since the lack of logistical infrastructure can make the installation and maintenance processes of decentralized generation systems more expensive. The logistics to implement the photovoltaic system involve several aspects.

First, it is necessary to plan and carry out a detailed survey of the communities to be served. Next, it is necessary to design and size the photovoltaic systems according to the needs of each location (54). This involves determining the required solar power generation capacity, the number and wattage of solar panels, energy storage systems (such as batteries), and indoor distribution systems.

Once designed, the necessary equipment, such as solar panels, inverters, batteries and cables, must be purchased and transported to communities by suitable means (such as boats, planes or land vehicles) ensuring the safe and efficient delivery of the equipment (31,52). Once installed, photovoltaic systems must be regularly monitored and maintained to ensure their proper functioning. Therefore, the lack of adequate infrastructure, such as road lines and bridges, represents higher costs for providing the service, which can influence the tariffs.

Added to the logistical cost, there is a challenge regarding the technical training of local communities and companies involved in the implementation of these projects. It is necessary to ensure that there is adequate knowledge and skills for the correct operation and maintenance of power generation systems, as a means to ensure the sustainability and durability of these solutions. All these elements represent additional costs assumed by the concessionaires.

These costs necessary to effectively obtain the benefits intended by the entrepreneur translate into transaction costs, which means that the entrepreneur transfers to the price the uncertainties and insecurities that permeate his activity (15,32). In the context of concessions, these costs can arise due to uncertainties about issues such as geographic conditions, access to resources, future demand and regulatory changes. These uncertainties may lead concessionaires to transfer risks and uncertainties to the prices charged to users. This may result in higher tariffs to offset the additional costs and uncertainties faced by concessionaires. Consequently, it may be incompatible to provide affordable rates, that is, rates that are accessible to users.

Achieving the objective of affordable tariffs requires careful consideration of the risk attributed to concessionaires (14, 16, 26). Governments, highlighted in green in Figure 2, must balance the need to encourage private investment and economic development with protecting user interests and ensuring affordable tariffs. In this sense, the concession contracts must establish clear mechanisms for the allocation and management of risk between the government and the concessionaires, since the challenges that the region imposes are not mere technical details that can be postponed or left aside to be discovered by the magic of the market (36,53). This may include defining tariff review criteria, risk-sharing and incentives mechanisms for efficiency and performance as a means to facilitate local socio-economic development.

The increased risk faced by concessionaires can harm local economic development. If risks are excessive or poorly managed, it can discourage investment and limit economic growth in the region. Concessionaires reluctant to take high risks may be less likely to expand their businesses, invest in additional infrastructure or provide quality services.

Therefore, it is critical that governments carefully understand and assess the risks involved in concessions and adopt appropriate strategies to mitigate them (14,16). This may include creating a stable regulatory environment, implementing risk-sharing mechanisms and promoting public-

private partnerships that balance concessionaire interests and local economic development objectives.

This is because the Amazon population is characterized by great socioeconomic diversity, with urban and rural areas, and traditional and indigenous communities. This can lead to disparities in electricity tariffs, as some areas may require additional investments to guarantee access to the service. In this sense, the risks for concessionaires are even greater, since Art. 5 of the decree establishing the program does not explicitly mention the participation of the government in the operation and maintenance of the systems, but mentions that "ANEEL will establish the cost referring to the operation and maintenance of generation systems, with or without associated grids" (5,7).

This lack of clarity regarding the government's participation in the operation and maintenance of the systems can represent a financial risk for concessionaires (16,26). Although ANEEL sets the cost of these services, it is important to consider whether there will be adequate profitability to cover the expenses incurred by the concessionaires to guarantee the operation and maintenance of the systems in perfect working order. Also, the concessionaires are responsible for fulfilling the obligations established by ANEEL concerning the operation and maintenance of the systems (24).

This implies assuming financial responsibility for any problems that may arise during operation, such as repairs, replacement of components or necessary technological updates. These financial risks can be amplified by uncertainty regarding the durability and service life of photovoltaic systems, as well as the variation in maintenance costs over time. Incidentally, the possibility of adverse events, such as natural disasters or vandalism, may also pose additional financial risks for concessionaires.

It is important to point out that the mitigation of these financial risks depends on an adequate assessment of the costs involved in the operation and maintenance of the systems, as well as on the clear definition of responsibilities between the concessionaires and the government. The existence of clear and transparent contracts between the parties can help mitigate these risks and ensure the financial viability of concessionaires under the MLA program.

The words contract, conventional, program, system, set, viability and distributor are some of the items highlighted in red. Contracts play a crucial role in the relationship between the government and the companies involved in the program, as they are the instruments of regulation, establishing the rights and obligations of the parties involved and guaranteeing the provision of the electrification service (14,15). Systems and feasibility underscore the importance of considering different electrification technologies.

These contracts are regulatory instruments that establish the rights and obligations of the parties involved, guaranteeing the provision of electrification services in remote regions. And when analyzing Figure 2, which was presented earlier, we can observe a gap between cluster 3, highlighted in red, which describes the role of the contract, and cluster 4, in violet, which represents the needs of society, the socioeconomic importance of energy in these remote areas and the need for proper planning.

This distancing can be explained by cluster 2, in yellow, which addresses the logistical challenges related to operating and maintaining the system in these remote regions. These challenges can include logistical difficulties, lack of qualified professionals and the complexity involved in operating and maintaining power generation systems. Therefore, it is essential to consider these different aspects, such as the role of contracts, society's needs and operational challenges, to ensure the success of the MLA program and the effective provision of the electrification service in these remote regions.

This requires an integrated and strategic approach, involving the government, companies and society, as a means to overcome the challenges and achieve the proposed objectives based on a viable action for the companies. In this sense, the word "feasibility" suggests the importance of considering the specific characteristics and needs of each region in terms of assessing the economic and financial viability of electrification projects in remote regions widely discussed in the literature (15,16,28,30).

One of the main challenges in making electrification projects viable in remote regions is related to the high costs of implementing and operating the necessary infrastructure, such as transmission lines and distribution networks. The low population density and the difficult geography of these areas increase the installation and maintenance costs of electrical systems, which can compromise the economic viability of the projects.

One way to overcome economic and financial challenges is to seek innovative and sustainable solutions, such as the adoption of renewable energies and the implementation of decentralized generation systems, such as solar photovoltaic systems, as the project foresees and the concessionaires have been acting. These solutions can reduce operating costs and make projects more viable in the long term, as well as promote the use of clean energy sources and contribute to the environmental sustainability of remote regions.

The area highlighted in red demonstrates that in addition to honoring the commitments to universal access to electricity, the program hopes that through the use of this resource, social and economic development will be generated for the benefited areas. Enabling improvements in education, health, access to information and the promotion of activities aimed at increasing family income. Thus highlighting the words: comply, productive, articulation, need, important, society, commitment and community.

As previously seen, the program aims to universalize electricity to remote regions of the Legal Amazon, as a means to bring about socio-economic changes for its beneficiaries. Therefore, this group is the central factor of the Cartesian plane, while the others are around it, with different degrees of proximity. It is observed that for the MLA to meet the established goals, it is necessary to understand the reality of these families, the most viable way to reach the households and supply this energy (traditional or by the photovoltaic system) and understand how the installation and maintenance of the systems will be carried out. Because of this, the government uses contracts with companies providing these services in each region.

The similarity analysis was used as a means to detect the degree of connection between the elements identified in the analyzed corpus (figure 3). Through it, it is possible to observe that, for the implementation of the MLA Program, the government acts as a key figure of connection between the need for access to electricity, presented by families located in remote areas of the Legal Amazon, and the need of concessionaires, permit holders and those authorized for energy installation and distribution services, obtain more customers and/or services. These deficiencies permeate the Government's need to reach out to these families and ensure that this public policy is implemented.

However, the most viable means of guaranteeing that these needs were met was through the execution of contracts. Thus, the companies responsible for each state of the Legal Amazon are responsible for accessing and implementing the most suitable system for each location, as well as meeting the required goals. The population has access to electricity, either traditionally or through photovoltaic systems, and the government guarantees the universalization of this service. Thus, it is possible to generate the expected socioeconomic development in these regions through the involvement of communities in the systems' operation and maintenance processes.

The communities are engaged through educational initiatives on how to use electricity safely, expressing a direct relationship between the program, the concessionaires and society, figure 3.

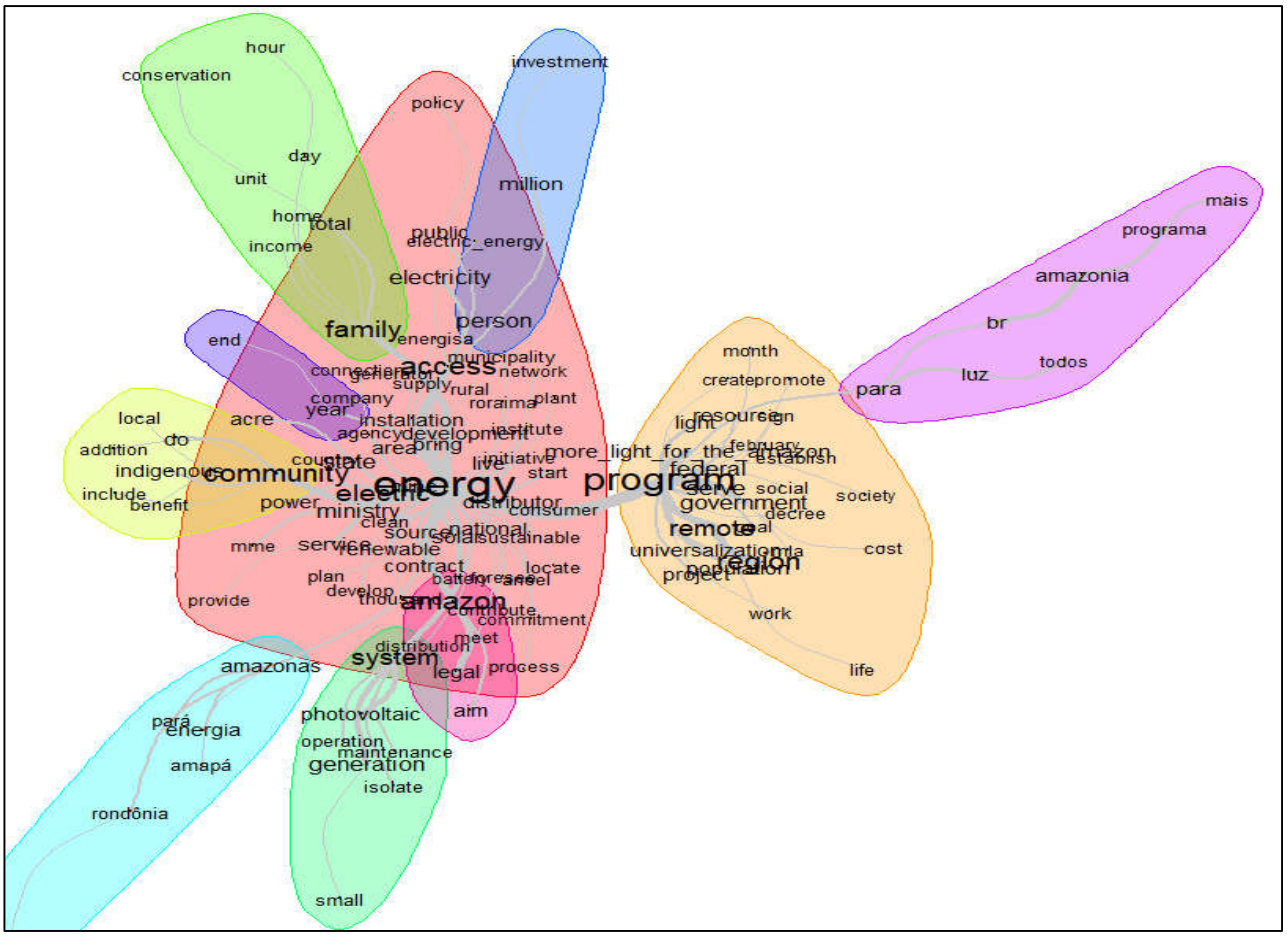

Figure 3. Connection between descriptive elements from the similarity analysis.

Because of the research carried out, it is possible to observe that the electrification programs, initially, could not reach their objectives due to the absence of strategies and action from the State. Only after 2003, with the creation of the program Light for All-LPT, did it start to act as a key actor in the development of public policies, ensuring that the rural population had access to electricity, as well as reconciling this action with the interests of private companies (concessionaires). However, the first referrals given to the Program show that, at least for now, it is limited, in practice, to supplying electricity for the minimum needs of communities, restricted to domestic use (31). Thus, it began to act as a supervisor, as these works, although carried out by private companies, are carried out in its name.

5. Conclusions

This research aimed to analyze the MLA Program as a means to identify the role of each of the parties involved in the concession process (Government and private companies) and the limitations faced for the success of the program. Through the information presented, it is concluded that the government plays the role of inducing agent and supervisor of the process. It acts as an inducer when developing public policies that aim to overcome the lack of access to electricity in communities located in remote regions of the Legal Amazon. In addition, the government also plays a supervisory role, ensuring that concessionaires comply with the objectives and targets established in the concession contracts.

On the other hand, private companies have the role of implementing the actions foreseen in the MLA Program. They are the ones who assume responsibility for the generation, transmission, distribution and sale of electricity in the remote regions covered by the program. Electric power concessionaires have the task of providing energy to communities through the necessary and adequate infrastructure to meet local demands.

One of the approaches adopted by the program is the use of solar generation microsystems, which brings significant benefits. These systems allow the reduction of operating costs, minimize environmental impacts and avoid excessive dependence on inflexible thermoelectric plants. Furthermore, by concentrating the electricity generation and distribution process on a single actor, there is an improvement in the organization of the governance structure. In this way, the disorganization that normally affects the governance of the electricity sector is overcome.

This more integrated and centralized approach contributes to a more efficient and coordinated management of electricity-related activities. By eliminating fragmentation and promoting the concentration of responsibilities, the program seeks to optimize decision-making processes, ensure greater efficiency in the implementation of actions and strengthen coordination between the different parties involved.

Furthermore, by focusing on microgeneration from renewable sources, the program also seeks to promote environmental sustainability. The use of solar energy as the main source of generation contributes to the reduction of greenhouse gas emissions, as well as to the preservation of natural resources in the Amazon region.

However, despite the benefits of the program, it is important to recognize the challenges and limitations it faces, especially given the characteristics of the Amazon region. The Amazon is marked by a complex geography, with vast areas of difficult access, low population density and unique environmental challenges. These characteristics make the expansion of the conventional electrical grid a challenge, especially in small towns where the financial return on investment may be impractical.

This reality contributes to the increase in the costs of implementation and operation of electrical infrastructures, which can compromise the economic viability of concessionaires. But through grants, the government minimizes these problems, as well as avoids the transfer of risk to the end user in the name of local socioeconomic development. Even so, the expansion of photovoltaic generation as a solution to meet isolated systems also faces additional challenges. Two key factors are the high logistical costs and the lack of qualified local professionals. In remote regions, the operation and maintenance activities of electrical systems involve greater complexity due to adverse geographic and environmental conditions.

In this context, the need arises for a more integrated approach, in which the private sector and communities play a more active role in the operation and maintenance of systems. Community participation becomes crucial to overcome logistical challenges and ensuring project sustainability. By involving residents, it is possible to promote training and skills development, making them an integral part of the management and maintenance of electrical systems.

In addition, it is important to explore strategic partnerships and encourage technological innovation to face the specific challenges of the Amazon region. This may include developing solutions tailored to local conditions, such as the use of advanced monitoring and control technologies, energy storage systems and the integration of complementary renewable energies.

Thus, by recognizing the limitations imposed by the characteristics of the Amazon region, it is possible to adopt more flexible and collaborative approaches, involving the private sector, local communities and the use of appropriate technologies. Only then will the electrification program in the Amazon be able to effectively face the challenges and achieve its objectives of bringing electricity to remote communities, promoting socioeconomic development and improving the quality of life of these populations.

This program shows that the government, in partnership with private companies, is seeking strategies to overcome limitations and integrate isolated communities. This involves the search for adequate financing, the promotion of strategic partnerships and the adoption of innovative and sustainable solutions for the generation and distribution of electric energy. Therefore, this study contributes to understanding the importance of public policies aimed at families found in a situation of exclusion and without access to essential products/services for social well-being. In addition, it demonstrates the importance of public managers being equipped with information before implementing public policies.

In the process of research and analysis of the MLA Program, it was difficult to obtain detailed information about the program, as well as get data from concessionaires and responsible government agencies. This lack of transparency and access to more in-depth information makes it difficult to fully understand how the program works and the impacts achieved.

Given this scenario, it is pertinent and opportune to carry out additional studies and consultations to investigate the feasibility of operating and maintaining the power generation systems implemented in the communities that benefited from the program. This more in-depth analysis will allow for a more precise understanding of the challenges faced by communities in the management and conservation of these systems, as well as identifying opportunities for improvement and ensuring the sustainability of these electrification initiatives.

To do so, it is essential to understand the involvement of local communities, the role and capacity of municipal governments and other actors in the coordination structure of actions. Through dialogue and the exchange of knowledge, it will be possible to obtain more precise information about the effectiveness of the program, as well as to identify possible gaps or difficulties in the operation and maintenance of energy generation systems. Furthermore, it is important to encourage the availability of more detailed and up-to-date data, ensuring greater transparency and facilitating future research and analysis.

These studies and consultations can cover a wide range of aspects, such as the capacity of the communities to assume responsibility for the operation and maintenance of the systems, the availability of technical and financial resources for these activities, the logistical challenges faced in the remote regions of the Amazon and the necessary training so that communities can efficiently manage these power generation systems.

The results of these surveys and consultations can provide valuable subsidies for the improvement of the program, allowing the implementation of more effective measures to guarantee the sustainable and long-term operation of the energy generation systems in the communities of the Amazon. In addition, they will contribute to strengthening transparency and accountability, enabling a better understanding of the results achieved and the necessary improvements.

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